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TABLE OF CONTENTS

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ADDITIONAL NOTES ON DEGENERIA VITIENSIS

A. C. SMITH

With one plate and one text-figure

WHEN THE FAMILY Degeneriaceae was proposed in 1942 (in Jour. Arnold Arb. 23: 356–365. *pl. 1–5*) by Prof. I. W. Bailey and the writer, it must have seemed to some readers that we were highly optimistic in suggesting that a new species based on only two known collections be immediately established as representing a monotypic family. Few plant families have such an abrupt inception. It is more traditional to refer a genus of doubtful affinities to some presumably allied family, in which it may languish for many years or decades, until the researches of monographers exclude it from all likely families and establish that it merits family rank. Even then the position of the genus is suspect, for many herbarium custodians are allergic to monotypic or small families and, rather than alter their system, cling to unwieldy plant-groupings which have no morphological justification. Whether the family Degeneriaceae will be accepted in herbaria or will be thrust into a distended "magnoliaceous" concept (which already in some herbaria includes highly discordant elements) remains to be seen.

However, in 1942 Prof. Bailey and I could not bring ourselves to place our new genus *Degeneria* in either the Magnoliaceae or Himantandraceae, clearly the only existing families of its immediate alliance. The discovery of a third collection, from southeastern Viti Levu (cf. Bull. Torrey Club 70: 537. 1943), did not add to our knowledge of the morphology of the genus. In order to verify our conclusions or to make possible a re-evaluation of our family concept, new material for morphological and anatomical study was clearly desirable. Consequently, when I had an opportunity to undertake a second collecting trip to Fiji in 1947,[1] one of

[1] The collections upon which this study is primarily based were obtained in Fiji between April, 1947, and January, 1948, in the course of exploration under the auspices of the Arnold Arboretum of Harvard University. Generous financial support was supplied by the John Simon Guggenheim Memorial Foundation, the Penrose Fund of the American Philosophical Society, and the Bache Fund of the National Academy of Sciences. To these organizations the writer is deeply grateful.

my primary objectives was to locate, if possible, additional specimens of *Degeneria vitiensis* and to obtain material for study by my colleagues Prof. Bailey and Dr. B. G. L. Swamy. It is not within the scope of this treatment to discuss in detail the morphological aspects of *Degeneria,* now somewhat better known than in 1942, which justify its position in a distinct family. In the following article in this Journal, Dr. Swamy ably analyzes the characters of our genus. Here I shall refer only to the occurrence, habit, and habitat of *Degeneria vitiensis,* on the basis of my field-study of it in 1947.

OCCURRENCE

The principal purpose of the Fijian exploration mentioned above was the acquisition of herbarium material which would permit a better knowledge of the flora and which would widen the basis for future floristic studies of the archipelago. Consequently I attempted to visit those regions which had been comparatively neglected by previous collectors. The first six months were spent on Viti Levu, for the most part at higher elevations. My first objectives were the two forested mountain-ranges which stand above the predominantly reed-covered western portion of Viti Levu — the Mt. Evans and Mt. Koromba Ranges. During two months in this area no specimens of *Degeneria* were found. Subsequently a base was established at Nandarivatu, a now nearly deserted government station on the northern escarpment of Viti Levu at an elevation of about 800 meters. From this base numerous trips southward, into the extensive forested area drained by the upper Singatoka River, were made. During June and July the forested area dominated by Fiji's highest peak, Tomanivi [Mt. Victoria], was explored without observation of *Degeneria.* Degener's type-locality is in the vicinity of a small Fijian settlement, Nauwanga, which lies in the valley of Nandala Creek (one of the Singatoka headwaters) a few miles south of Nandarivatu; I did not work in that immediate vicinity in detail.

Due to other interests, I had relegated the search for *Degeneria* to a lesser position when I began to work southward from Tomanivi onto the Rairaimatuku Plateau, a poorly drained, uninhabited, and essentially uncollected upland region, about 25 by 15 miles in size, occupying the center of Viti Levu. It was, therefore, an exciting surprise to find the desired species. Collectors will agree with me that the rediscovery of a rare plant gives an emotional pleasure incomparably greater than its original discovery, at which time it is unexpected and usually unrecognized. For my part, I have no remembrance whatever of my first collection of *Degeneria* on Vanua Levu in 1934. But the date (August 7, 1947) and the place of my second collection of the species will not be forgotten by me. From my headquarters in the village of Nandrau, which lies on the steep western slope of the plateau in the Singatoka valley, I was working toward the smaller village of Nanga, which is similarly situated a few miles to the south. The trail between these villages leads through the dense forest of the plateau a mile or two from its edge. We had left this trail and were slowly progressing through the forest toward the east, over the rounded summit of a small elevation, when one of my Fijian assistants brought me a strange fruit from the forest-floor. (It is fortunate for most of us who collect in tropical forests that we have keen-eyed native helpers, without whom we would overlook many discoveries for which our herbarium-labels unblushingly give us the credit.) After we located the tree — and this was not easy in the dense-foliaged rain-forest — I had plenty of time to compose myself, for it proved to be one of those stubborn trees, bound to others by lianas, which takes half an hour to fell. Once the tree was down and I had reassured myself it was really a specimen of the elusive *Degeneria,* we searched it thoroughly and obtained material for numerous herbarium specimens.

This individual was in the same condition as my Vanua Levu collection, with small fruits in the stage of development which Prof. Bailey and I had erroneously assumed to be mature in our original study. None of my field-crew had seen the species before, but in the village of Nanga one old man assured us that it was very rare but that he knew it by the name of *vavaloa,* which can be translated as "black shoe." The aptitude of this name is apparent only when one has seen the mature fruit.[2] In other parts of Fiji the species appears to be known as *yaranggele* (in the Wainunu region of Vanua Levu) or *masiratu* (in southern Naitasiri, Viti Levu).

My field-crew, now being aware of the identity of the plant and of my desire for adequate flowering material, sought carefully for additional specimens, but none were forthcoming on the Rairaimatuku Plateau. However, after we had returned to the vicinity of Tomanivi we discovered the species with increasing frequency, as it became more familiar to us. On September 2, not far from a sawmill which operates at the western base of Tomanivi, we found individuals in full flower and with mature fruits. Later, we found the species in some abundance very near Nandarivatu, in the precise locations which had earlier been searched in vain. The area immediately adjacent to Nandarivatu and Tomanivi has been examined by several highly competent collectors, including Gibbs, im Thurn, Gillespie, and Degener. That none of them except the last obtained specimens of this genus need cause no surprise. Like most trees of the upper storey of the rain-forest, the *vavaloa* mingles its branches and foliage with those of many other species, and even when the tree is in full flower or fruit these organs are not visible from the ground. It is only an occasional clue — a fruit or the vascular skeleton of one on the forest-floor — that indicates the presence of the plant, and such clues can readily be overlooked or ignored by one unfamiliar with the plant. Eventually my Fijian friends learned to recognize *Degeneria* at a glance by its bark, but I believe that only a trained forester could equal them in this respect.

[2] I have also recorded the name *vavaloa* as applied, on one occasion, to *Oxymitra monosperma,* which has a fairly large inequilateral mature carpel, and on another occasion to *Hernandia olivacea.* There is no literal reason for the latter application, and my informant was probably over-enthusiastic.

Altogether I observed and made notes upon 55 trees of *Degeneria* during August, September, and October of 1947. From ten of these herbarium specimens were taken, in addition to wood samples and abundant material in preservative. It is obvious that the observed individuals form only a minute fraction of the total population; there must be many thousands of *Degeneria* trees in the region explored. This region may be defined as the northern part of the forest which covers the central portion of Viti Levu, and it may be circumscribed by a semi-circle, with a radius of less than 15 miles, lying due south of Nandarivatu. The area would fall into the old Province of Tholo North, now divided among the four Provinces of Mba, Nandronga & Navosa, Ra, and Naitasiri.

Degeneria vitiensis can no longer be considered rare in upland Viti Levu, but of course it cannot be described as common when compared with some of the characteristic species listed later in this paper. To the southward and southeastward of the region discussed above the forest seems essentially similar, and it is likely that the same frequency of *Degeneria* would be maintained on the entire central plateau of the island and in the forests drained by the Rewa and Navua tributaries. In favorable localities it occurs close to sea-level, as attested by Mr. B. E. Parham's collections of it in southeastern Viti Levu and my own in Vanua Levu.

It seems advisable to list here all the herbarium specimens of *Degeneria vitiensis* at present known; they are arranged in general from north to south on Viti Levu. My own 1947 collections are deposited in the herbarium of the Arnold Arboretum, and numerous duplicates will later be distributed. Mr. Parham's collections are in the herbarium of the Department of Agriculture, Suva, with duplicates at the Arnold Arboretum.

VITI LEVU: Mba: Hills between Nandala and Nukunuku Creeks, along trail from Nandarivatu toward Lewa, alt. 750–850 m., *Smith 6170, 6190;* western slopes of Mt. Nanggaranambuluta [Lomalangi], east of Nandarivatu, alt. 850–900 m., *Smith 6301, 6318;* hills east of Nandala Creek, about 3 miles south of Nandarivatu, alt. 850–950 m., *Smith 5923;* Nauwanga, valley of Nandala Creek south of Nandarivatu, alt. 750 m., *Degener 14537* (TYPE, Arnold Arb.; duplicates widely distributed), Feb. 24, 1941; hills between Nggaliwana and Tumbeindreketi Creeks, east of the sawmill at Navai, alt. 750–800 m., *Smith 5875, 5880, 6018* (juvenile); southwestern slopes of Mt. Tomanivi (Mt. Victoria), alt. about 850 m., *Smith 5744;* Nandronga & Navosa: Northern portion of Rairaimatuku Plateau, between Nandrau and Nanga, alt. 725–835 m., *Smith 5555;* Naitasiri: Nanduna, Waindina River, Navuakethe district, alt. 90–120 m., *B. E. Parham 1488* (March 7, 1939), *3008* (June 19, 1945).[3] VANUA LEVU: Mbua: Lower Wainunu River valley, alt. 0–200 m., *Smith 1754* (duplicates in several herbaria), May 7, 1934.

These localities are indicated on the accompanying map (*fig. 1*), which also shows in an extremely approximate manner the boundary between

[3] Mr. Parham kindly arranged to have a Fijian assistant in the Department of Agriculture, Apenito Gonekalou, visit this same locality on Jan. 4, 1948. Several trees were observed but no flowers or fruits could be obtained. However, Apenito obtained several seedlings, which were preserved in FAA and which have been studied by Prof. Bailey and Dr. Swamy. My own several attempts to germinate seeds at Nandarivatu failed, and seeds which were returned to Harvard by air-mail likewise proved unviable.

forest and grassland. Actually, of course, this boundary is a fairly wide and complex transitional zone.

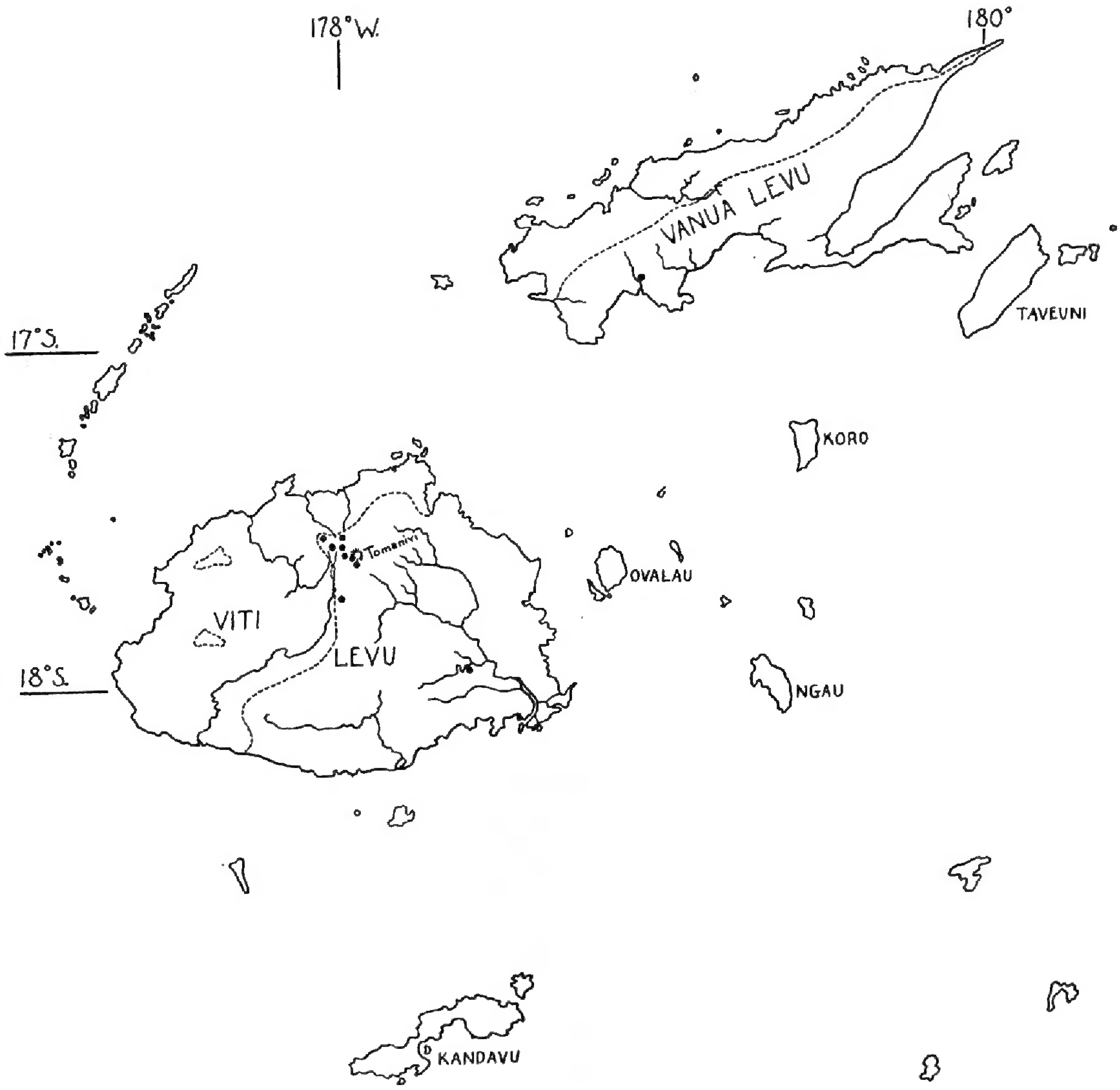

FIG. 1. Sketch map of western Fiji (Lau Group omitted), showing known stations for *Degeneria vitiensis*. The dotted lines show the approximate boundaries, on the two large islands, between forested and grassland areas.

To summarize this discussion of the occurrence of *Degeneria vitiensis*, field-observations lead me to suppose that it may eventually be found in any undisturbed rain-forest area of Viti Levu and Vanua Levu between sea-level and approximately 950 meters. It should also be sought in the forested regions of the islands of Taveuni, Koro, Ovalau, Ngau, and Kandavu, although these forests appear much less diverse in composition than those of the two large islands. I have not observed the species at higher elevations than 950 m.; from this point to the crests of ridges and summits of peaks the trees are smaller and frequently gnarled, with more abundant epiphytes and cryptogams. The highest elevation in Fiji is 1323 meters, on the summit of Tomanivi, but several hills on Viti Levu exceed 1000 meters. The highest elevation on Vanua Levu is 1030 meters, on the summit of Mbatini. Conditions of exposure in the Vanua Levu hills seem to be such that the truly montane forest reaches lower elevations than it does on Viti Levu, and consequently *Degeneria* is not anticipated above 700 or 800 meters on Vanua Levu.

HABIT

Seedlings which could be positively assigned to *Degeneria* were not observed by me personally, but fortunately those collected in Naitasiri, mentioned above, are available for study; their salient features are discussed by Dr. Swamy in the following paper.

The juvenile plant is a slender treelet with a spreading crown and very large leaves. Although the petioles of these leaves are no longer than some observed on mature trees, the blades are conspicuously larger, attaining a size of 25–45 × 10–14 cm. They are sometimes gradually attenuate to the base and long-decurrent on the petiole, while the apex may be deltoid-cuspidate and as much as 1 cm. long, a character not observed in mature leaf-blades, which seem always to be either rounded or lightly emarginate at the apex. The juvenile leaf-blades sometimes have as many as 30 pairs of principal secondary nerves, whereas those of mature plants seldom have more than 18 such pairs.

The mature tree, like most species of the Fijian rain-forest, is extremely slender for its height, with a freely branching crown and dense foliage. At apparently maximum growth it may be from 18 to 30 meters high, at which stage its trunk has a breast-high diameter of only 45–70 cm. Characteristically the trunk has 3–7 fairly obvious rounded buttresses, these being usually apparent upward for about one or rarely for two meters. The individual portrayed in Pl. 1, *fig. A,* is only half-grown and does not have the buttresses well developed. The bark is dark gray and comparatively thick, with rather regular fissures.

Apparently our two original collections were diverse enough to cover essentially all the dimensional foliar variation now known. It may be repeated that the leaf-blades of mature trees are extremely variable in size, sometimes only 5 × 2.5 cm. (our original dimensions having been 9–27 × 3.5–13.5 cm.). The principal secondary nerves may be as few as 8 per side (originally stated as 10–18).

Some specimens of *Degeneria* observed in 1947 were spectacularly loaded with flowers, but, as mentioned above, the effect of this prolific flowering is lost in the forest-canopy. Fully open flowers are sometimes 5 cm. in diameter, but they disintegrate and lose their petals very quickly. At anthesis they emit a pleasing fragrance suggestive of that of some annonaceous flowers, e.g. *Cananga odorata.*

Dissection of preserved flowers and fruits by Dr. Swamy permits the following emendation of the original description. The sepals are very rarely 4 in number, although 3 is certainly the characteristic number. The petals (originally mentioned as 12 or 13 in number) are seen to be occasionally as many as 18; they are arranged in 3–5 series, and the maximum size now observed is 24 × 14.5 mm. (originally stated as 19 × 12 mm.). The stamens may be 20–30 in number and 3- or 4-seriate; the largest ones observed are 9.5 × 2.5 mm. (originally stated as 6 × 2.5 mm.), with thecae up to 5 mm. long. The staminodes are 10–13 in number (rather than 11 or 12) and up to 7 × 3.5 mm. in size. The carpel is practically always single, as previously stated. However, in one dissection Dr. Swamy found two carpels in a flower, and one of my herbarium specimens (no. *5555*) shows a single instance of two developing fruits. The number of ovules varies considerably beyond the 24 or 26 mentioned originally, being as now observed 20–32, although the extreme numbers are rare. The fruiting pedicel sometimes attains a length of 5 cm. The mature fruit has not previously been described. The most advanced fruits seen by me were still attached to the branchlets, but they occur far back from the growing point, on a portion from which leaves have fallen. Sometimes the same tree also bears half-developed fruits, which are more distal on the branchlets but still below the flowers. Thus one may observe specimens at full anthesis with flowers associated with the foliage, with half-developed fruits somewhat lower on the branchlets, and with essentially mature fruits still lower. In such cases fruits in an intermediate stage of development were not found, and this may incline one to suppose that two seasons (but not necessarily two calendar years) are needed for fruits to reach maturity. When essentially mature and apparently ready to fall from the tree, the fruits are rich pink to purple in color, falcate-oblong-ellipsoid in shape, and up to 10.5 × 4.5 × 4.5 cm. in size. I did not observe dehisced fruits attached to the tree, but some which I dislodged were later observed, on the forest-floor, to have dehisced along the ventral suture. The elaborate vascular skeletons of decayed fruits were sometimes found, and these were always wide open along the ventral margin. Hence we feel sure that our original mention of the fruit as indehiscent is inaccurate. The pericarp, except for its hard outer layer, is very thick and fleshy, becoming greatly shriveled in drying. The "waxy irregularly lobed appendages" which we originally described and figured as arising from the endocarp are actually merely irregular remnants of the carpellary wall. Most of the ovules appear to develop, but only rarely are as many as 32 seeds to be found in a fruit. The fresh seeds are up to 16 mm. long and 12 mm. broad; their outer coat is thick, smooth, waxy, and bright orange-red in color.

HABITAT

Degeneria vitiensis is among the largest trees of the Fijian rain-forest. It has been observed on flat land as well as on extremely steep hillsides, on well-drained soil in undisturbed forest. The Fijian forest reaches its best development under very equable climatic conditions, as demonstrated by Tables 1 and 2, in which temperature and rainfall statistics are given for a few selected localities in the forested portions of the two large islands. The annual variation in temperature is comparatively slight, and alti-

TABLE 1

Temperature statistics of selected localities in Fiji, from records of Meterological Department, Suva

Place, Province, Island	No. years covered by record	Mean temperature ° F.	Absolute maximum ° F. and month	Absolute minimum ° F. and month
Suva, Rewa, Viti Levu	56	77.1	98 March	55 July November
Nandarivatu, Mba, Viti Levu	5	68.3	85 February March	45 July

TABLE 2

Rainfall statistics of selected localities in Fiji, from records of Meteorological Department, Suva

Place, Province, Island	No. years covered by record	Normal annual rainfall (inches)	Normal number of wet days	Normal rainfall (inches), wettest month	Normal rainfall (inches), driest month
Suva, Rewa, Viti Levu	51–57	120.86	246.8	14.73 March	5.41 July
Nasinu, Naitasiri, Viti Levu	11–15	129.51	220.5	16.95 April	4.98 June
Vunindawa, Naitasiri, Viti Levu	20–33	140.10	175.6	17.16 December	4.14 July
Nandarivatu, Mba, Viti Levu	19–45	137.63	176.3	25.06 February	3.56 July
Wainunu, Mbua, Vanua Levu	20–66	146.46	199.0	18.23 January	5.64 July
Yanawai, Mbua, Vanua Levu	8	202.34	237.0	22.01 May	13.14 June
Salialevu, Thakaundrove, Vanua Levu	11–25	213.57	183.5	20.99 October	13.63 July

tudes up to 800 m., that of Nandarivatu, produce an average fall in temperature of only 10°F. as compared with localities at sea-level. Rainfall is well distributed throughout the year in the forested areas of Fiji, and even in the driest months four or more inches of rain may be expected. For permission to reproduce these statistics I am greatly indebted to Mr. Ralph Dyer, Director of the Meteorological Department in Suva.

The forest inhabited by *Degeneria* cannot adequately be characterized by mention of any single species or any small group of species; it is greatly diversified, although sometimes locally dominated by the *ndakua* (*Agathis vitiensis*), conspicuous by its comparative great size. The more frequently observed components of this forest, as seen in north-central Viti Levu, may be mentioned as follows:

Degeneria vitiensis Bailey & Smith

LARGE UPPER STOREY TREES (approaching or exceeding 30 meters in height): *Agathis vitiensis* (common), *Podocarpus vitiensis* (common), *Dacrydium* sp. (frequent, no. *6244* [4]), *Ficus obliqua, Hernandia olivacea, Endospermum macrophyllum, Canarium vitiense, Garcinia pseudoguttifera, Calophyllum vitiense, Elaeocarpus* spp. (e.g. no. *5954*), Sapotaceae spp. (e.g. no. *6195*).

TREES OF MEDIUM HEIGHT: *Podocarpus* sp. (*asimbolo,* an important timber tree), *Gironniera celtidifolia* (often abundant), Lauraceae spp. (*Cinnamomum, Cryptocarya, Endiandra*), *Myristica castaneaefolia, Xylopia* no. *5868* and other Annonaceae, *Elaeocarpus* spp. (e.g. no. *6189*).

UNDERSTOREY TREES: *Gnetum Gnemon, Aglaia* spp., *Schefflera vitiensis, Discocalyx* spp., *Diospyros* spp., *Couthovia collina,* numerous Rubiaceae, including *Psychotria* spp., *Airosperma trichotomum, Readea membranacea,* and *Mastixiodendron flavidum.*

SHRUBS: *Piper* spp., *Elatostema Archboldianum* and *E.* no. *5976, Cyrtandra* spp., *Psychotria* spp.

VINES: *Epipremnum pinnatum, Piper insectifugum, Agatea violaris, Medinilla* spp., *Strychnos vitiensis.*

This type of rain-forest abounds in ferns, both terrestrial and epiphytic, but lower cryptogams are comparatively few, reaching their greatest profusion at higher elevations or on exposed ridges where the above components are generally not found.

EXPLANATION OF THE PLATE

Degeneria vitiensis I. W. Bailey & A. C. Smith. **Fig. A.** Trunk of medium-sized tree. **Fig. B.** Flowering and fruiting branchlets, showing position of essentially mature fruit below the leaves, × 1/5. **Fig. C.** Flowering branchlet, with nearly mature flowers, × 1/3. **Fig. D.** Essentially mature fruit, showing line of ventral suture, × 1/3. **Fig. E.** Lateral view of essentially mature fruit, × 1/3. *Fig. A* from *Smith 6301; Figs. B-E* from *Smith 5880.*

DEPARTMENT OF BOTANY,
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[4] In these lists a few species which have not yet been identified are referred to by my field-numbers.

FURTHER CONTRIBUTIONS TO THE MORPHOLOGY OF THE DEGENERIACEAE

B. G. L. SWAMY

With four plates and thirteen text-figures

DURING HIS COLLECTING TRIP in the Fiji Islands in 1947,[1] Dr. A. C. Smith was able to pickle valuable material of *Degeneria vitiensis* I. W. Bailey & A. C. Sm. This material includes not only leaves, nodes, shoot apices, seedlings, etc., but also flowers and fruits in almost all stages of development. Although most of the material was fixed in formalin-acetic-alcohol, limitation of resources in one case forced Dr. Smith to substitute "gin" when he secured important developmental stages of the gametophytes. However, the gin-fixed material has fortunately rendered itself suitable for interpretation, although the slides may not satisfy all the requirements of technical perfection. The material on hand has made possible not only a verification of the original findings of Bailey and Smith (1), but also new observations on the gametophytic and post-fertilization development, vascularization of the flower, seedling structure, etc. I sincerely thank Dr. Smith for placing the material at my disposal and thereby providing me with the opportunity of studying it. I cannot adequately express my gratitude and appreciation to Prof. I. W. Bailey for his unfailing encouragement and illuminating suggestions during this study and also for his assistance in the preparation of photomicrographs.

SECONDARY XYLEM

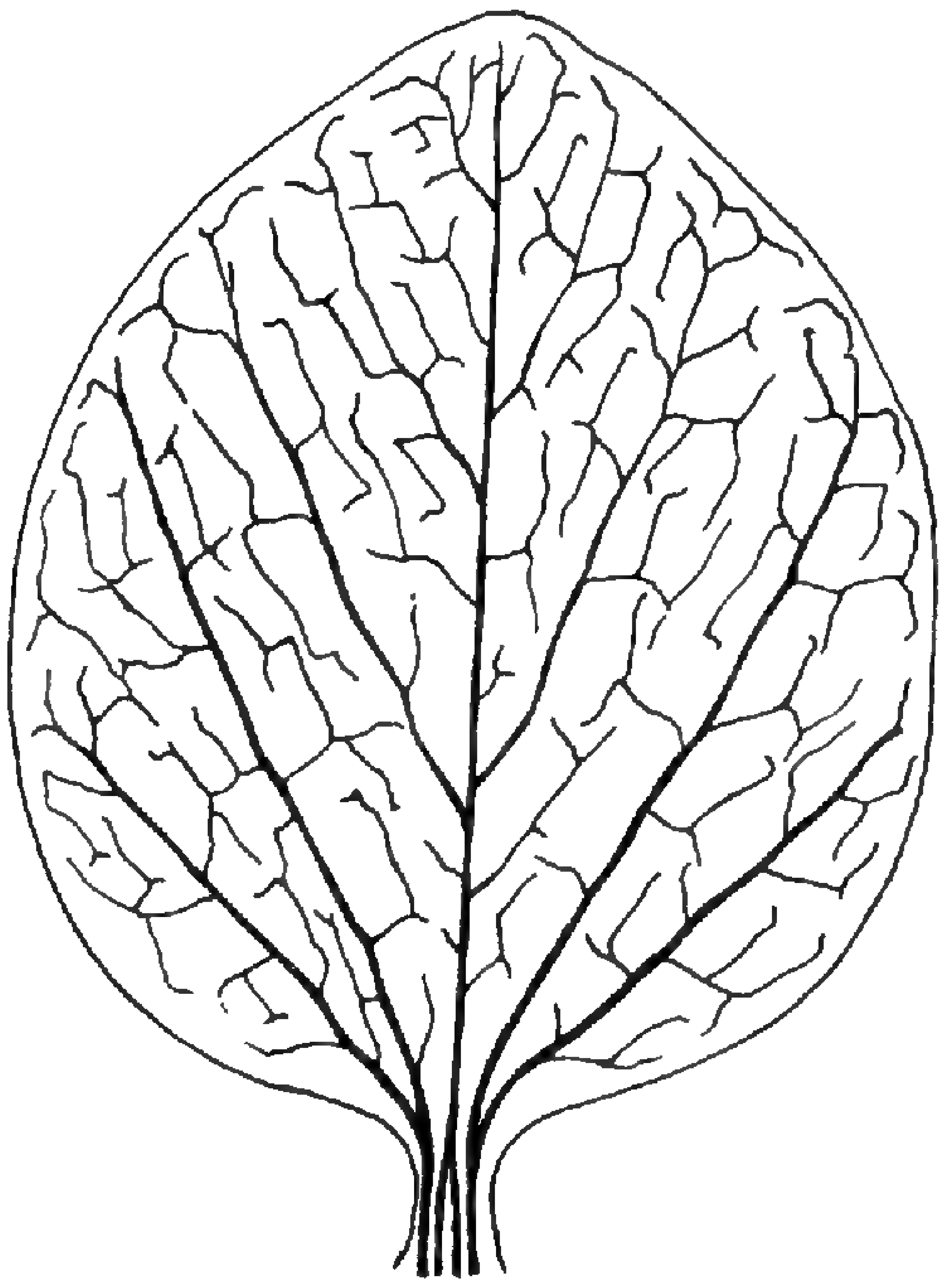
There is not much to be added to the anatomical characteristics of the secondary xylem, which have already been described by Bailey and Smith (1). However, the following points as revealed by the peripheral regions of a large stem measuring about 60 cm. in diameter (#5880),[2] may be noted. In the inner regions of the secondary xylem, the multiseriate rays are predominantly 3–4-seriate, fairly high, usually with one to three upright cells at either end as seen in tangential sections; the uniseriate rays are infrequent, shorter than the multiseriates and composed of upright cells. In the outermost region of this old specimen, the multiseriate rays become predominantly 4–5-seriate, shorter and without any upright cells at the margins. Uniseriate rays are eliminated. The narrow bands of apotracheal parenchyma are distributed throughout the secondary xylem. This situation is in contrast to the secondary xylem of the magnoliaceous genera of the north temperate climate, where the parenchyma is confined to the outer face of the growth rings.

[1] See the preceding article in this journal.

[2] In the few instances where it has seemed advisable to refer to a specific collection, the number indicates Dr. Smith's field-number. For locality, etc., see the preceding paper in this journal.

SEEDLING

Four seedlings of *Degeneria* were available for examination and all of them possess three cotyledons. The whorl of thin, palmately veined cotyledons is preceded by a long hypocotyl, 6–10 cm. The first leaf is characteristically emarginate, pinnately veined, and more nearly elliptic in



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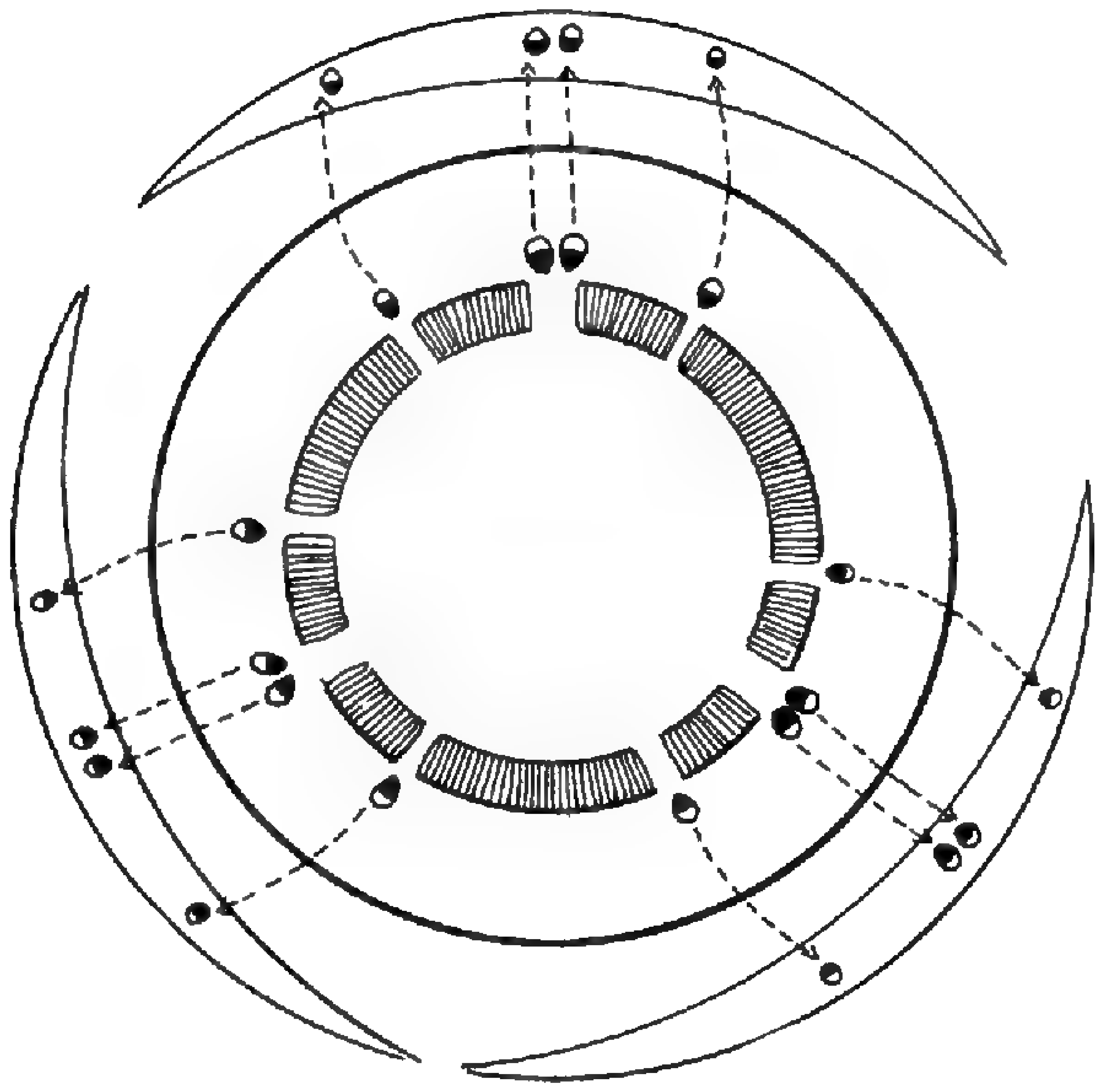

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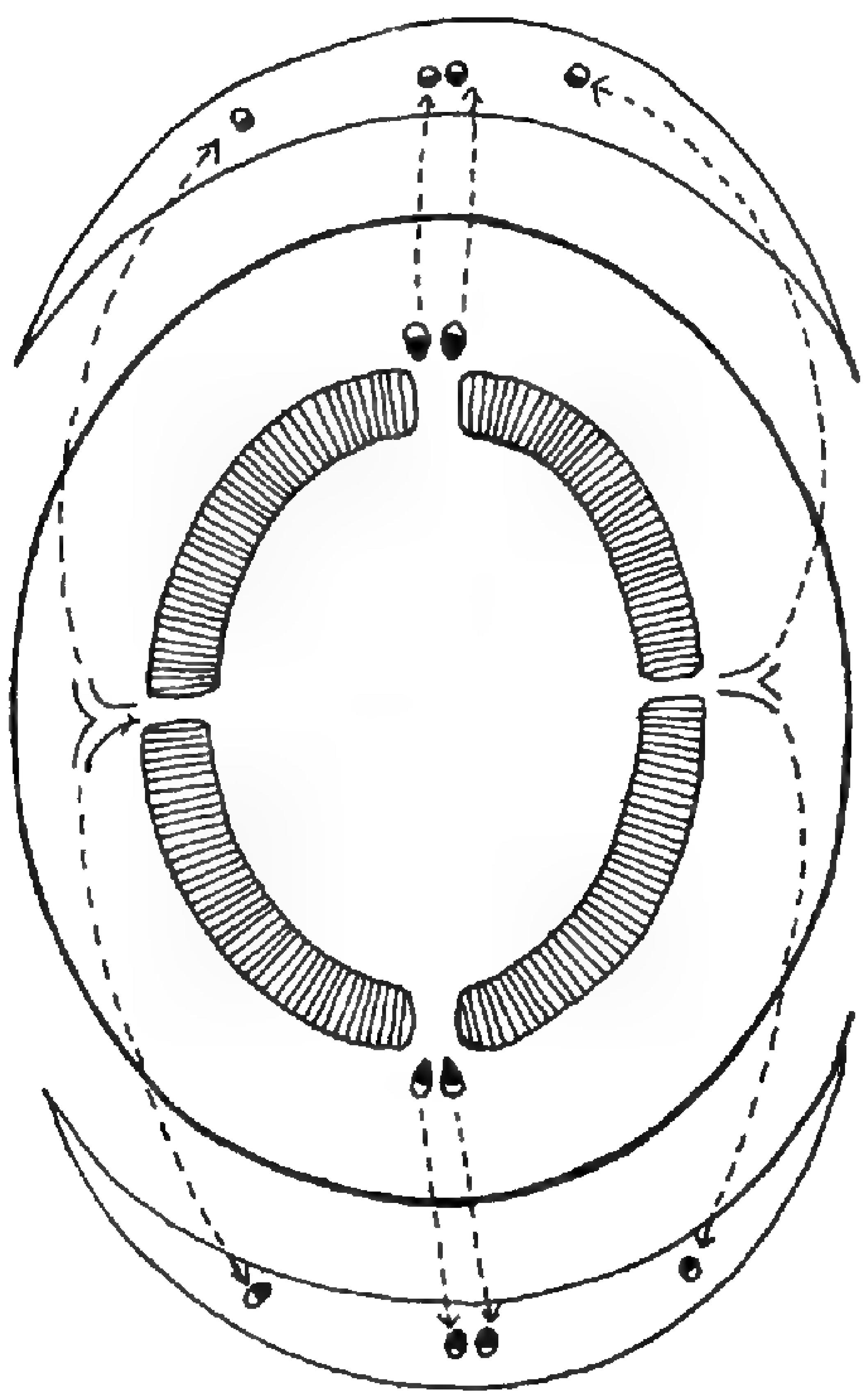

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FIGS. 1–2. *Fig. 1.* Diagram showing the vascular pattern of the cotyledonary node of *Degeneria*. *Fig. 1a.* Diagram to show the pattern of vascularization in the cotyledon, × 5. *Fig. 2.* Diagram showing the vascular pattern of the cotyledonary node in *Magnolia grandiflora*.

outline. The subsequent leaves soon assume the elliptic to obovate-elliptic norm of the genus.

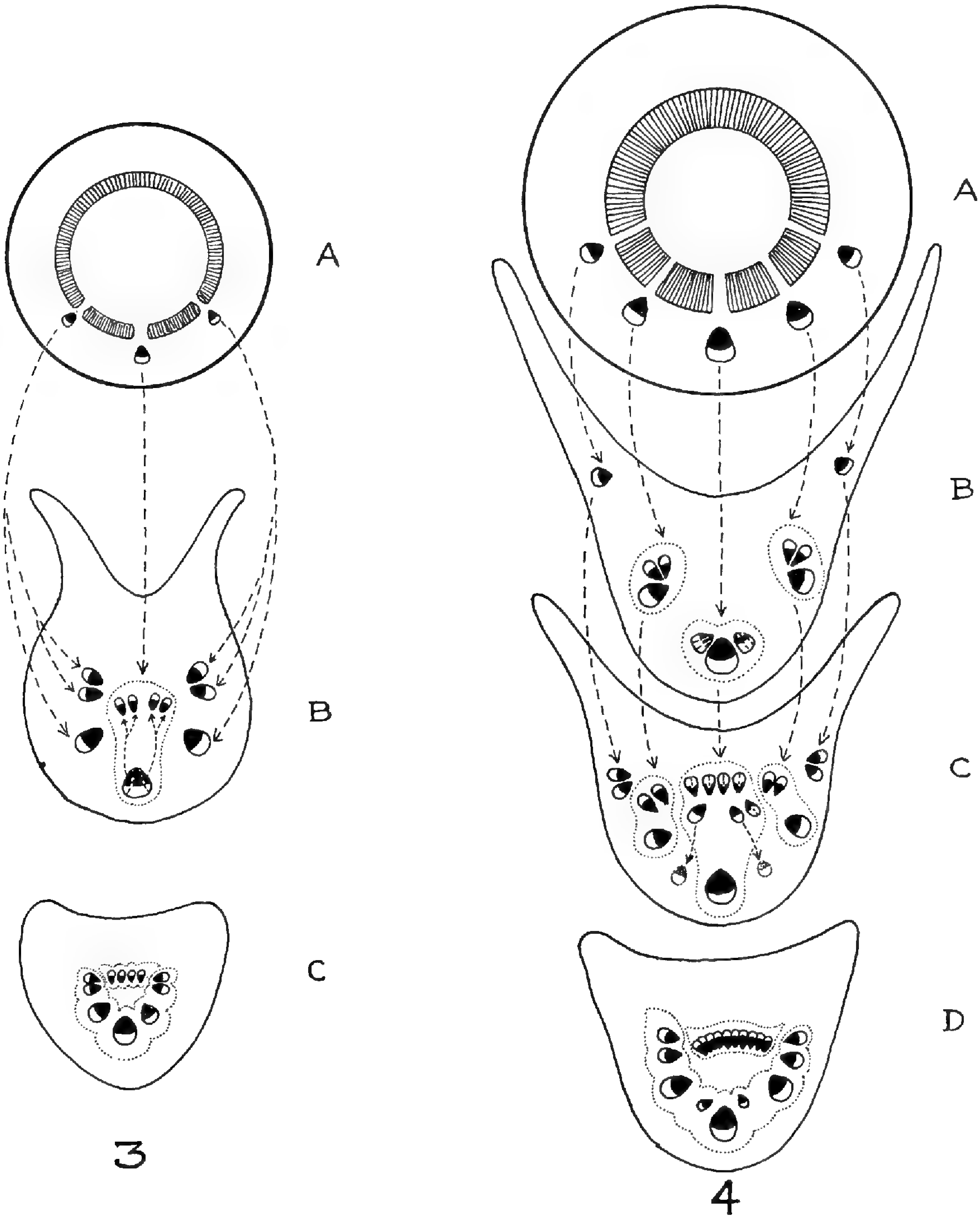
Two median vascular traces originating from a single gap in the stele enter each cotyledon. These strands remain distinct in the petiole, *Figs.* 1, 1a, but unite in the basal part of the lamina into a single strand which then forms the median vein of the cotyledon. The phloem of the strand maintains its doubleness till about half the distance in the cotyledon and then unites. The marginal traces of the cotyledons arise from separate gaps in the stele, *Fig.* 1, and bifurcate in the basal part of the lamina, *Fig.* 1a; the bifurcated strands diverge in the blade in a palmate fashion. The branches of these lateral strands vascularize most of the lower half of the blade. The remainder of the cotyledon is vascularized by the branch system of the median strand, *Fig.* 1a.

The seedlings of the Magnoliaceae (*Magnolia, Michelia, Liriodendron*) are provided with two cotyledons in the great majority of cases, *Fig.* 2. The median pair of strands originates in the same manner as in *Degeneria,* but the four lateral strands of the two cotyledons are derived by the bifurcation of two traces which arise from two gaps in the stele. Even in those abnormal instances of tricotyledonous seedlings which are now and then encountered in *Magnolia stellata,* the lateral traces of the adjacently placed cotyledons arise in the same way. This pattern seems to be stabilized fairly well in the family, although *Magnolia Soulangeana* (7) appears to possess a nodal anatomy similar to *Degeneria.*

ANATOMY OF THE NODE AND PETIOLE

The first few leaves of the seedling receive three traces from a corresponding number of gaps in the stele, *Fig.* 3A, and thus the nodes on which these leaves are borne are trilacunar. In serially arranged transverse sections of the petiole, the three traces exhibit the following changes in their courses outward into the leaf. The median trace trifurcates, forming a large central strand and two smaller lateral ones. The lateral strands, from a purely descriptive point of view, appear to shift adaxially toward the upper part of the petiole and split into four small bundles having an inverted orientation of xylem and phloem, *Fig.* 3B. The lateral traces (compare *Figs.* 3A and 3B) bifurcate, and the more adaxially situated products of this division subsequently divide, forming a total of six strands, three on each side of the derivatives of the median trace. Higher in the petiole, the large abaxial segment of the median trace and the branches of the lateral traces converge in the form of a large arc of seven strands, *Fig.* 3C. This arc is closed by the four smaller derivative strands of the median trace, thus giving rise to an adaxially flattened eustele.

In contrast to the seedling nodes, those on the mature stem are pentalacunar, *Fig.* 4A, as reported by Bailey and Smith (1), although very large leaves of vigorously growing saplings may receive more than five bundles from the corresponding nodes. With increase in the number of traces the vascularization pattern of the petiole becomes more complex. The median trace trifurcates at the base of the petiole, *Fig.* 4B, the lateral segments of which break up into a varying number of eight to twelve strands. These smaller strands aggregate in the upper part of the petiole, the individual strands orienting to form a loose "inner eustele," *Fig.* 4C. The second pair of laterals also divide. At a higher level, two to four strands from the "inner eustele" swing back into an abaxial position on either side of the median trace, as indicated by broken arrows in *Fig.* 4C. The paired adaxial segments of the first pair of laterals join the corre-

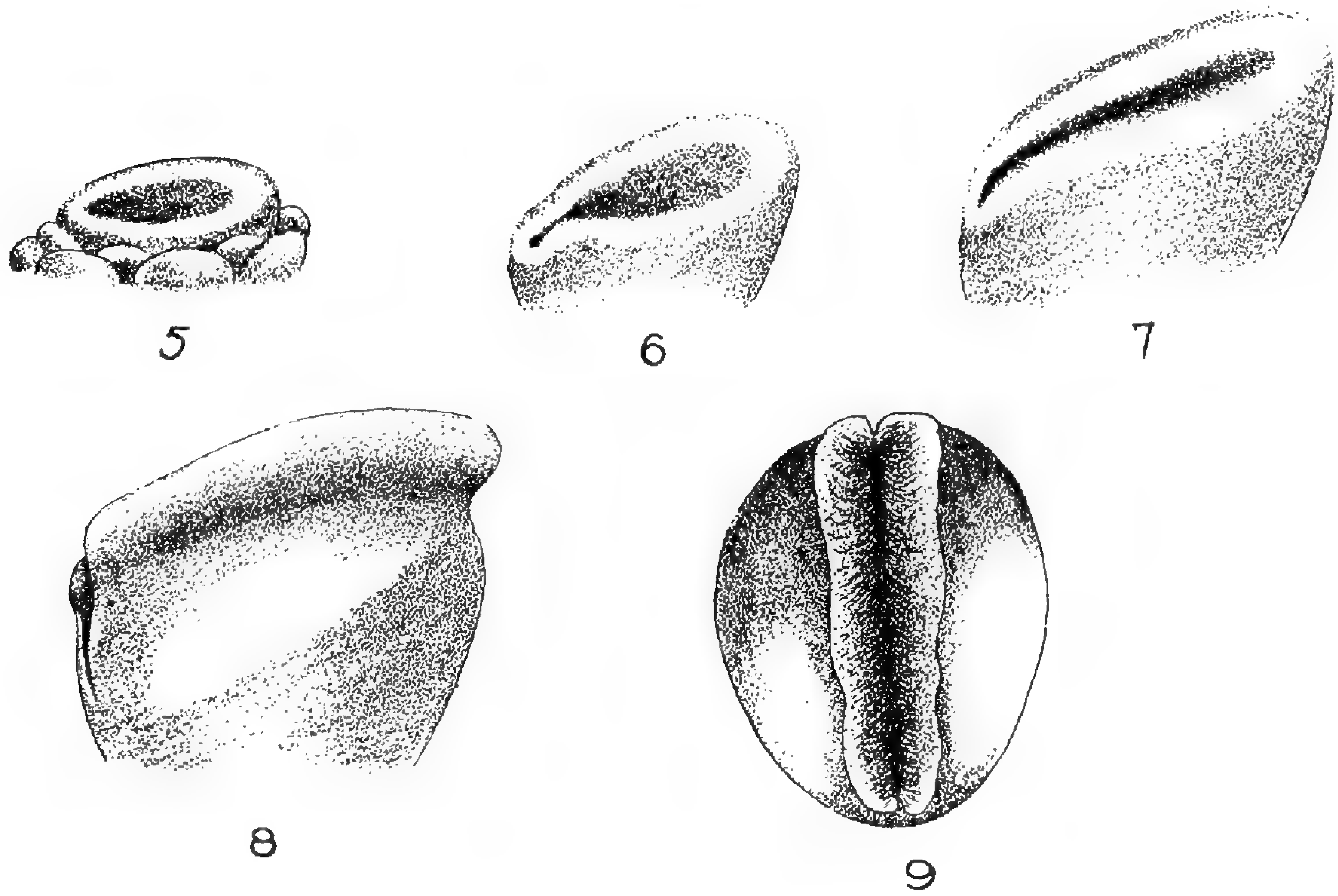


FIGS. 3, 4. *Fig. 3.* Series of diagrams illustrating the behavior of the vascular traces at the node and in the petiole of a seedling leaf. A represents the nodal level; B and C, basal and upper levels of the petiole. *Fig. 4.* Same; in the adult leaf. A represents the nodal level; B, C, and D, successively higher levels in the petiole.

sponding ends of the now more or less opened "inner eustele" in the form of a strap, which occupies the flattened upper side of the petiole. The remainder of the traces unite into a large horse-shoe-shaped arc, the ends of which approximate the lateral extremities of the strap-shaped segment, thus forming an adaxially flattened eustele, *Fig.* 4D. In spite of these complications, the fundamental pattern — trifurcation of the median trace and the organization of the adaxial strap-shaped segment largely by the lateral segments of the median trace — is the same in both the seedling and the adult leaves. In the latter, the number of bundles involved is decidedly larger and a few of the strands of the median system swing back into an abaxial position, which situation has no counterpart in the trilacunar seedling leaves.

ORGANOGENY

The first structures to develop on the thalamus are the calyx members. The differentiation of the petals takes place in quick succession, the outermost members originating first, *Fig.* 82. There seems to be a time lag before the initiation of the androecium, during which period the corolla completely envelops the broad, mound-shaped floral apex, *Fig.* 83. The ontogenetic differentiation of the staminal whorls is also in a centripetal



FIGS. 5–9. Stages in the development of the carpel.

succession. Some of the last-formed members of the androecium later transform themselves into staminodes. After the initiation of the androecium, *Fig.* 84, the floral apex is rendered narrower and somewhat blunt. This apex is used up in the organization of the solitary carpel, *Fig.* 85. Thus the order of development of calyx, corolla, androecium and gynoecium, as well as of the individual whorls of corolla and androecium, is in centripetal succession.

As a result of the confinement of meristematic activity to the rim of the carpel primordium, an embossed periphery is created. At this stage, the primordium appears as a shallow cup, having an outline similar to that of a horse-shoe, the free ends of which are fused, *Fig.* 5. A few cells on this ventral side fail to divide but the surrounding cells continue divisions; as a result, a notch appears in the wall of the cup, *Fig.* 6. Furthermore, the cells of the rim on the dorsal side maintain a faster rate of division and the tissue on this side grows rapidly in height. This results in a conduplicate structure enclosing a cavity between the folds. The structure itself is abaxially deformed, *Fig.* 7. The free edges grow out externally in the form of flanges, whose margins flare apart, *Figs.* 8, 9. A transverse section of the carpel at this stage is represented in *Fig.* 89. The internal surfaces of the flanges later become stigmatic, as will be described on a subsequent page.

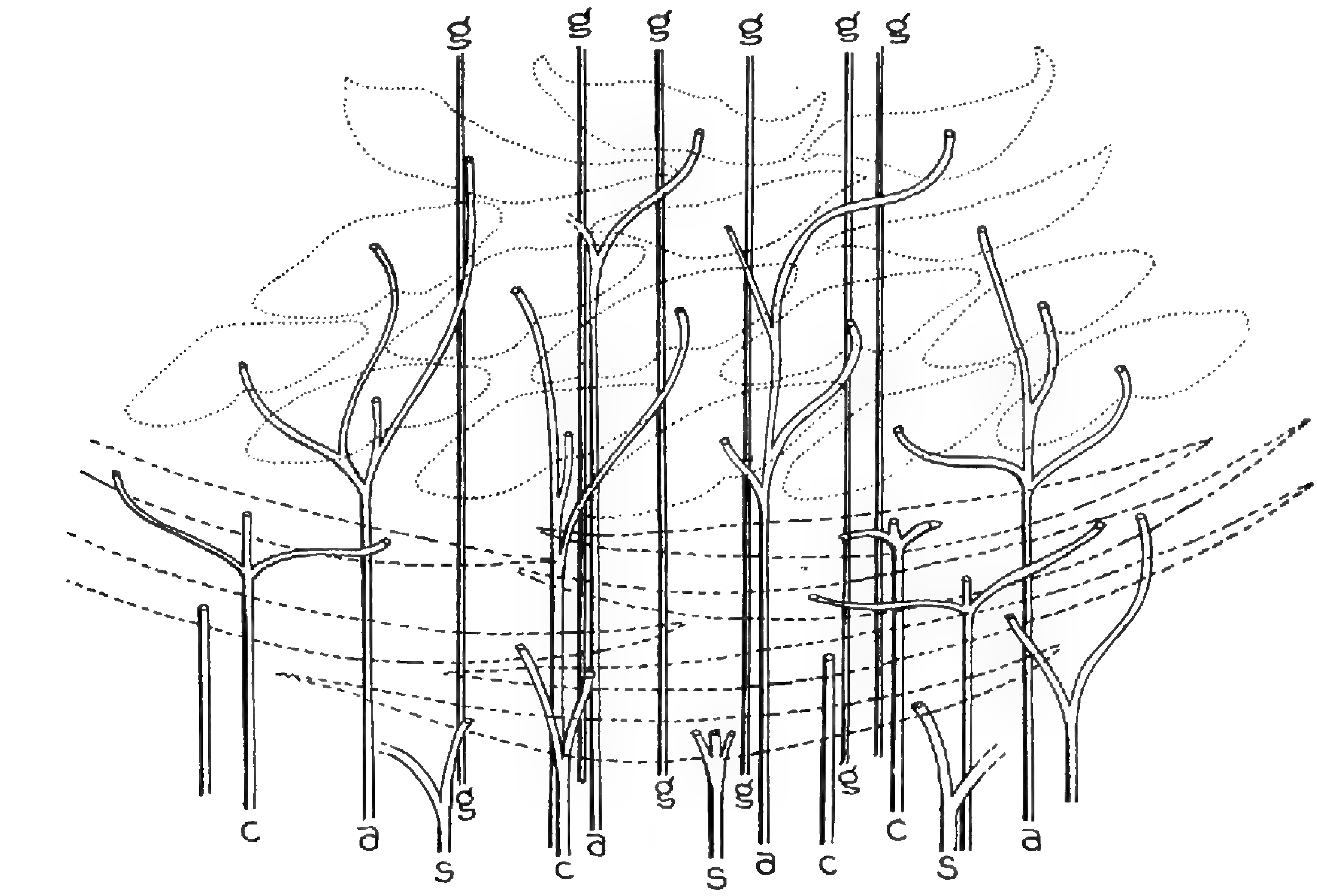
VASCULARIZATION OF THE FLOWER

An ontogenetic outlook in studies dealing with the vascular anatomy of flowers is an essential factor for an understanding of the real significance of the phenomena involved. The procambial system laid down during the early development is subject to a high degree of modification as the flower attains maturity. The modifications involve either an elaboration of the system which brings greater complexities into the adult vascular structure, or a reduction whereby the mature vasculature becomes very much simplified. In order to emphasize the degree and nature of the complications that attend the procambial pattern of the *Degeneria* flower, the topic will be considered at present under two heads — the procambial pattern and the vascular pattern at anthesis. The adaptation of this method should not be interpreted as implying that all the organs of the flower have their vasculature represented only by the procambial strands at any one single step and that the strands become differentiated into xylem and phloem at another single step. In fact, hand in hand with the extension of the procambial strands into the newly formed structures on the floral axis, the older portions of the same strands become transformed into xylem and phloem. This being the case, it would be misleading to look at the phenomenon as involving two definite steps. The distinction made at present is only for the sake of description.

Procambial pattern:

Figure 10 represents what may be called the "procambial diagram" of a sector of the flower. This diagram is synthesized after following the course of differentiation and extension of the procambium into the respective structures of the flower as they are being formed on the thalamus; the secondary modifications of these strands have been deliberately omitted in this figure, but have been incorporated in the diagram representing the vascular pattern at anthesis, *Fig.* 11.

In general, the method of supply of the procambial strands to the sepals and petals is very similar. Each member receives a median and two mar-



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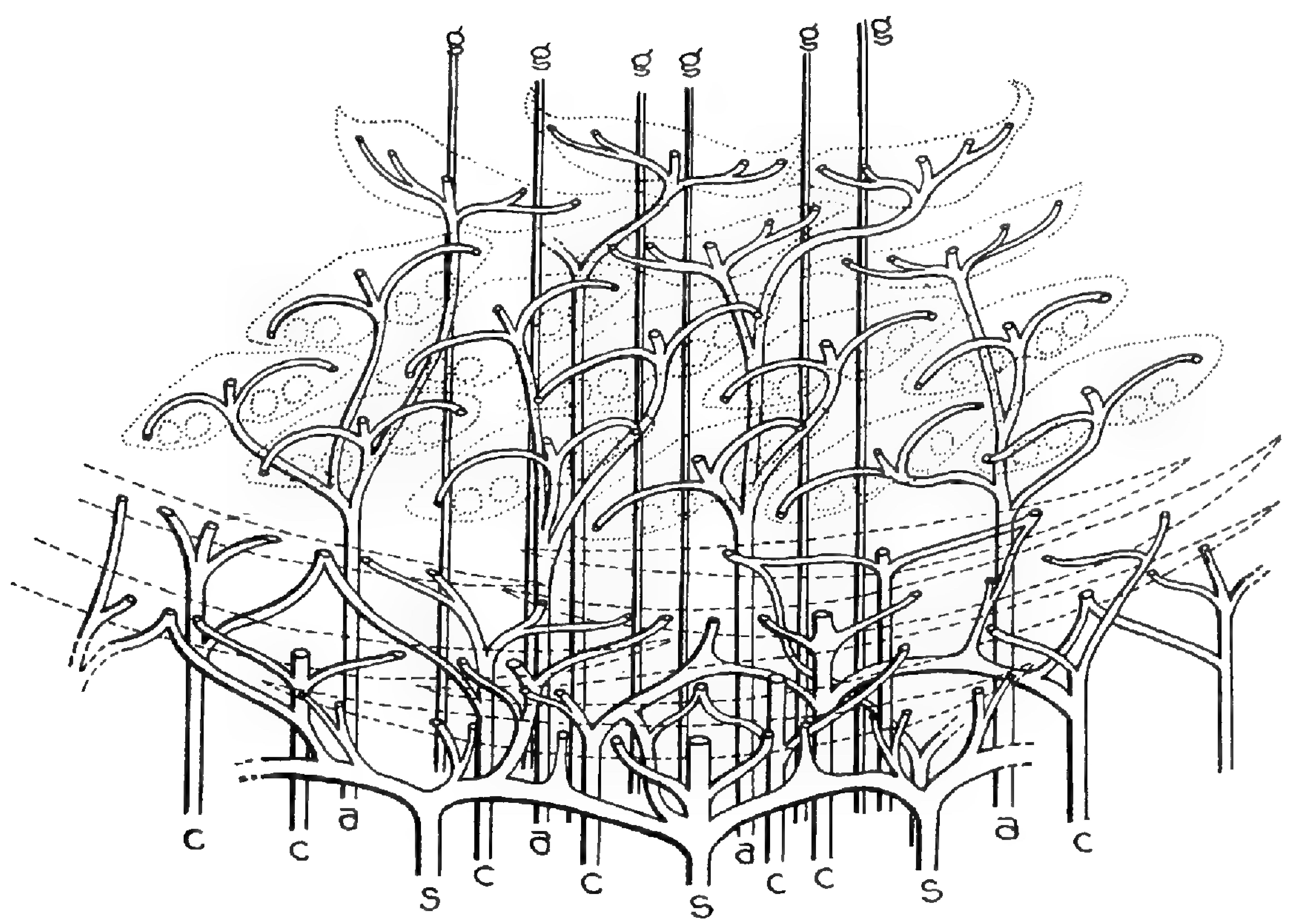

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FIGS. 10, 11. *Fig. 10.* Procambial diagram of a sector of a flower, depicted as seen from the side with one of the calyx lobes facing the reader. *s* — vascular traces supplying the sepal members; *c* — of petal members; *a* — of androecial members; *g* — of gynoecium. *Fig. 11.* Vascular diagram of the same sector at anthesis. Lettering as in Fig. 10.

ginal traces, *Fig.* 10 (traces of the sepals marked *s*, of the corolla, *c*). The marginal traces of the adjacently placed members are usually derived from a common stelar bundle. However, each of the petals belonging to the innermost whorl receives a single bundle, which trifurcates into median and marginal traces. Each member of the androecium receives a single trace. It may be noted that the supply of a group of four or five stamens originates from a single stelar bundle (marked *a*). The remainder of the procambial bundles (marked *g*) fuse with each other into seven to nine larger units before entering the carpel.

Vascular pattern at anthesis:

By the time the flower bud attains the stage of anthesis, the simple pattern of vascularization just described becomes highly modified, of course, retaining the original ground plan in all essentials (compare *Figs.* 10 and 11; the latter diagram represents the same sector of the flower as that depicted in the former). The important modifications that are involved may be briefly stated as follows.

Perianth. — The vasculature of the perianth members is subject to a high degree of modification. The median and marginal traces of each member branch, and the branches anastomose not only with one another but also with similar branches belonging to the members of the adjacent whorls. Numerous new traces originate from the points of anastomoses and occupy positions on either side of the median and marginal traces of each perianth lobe.

Androecium. — In the androecial members, the modification is less pronounced. The single vein trifurcates into the median and marginal traces at the very base of the microsporophyll. In the staminodes, the marginal traces undergo a further bifurcation at the base and are generally more highly developed than in the stamens.

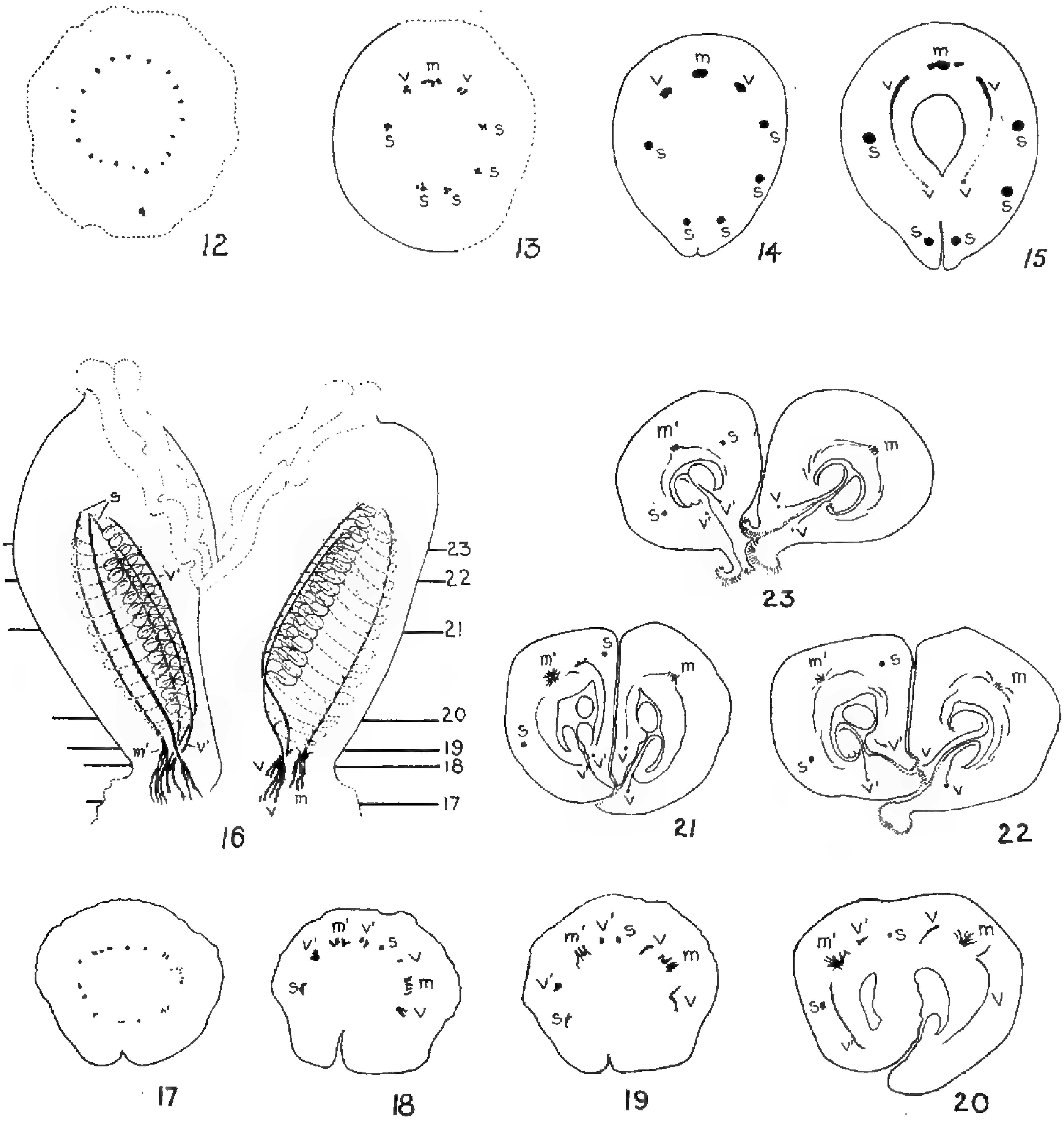
In this connection some points in the ontogeny of the stamens and staminodes may be considered. The primordia of all the individual members of the androecium are alike in shape, size and histological characteristics. The cells are richly protoplasmic and show a great and uniform avidity for stains. With subsequent development, parenchymatization starts in the adaxially situated cells and proceeds in an abaxial direction. When this phenomenon advances to about half the distance between the abaxial and adaxial surfaces, a nest of small cells in the center becomes differentiated as the procambial strand. It is at about this time that the archesporial cells begin to differentiate in the hypodermal layer on the abaxial side. The archesporial cells undergo the first periclinal division, leading to the formation of the primary parietal and sporogenous layers. The development until this stage is characteristically seen to take place in all the primordia of the androecium, irrespective of their destination, whether staminal or staminodal.

From this stage onwards, in those primordia that belong to the innermost whorl and in a varying number of primordia that belong to the next outer whorl, the subsequent development of the sporogenous tissue becomes arrested and all the cells excepting the procambial strand become rapidly parenchymatized. By further differentiation of the component cells and by a modification of the external form, the appendages become staminodes. On the other hand, the development of the sporogenous tissue continues in the remaining primordia and the rate of parenchymatization of the cells becomes somewhat retarded, so that an abaxial patch of darkly staining cell layers still persists (compare the staminodes and the stamens in *Fig.* 85). These appendages mature into stamens.

Thus it will be seen that both the staminodes and stamens show a fundamentally similar origin and development until a certain stage, and the factors that make them develop into one or the other of these structures operate later; both structures are similar in their method of vascularization, although the marginal traces in the staminode divide once again. Furthermore, the stamens may often bear degenerate sporangia (1). All of these facts indicate that in *Degeneria,* the staminodes are best interpreted as sterile microsporophylls.

GYNOECIUM. — The gynoecium of *Degeneria* is represented by a solitary carpel occupying a terminal position on the floral axis. After supplying the members of the preceding whorls, a fairly large number of cauline bundles (varying usually between 18 and 25) are left over in the floral axis, *Fig.* 12. A few of these bundles, however, disappear at the base of the carpel; others recombine into seven to nine larger bundles, *Figs.* 13, 14. The three adjacently placed bundles (marked *m* and *v* in the figures) situated below the midrib region of the folded megasporophyll run into it as median and ventral traces; the other bundles (marked *s*) also enter the carpel and occupy positions in its wall as indicated in the illustrations, *Fig.* 15. The median trace gives out extensive side branches, which spread in the carpellary walls in a pinnate manner, *Figs.* 24–27. The ends of the branches finally anastomose with the ventral trace of the corresponding side. The branches of the ventral traces and to a small extent those of the dorsal trace take part in the vascularization of the ovules, as will be explained in a later paragraph. In contrast to the behavior of the ventral and median traces, the extra traces (marked *s*) in the carpel remain distinct and isolated — in location as well as in the degree of branching — from the system of the median and ventral traces. Even in the mature fruit, they persist as robust cords, maintaining the same configuration, *Fig.* 29. In other words, in spite of the fact that several traces enter the carpel, only three of them (the median and ventrals) behave as normal carpellary traces, whereas the others do not; the presence and behavior of the median and ventral traces in the carpel is typical and consistent, whereas the number of the extra traces is subject to fluctuation. This situation leads one to suspect strongly that the extra traces do not belong to the integral vascular system of the carpel and to conclude that the carpel of *Degeneria* is essentially a three-trace megasporophyll as in the Winteraceae(2).

How then can the extra traces of the carpel be explained? What may be their possible significance? In this connection it is worth while to recall the general behavior of floral apices in relation to vasculature. Unfortunately such studies have not been extended to a wide range of flowers. However, the information provided by Arber and other work-



FIGS. 12–23. *Figs. 12–15.* Transverse sections at successive levels starting from the base of the carpel. Explanation in text. *Fig. 16.* Semidiagrammatized pattern of vascularization in a two-carpelled gynoecium as seen from a side; reconstructed after a study of serial transverse sections. *Figs. 17–23.* Transverse sections of the two-carpelled gynoecium at levels indicated in Fig. 16 by corresponding numbers. All figs., × 10.

ers [3] is indicative of the following salient generalizations: In multicarpellate flowers the vascular bundles of the axis that are left over after supplying the perianth and androecium take part in the vascularization of the carpels in a normal and uniform manner. Thus all vascular bundles are "used up" by the carpels. This seems to be the usual behavior in the great majority of instances. But, particularly in genera

[3] See Arber, A. "The interpretation of the flower: A study of some aspects of morphological thought," Biol. Rev. 12: 157–184. 1937, and literature cited therein.

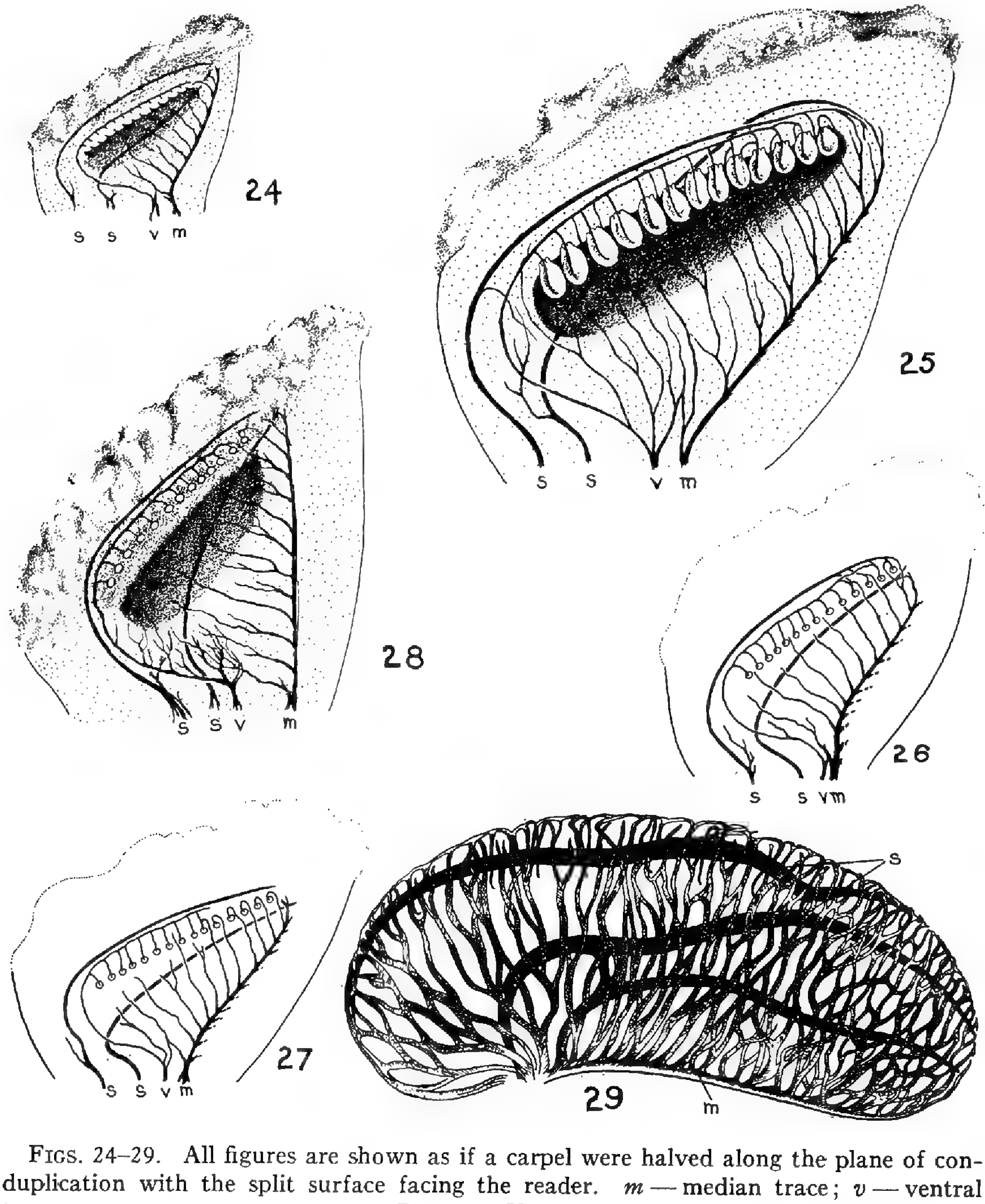
and species that exhibit a series in the reduction of many carpels to one, the following modifications are frequently seen, either singly or in various combinations. (i) The vascular bundles (residual vascular tissue) that would have supplied the missing carpel or carpels may still persist in the floral axis either as such or after anastomosing with one another in various ways. (ii) The residual bundles may disappear at a considerable distance below the persisting carpel or carpels. (iii) They may fuse with the bundles that are concerned in supplying the persisting carpel or carpels. (iv) They may enter the persisting carpel itself as supernumerary traces.

The situation in *Degeneria* seems to be a combination of the factors involved in items (i) and (iv). It may now be recalled that in *Degeneria* a large number of the stelar bundles are left over in the floral axis at the base of the carpel; that these fuse with one another into seven to nine larger bundles; that three of them form the median and ventral traces of the carpel; that the other extra bundles also enter the carpel and travel throughout its entire length; and that the behavior of the extra bundles within the carpel is markedly different from that of the median and ventral traces. The extra bundles therefore probably represent those that formerly supplied other carpels. In other words, the ancestral flower of *Degeneria* was in all probability multicarpellate. That this was most likely the actual condition is further supported by the method of vasculature of a bicarpellate flower.

Very rarely, flowers of *Degeneria* bear two carpels, attached at slightly different levels on the thalamus, *Figs.* 16–23. A transverse section just below the level of attachment of the carpels, *Fig.* 17, shows the bundles of the axis arranged in a ring in the same manner as in a monocarpellate flower, compare *Fig.* 12. The bundles unite in various ways with one another resulting in eight larger bundles, *Fig.* 18. The three bundles disposed towards the right hand side (marked *m, v*) supply the median and ventral traces to the first carpel. Of the remaining five bundles, the middle three (marked *m′, v′*) form the median and ventral traces of the second carpel; the other two bundles (marked *s*) also enter the upper carpel as supernumerary traces and behave in the same manner as in the case of the normal monocarpellate flower, that is, remain distinct from the integral vascular system of the carpel.

Two significant points emerge from this data. (i) The first carpel on the axis does not present any anomalies in its vascularization. (ii) The ultimate carpel receives only two extra traces in contrast to the monocarpellate gynoecium of the normal flower, where the number of such traces is larger, four to six. In other words, with more numerous carpels on the floral axis, the number of extra traces in the ultimate carpel becomes reduced and probably eliminated. Conversely, the presence of supernumerary traces in the normal monocarpellate flowers of *Degeneria* is closely associated with the phylogenetic reduction in the number of carpels.

VASCULARIZATION OF THE OVULES. — At the very base of the carpel, the ventral trace gives off two or three side branches which further ramify and anastomose with the system of the median trace, *Figs. 24–27*. The remainder of the trace continues to run along the ovule-bearing region. In general, this trace remains relatively weakly developed and on this account there is every possibility of overlooking its presence and at the



FIGS. 24–29. All figures are shown as if a carpel were halved along the plane of conduplication with the split surface facing the reader. *m* — median trace; *v* — ventral trace; *s* — supernumerary trace. *Fig. 24.* Vascularization of the carpel at the time of origin of ovular primordia, × 25. *Fig. 25.* Same, at anthesis, × 25. *Figs. 26* and *27.* Variations in the vascularization of the ovules at anthesis. Small circles denote the funicles with the ovules removed. Semidiagrammatic, × 17. *Fig. 28.* Drawing to show the expanse of the papillate stigmatic surface at anthesis; note its extension towards the interior of the carpel beyond the ovule-bearing region; ovules are removed and their respective places of attachment are denoted as empty circles, × 20. Also compare figs. 52 and 87. *Fig. 29.* Vasculature of mature fruit, × 2.5.

same time mistaking the otherwise well developed supernumerary trace, *s* in *Figs.* 24–27, 41–44, for the ventral.

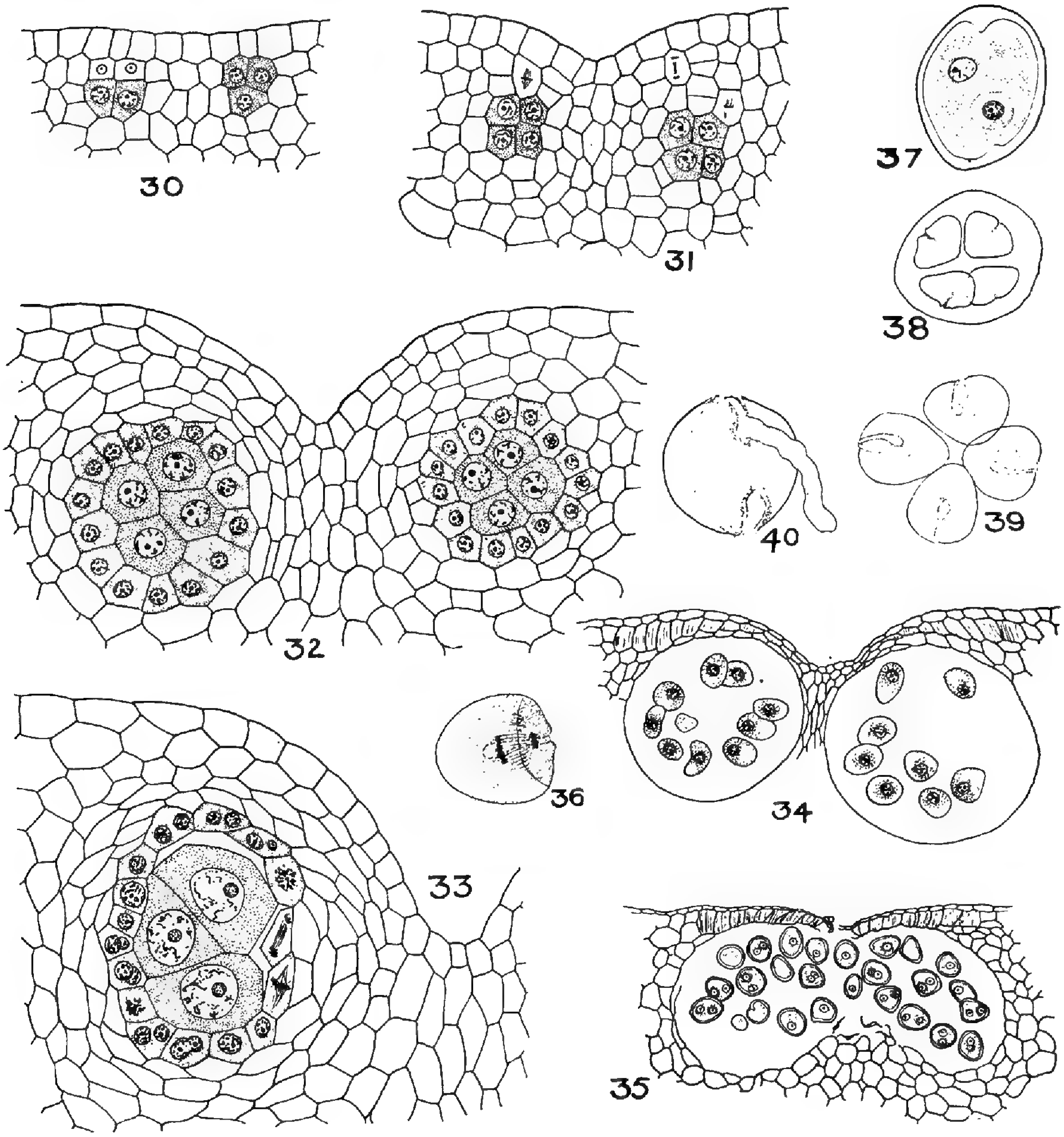
The ventral trace is concerned with the vascularization of the majority of the ovules. It sends out a number of slender branches all along its length and each branch enters an ovule. This pattern is stabilized in the ovules that are situated towards the basal region of the carpel. On the other hand, some of the ovules that are situated especially towards the distal end exhibit an altogether different situation. It has been pointed out that the median trace of the carpel builds up an extensive branch system and that the branches reach towards the ventral traces with which they ultimately fuse. Frequently, some of the branches of the median system fuse with the ovular traces given out by the ventrals (see the penultimate ovules towards the distal end in *Fig.* 25), whereby such ovules should be considered as having been vascularized by both the median and ventral systems. Less frequently the ventral trace is precociously used up and the distally situated ovules derive their vascular supply only from the median system, *Fig.* 27. In very rare instances, the supernumerary traces may also send out one or two slender branches that fuse with those of the distally situated ovular traces, *Fig.* 26. These various methods of vascularization often occur in the same carpel in varying combinations and fluctuate from carpel to carpel.

MICROSPORANGIUM AND MICROSPORES

As pointed out by Bailey and Smith (1), the microsporangia are immersed beneath the abaxial surface of the sporophyll. As already mentioned on a previous page of the present contribution, the primary archesporium differentiates in the hypodermal layer of the abaxial surface. This fact negates any suggestions that the extrorse dehiscence in *Degeneria* is due to an ontogenetic shift in the position of the sporangia.

Although the primary archesporial cells are strictly hypodermal in origin, occasionally one or two cells belonging to the sub-hypodermal layer also show the characteristics of archesporial cells (group of three cells in the right side of *Fig.* 30). It is quite possible that the cells of the subhypodermal layer may infrequently become a part of the archesporium and share its subsequent development. Two adjacent groups of archesporial cells, each group consisting of two or three cells as seen in transverse sections, are differentiated between the median and marginal traces of the sporophyll. The first division in the archesporium results in the formation of parietal and sporogenous layers, *Fig.* 30. The parietal layer by further periclinal divisions builds up four or five wall layers and the tapetum, whereby the sporogenous cells become deep-seated in the tissue of the sporophyll, *Fig.* 31. The outermost of the wall layers later transforms into the endothecium. The sporogenous cells also may divide once and thus increase in number before differentiating as microspore mother cells.

Simultaneously with their enlargement, the microspore mother cells become jacketed by a continuous layer of tapetum, *Fig.* 32. When the



FIGS. 30–40. *Fig. 30.* Two adjacent groups of sporogenous cells of one half of the microsporophyll. In the right group, the archesporium is shown, in the left it has divided into the parietal and sporogenous layers, × 200. *Fig. 31.* Same, showing the differentiation of wall layers; the primary sporogenous cells have also divided, × 200. *Fig. 32.* Same, showing the organization of tapetum, × 200. *Fig. 33.* A single sporogenous group with its tapetum, some of the tapetal cells are binucleate and the nuclei in others are in various stages of division or reunion, × 200. *Fig. 34.* Two adjacent sporangia showing the disappearance of the tapetum, uninucleate microspores and the initiation of the endothecial thickening, × 50. *Fig. 35.* Same, at the shedding stage; the pollen grains are two-celled, × 50. *Fig. 36.* Division of the microspore. The broken line indicates the position of the germinal furrow, × 200. *Fig. 37.* Pollen grain at the shedding stage showing the faintly-stained vegetative nucleus and the darkly stained generative cell, × 200. *Fig. 38.* A young tetrad showing the initiation of the furrow on the distal face of each spore, × 135. *Fig. 39.* Pollen grains of a tetrad immediately after separation, showing the well defined furrow, × 135. *Fig. 40.* A germinated pollen grain removed from the papillate surface of a carpel; note the emergence of the tube from the broadened end of the furrow, × 200.

nucleus of the microspore mother cell is in the prophasic stages of the first meiosis, the tapetal cells become binucleate, *Fig.* 33. Frequently some of the nuclei fuse again and occasionally redivide. However, they do not migrate out of their cells and their general behavior is in conformity with the secretory type of tapetal organization. The cells of the tapetum function actively until after the first division of the microspore mother cell and then degenerate.

The microspore mother cell undergoes the meiotic divisions in a simultaneous manner and produces a tetrad of microspores. Usually, the configuration of the latter is tetragonal, *Figs.* 38, 39, rather than tetrahedral. The young microspore, while it is still lodged within the original wall of the mother cell, shows a conspicuous fold on its distal face, *Fig.* 38. At the time of separation of microspores from the tetrad, *Fig.* 39, a narrow groove with slightly broadened extremities takes the place of the distal fold. It is this groove that differentiates as the germinal furrow (colpa) of the mature pollen grain. Thus it is clear that the position of the germinal furrow in the pollen of *Degeneria* is distal.

The uninucleate microspores, *Fig.* 34, soon become scattered in the sporangial cavity. The nucleus of the microspore migrates towards the distal side of the spore and a vacuole develops towards the proximal side. The first division of the spore nucleus is accomplished in this position. The orientation of the spindle during this division is such that the generative cell is always cut off towards the furrow-end of the grain, *Fig.* 36, that is, towards the exterior end of the tetrad. The generative cell, after a time, shifts its position and comes to lie nearer the interior of the grain, *Fig.* 37. The pollen grains are shed in this two-celled condition.

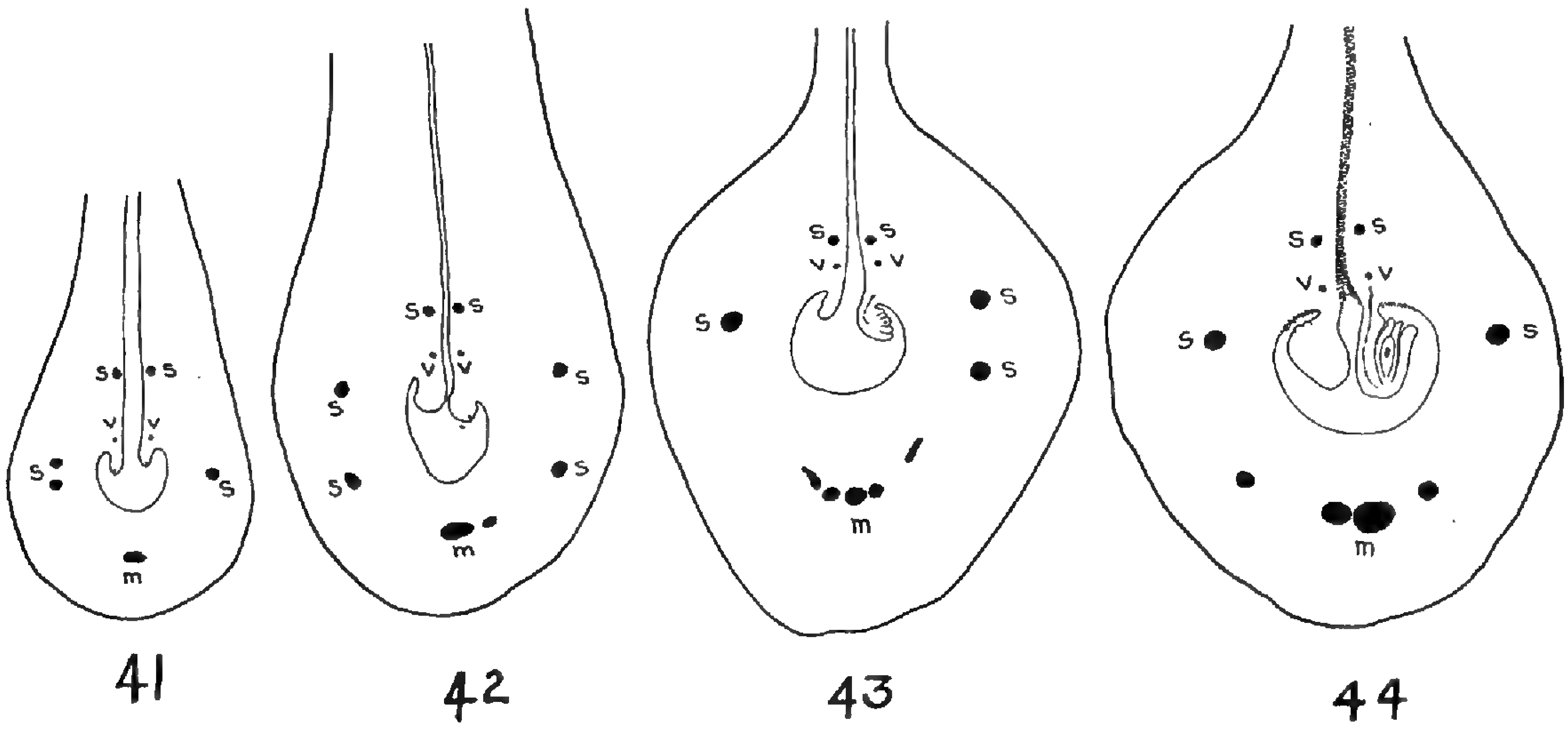
At the time of the division of the microspore nucleus, the cell layers separating the adjacent sporangia break down and their cavities become continuous. The endothecium is characteristically localized in disposition, not extending beyond the outer faces of the sporangia, *Fig.* 35.

MEGASPORANGIUM AND FEMALE GAMETOPHYTE

The ovule-bearing region of the carpel is situated far back of the margins of the conduplicately folded carpel, a feature clearly demonstrated in transverse sections, *Figs.* 41–44, 88–91. Longitudinal sections passing through the plane of conduplication also reveal the same feature, *Fig.* 86, and in addition, reveal the slanting orientation of the carpellary cavity and the ovule-bearing region in conformity with the abaxial deformation of the carpel. A single row of ovular primordia arises opposite each of the ventral bundles, *Figs.* 41, 88. Ten to thirteen primordia constitute a row and the ovule-bearing region itself is confined to the upper end of the carpellary cavity.

The ovular primordia grow into the cavity at first in a vertically downward direction, *Figs.* 41, 88. With the differentiation of the nucellus and integuments, the apex of the ovule undergoes a curvature of 90°, *Figs.* 42, 43, and by the time of sporogenesis, becomes bent on itself, thereby assuming a completely anatropous position, *Figs.* 44, 91.

Soon after the differentiation of the archesporial cell in the nucellus, the two integuments originate more or less simultaneously, *Fig.* 47. When the megaspore mother cell is fully differentiated, the inner integument comes to have three layers of cells and the outer, four to five layers. The number of cell layers in the integuments continue to increase and at the time of fertilization the inner integument consists of four cell layers at the region of the micropyle, but remains three layered in the part surrounding the nucellus; the outer integument comes to have seven or eight layers. As will be shown later, the thickness of the outer integument becomes further increased during post-fertilization development. Both integuments of the mature ovule envelop the nucellus completely and the inner integument organizes the micropyle, *Figs.* 49–51.

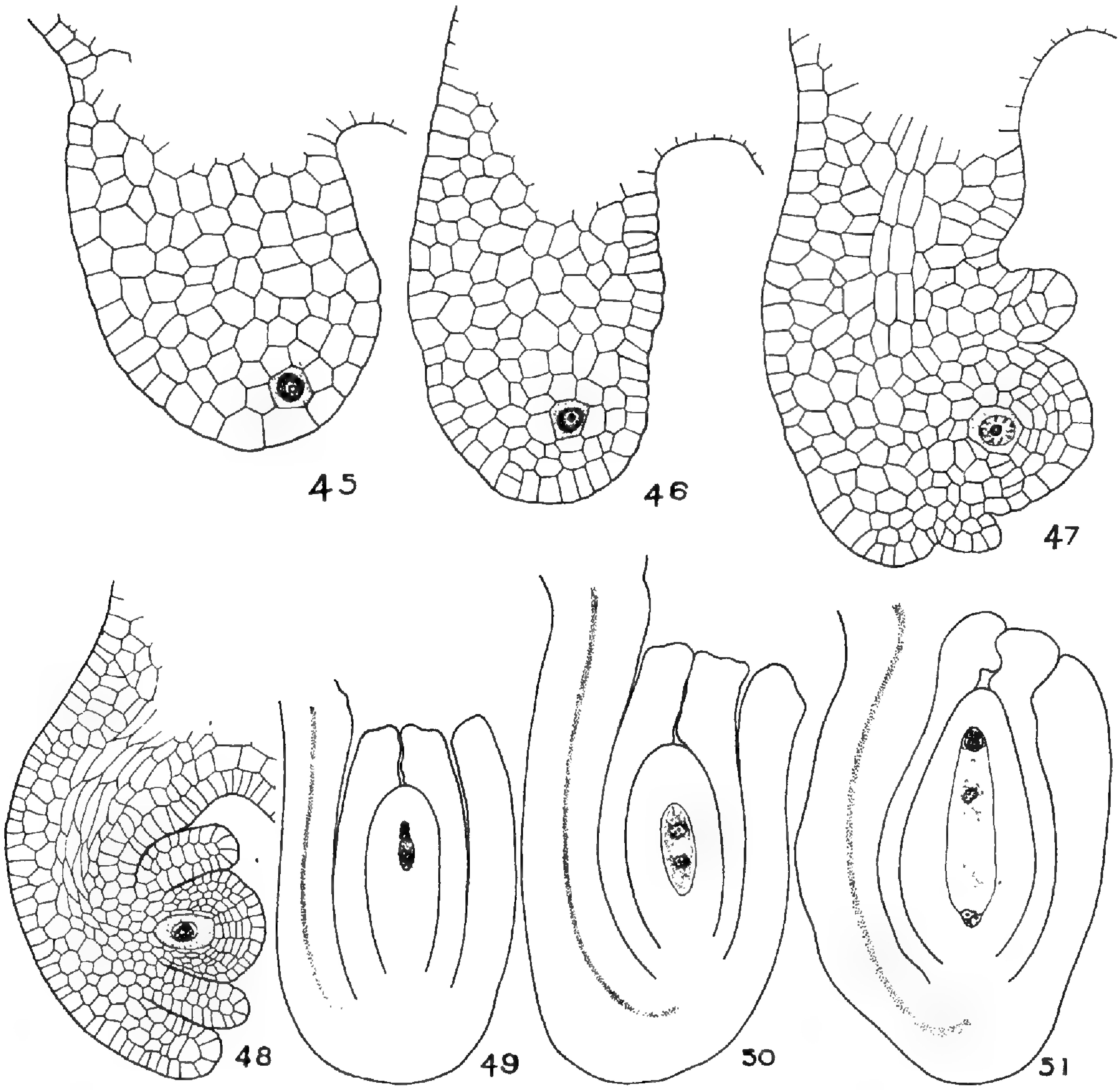


FIGS. 41–44. Transverse sections of carpels at different stages of development to show the curvature undergone by ovular primordia in assuming the anatropous position, × 12. *m* — median trace; *v* — ventral trace; *s* — supernumerary trace.

The subepidermal archesporial cell, *Fig.* 45, divides into a parietal and a sporogenous cell. The former gives rise to seven to ten layers of parietal tissue that cap the gametophyte; some of the layers persist in the developing seed for a long time, *Fig.* 101. The sporogenous cell functions as the megaspore mother cell, *Figs.* 46–48 and after undergoing the reduction divisions gives rise to a linear tetrad of megaspores, the chalazal one of which develops into the eight-nucleate gametophyte, *Figs.* 49–51. The fusion of the polar nuclei takes place usually before fertilization. However, in a few cases it may be postponed until the intervention of the sperm. The antipodals organize into cells and show signs of degeneration before the ovules are fertilized.

STIGMA, POLLEN TUBE, FERTILIZATION

It should be emphasized again that the ovule-bearing region of a *Degeneria* carpel does *not* represent the margin of the carpel and that the ends of the flared-out region of the sporophyll are the true margins. During earlier stages of development, *Fig.* 88, the closely approximated ventral surfaces of the conduplicate carpel form an open cleft extending from the locule to the exterior. Later, when the ovular primordia are differentiating into nucellus and integuments, the ventral halves of the conduplicate carpel tend to flare apart externally, *Fig.* 89. The epidermal cells of the adaxial surfaces in the region of this flaring develop into pro-



FIGS. 45–51. Figs. 45, 47 and 48 are enlarged from Figs. 41–43 respectively and are mounted with their corresponding orientation. *Fig. 45.* Archesporial cell in the nucellus. *Fig. 46.* Formation of parietal cells. *Fig. 47.* Origin of the integuments. *Fig. 48.* Megaspore mother cell in synizesis; parietal cells have increased in number. *Fig. 49.* Linear tetrad of megaspores, the chalazal one enlarging. *Fig. 50.* Two-nucleate embryo sac. *Fig. 51.* Mature eight-nucleate embryo sac. Figs. 45–48, × 182; Figs. 49–51, × 40.

tuberant hairs, *Figs.* 89, 93. This wave of glandular differentiation spreads outward toward the margins of the carpel and inward into the locule, *Fig.* 90, ultimately extending internally beyond the region of attachment of the ovules, *Fig.* 87. As a result, the narrow cleft between the adaxial surfaces that lie outside the ovule-bearing region becomes occluded by a closely interlocking system of papillate hairs, *Figs.* 90, 91, 94. At anthesis, the hairs on the flaring region grow into a dense felt and many of the individual hairs become two- or three-celled, *Fig.* 95, whereas in the locule they do not become as long or multicellular. Thus, a greater portion of the adaxial surface of the sporophyll — from the margin to a considerable distance towards the interior of the ovule-bearing region — becomes evenly papillate, *Fig.* 28. As will be shown presently, this entire surface is concerned in the penetration of the pollen tube and hence "stigmatic."

An examination of alcohol-preserved specimens reveals that during pollination the pollen grains become deposited anywhere on the adaxial surfaces of the outwardly flaring parts of the carpel. A few grains were also found attached on the abaxial surface; however, none of these grains show any signs of germination and appear to have lost their cell contents through degeneration. This observation indirectly emphasizes the importance of the papillate surface as an essential factor in the germination

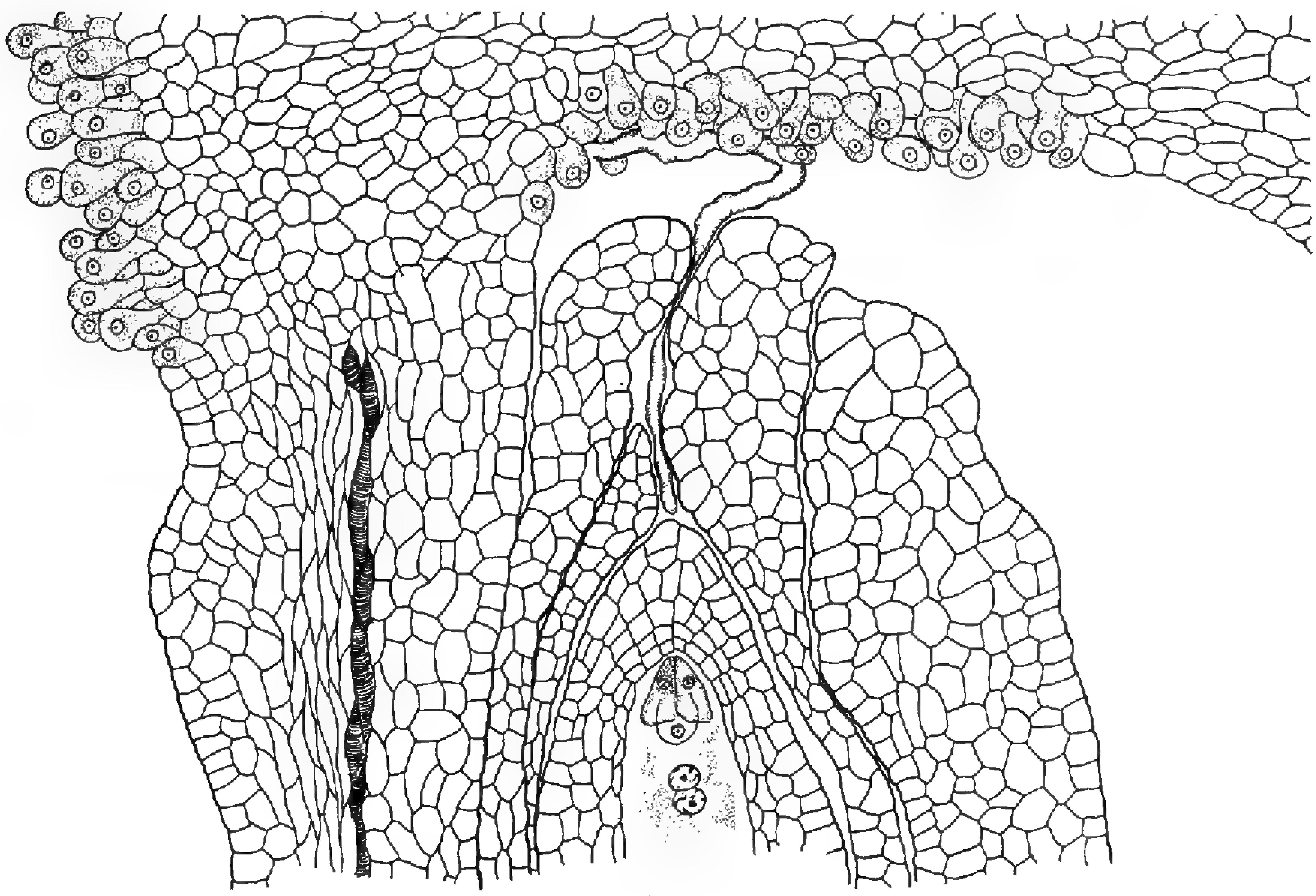


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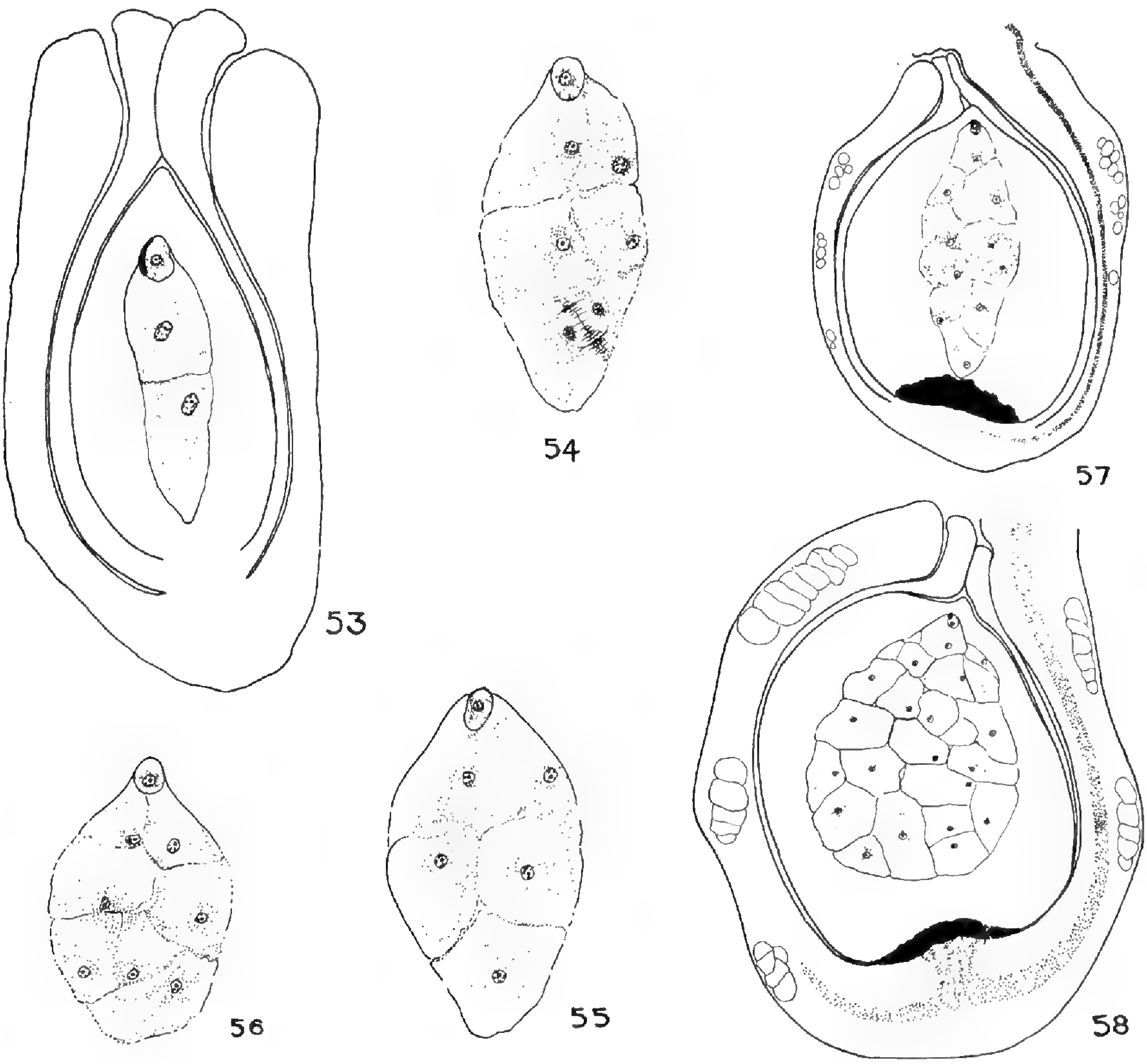
Fig. 52. Micropylar half of a mature ovule with a part of its funicle and associated carpellary tissue showing the papillate epidermis, the course of the pollen tube, etc., × 210.

of the pollen grains in *Degeneria*. The grains that are lodged on the hairy surface put forth pollen tubes. The tube arises not from the narrow region of the germinal furrow but rather from one of its broadened ends, *Fig.* 40. The course of the tube into the carpellary cavity is strictly along the papillate surface and at no time does the tube penetrate the carpellary tissue. Upon reaching the ovule-bearing region, it continues to grow between the funicles and reaches the extension of the papillate surface on the inside of the ovule-bearing region. Here the tube wanders about a little and then characteristically curves back and enters the micropyle, *Fig.* 52.

After reaching the lower end of the micropylar canal, the tube bores through the apex of the nucellus until the upper end of the embryo sac is reached. During the discharge of the pollen tube contents into the embryo sac, one of the synergids is usually destroyed. Double fertilization takes place in a typical manner. Triple fusion precedes syngamy.

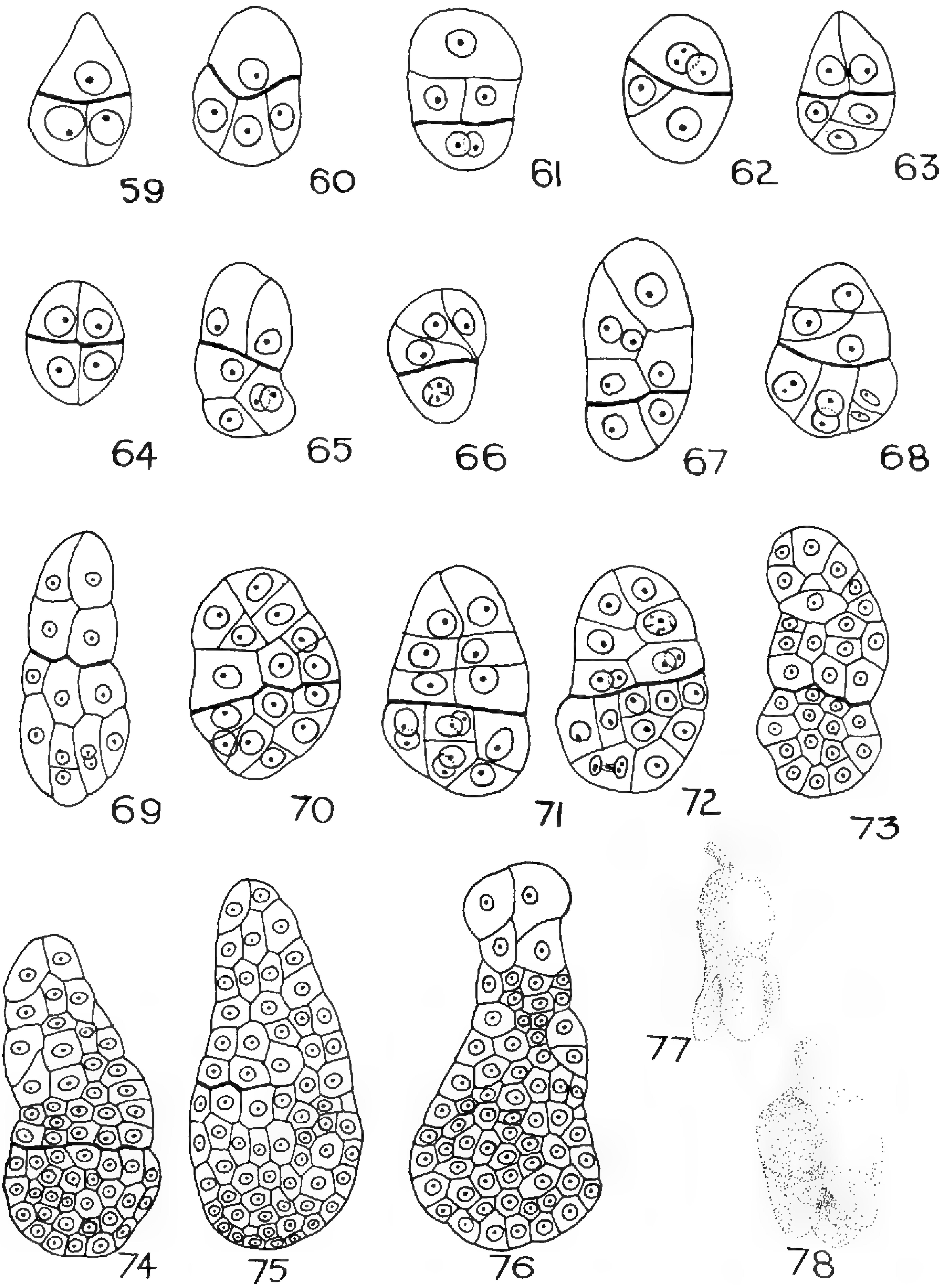
ENDOSPERM, EMBRYO

The first division of the primary endosperm nucleus results in a transverse chambering of the embryo sac, *Fig.* 53. The separating membrane is very thin and delicate. The nuclei of both chambers divide almost simultaneously and in quick succession, each division being followed by wall deposition until the embryo sac cavity becomes filled with a mass of extremely thin-walled cells, *Figs.* 54–58. The sequence of the divisions, however, does not follow any prescribed method. The tissue keeps on steadily increasing at the expense of the nucellus and finally occupies



FIGS. 53–58. *Fig. 53.* An ovule showing two-celled endosperm and zygote, × 40. *Figs. 54–56.* Early stages in the development of endosperm, × 100. *Figs. 57, 58.* Slightly later stages; note the differentiation of oil-bearing cells in the outer integument, the pad of degenerated nucellar cells (shown in black) at the chalaza and the extension of the vascular bundle on to the opposite side in Fig. 58, × 30.

the entire space enclosed within the integuments. The development of ruminations in this tissue will be considered in connection with the seed.



FIGS. 59–76. Stages in the development of embryo; explanation in text. The heavy transverse line in the figures denotes the boundary of the cells derived from the basal and terminal cells of the two-celled proembryo, × 283. FIGS. 77, 78. Embryos dissected from mature seeds; note the three cotyledons, swollen hypocotyl and stalk-like suspensor, × 90.

The zygote divides only after about 300 endosperm cells are formed. The first division is in a transverse plane and results in the formation of basal and terminal cells. The subsequent method of segmentation does not follow a strict pattern, as may be seen from *Figs.* 59–69. However, when a fairly large amount of material is studied, certain broad trends of developmental pattern suggest themselves. The second cell generation commences first in the terminal cell and this is invariably by a vertical wall, whereas the segmentation of the basal cell is generally delayed, *Figs.* 59, 60, 65. The division in the latter cell also is usually by a vertical wall, *Figs.* 62–65, thus resulting in two superposed tiers of two cells, *Fig.* 64; less frequently, the wall laid down is oblique or transverse. The division of the basal and terminal cells may be more or less simultaneous or in rare instances the development of the terminal cell lags behind, *Figs.* 66, 67. However, subsequent divisions follow in rapid succession, resulting in an ovoid mass of cells. The derivatives of the basal and terminal cells are distinguishable for a fairly long time, *Figs.* 73–75.

In spite of the highly plastic nature of the early segmentation, the method of tissue differentiation in the undifferentiated mass of cells is quite stabilized. All the derivatives of the terminal cell and about half of the derivatives of the basal cell enter into the construction of the embryo proper. The other half takes part in the construction of a massive suspensor. With the differentiation of the suspensor, the identity of the derivatives of the basal and terminal cells becomes obliterated, *Fig.* 76. In the mature embryo, the suspensor persists as a short stalk, *Figs.* 77, 78, 106; the hypocotyl region is bulbous; the cotyledons are well differentiated and three or rarely four in number. Internally, the stem and root apices, an incipient root cap and the procambial system are well organized. However, the size of the embryo is significantly small in relation to the large amount of endosperm, *Fig.* 79.

The cotyledonary number in *Degeneria* is remarkable. In *Magnolia grandiflora* (4) and possibly in other species of this family, tricotyledonous embryos are encountered occasionally as abnormalities. On the other hand, a tricotyledonous development in *Degeneria* seems to be the rule, as not even a single instance of an embryo with two cotyledons was seen among the large number of seeds examined. The following data give an

COLLECTION NUMBER	NUMBER OF SEEDS EXAMINED	TRICOTYLEDONOUS EMBRYOS	TETRACOTYLEDONOUS EMBRYOS
5880	a. 42 from 3 fruits	34	8
	b. 50 free seeds	44	6
6190	a. 46 from 4 fruits	39	7
	b. 50 free seeds	40	10
6318	a. 72 from 6 fruits	63	9
	b. 50 free seeds	42	8
	310	262 or, nearly 87%	48 or, nearly 13%

estimate of the frequency of the occurrence of the tricotyledonous and tetracotyledonous embryos in *Degeneria.*

The embryogeny of magnoliaceous species such as *Magnolia virginiana* (5), *M. grandiflora* (4), *M. Soulangeana, Michelia fuscata, M. Champaca* and *Liriodendron tulipifera* (unpublished observations of the author) presents several points of similarity with *Degeneria.* The plasticity in the developmental pattern of the two-celled proembryo, the organization of an oval mass of undifferentiated cells before tissue differentiation, the development of a massive suspensor and its persistence in the mature embryo, the swollen nature of the hypocotyl, the nearly triangular shape of the cotyledon, and finally the size relationships of the mature embryo and endosperm, are the more significant resemblances. Although the embryos of *Degeneria* are prevailingly tricotyledonous, such tricotyledonous nodes are of not infrequent occurrence in large populations of seedlings of magnoliaceous plants.

SEED

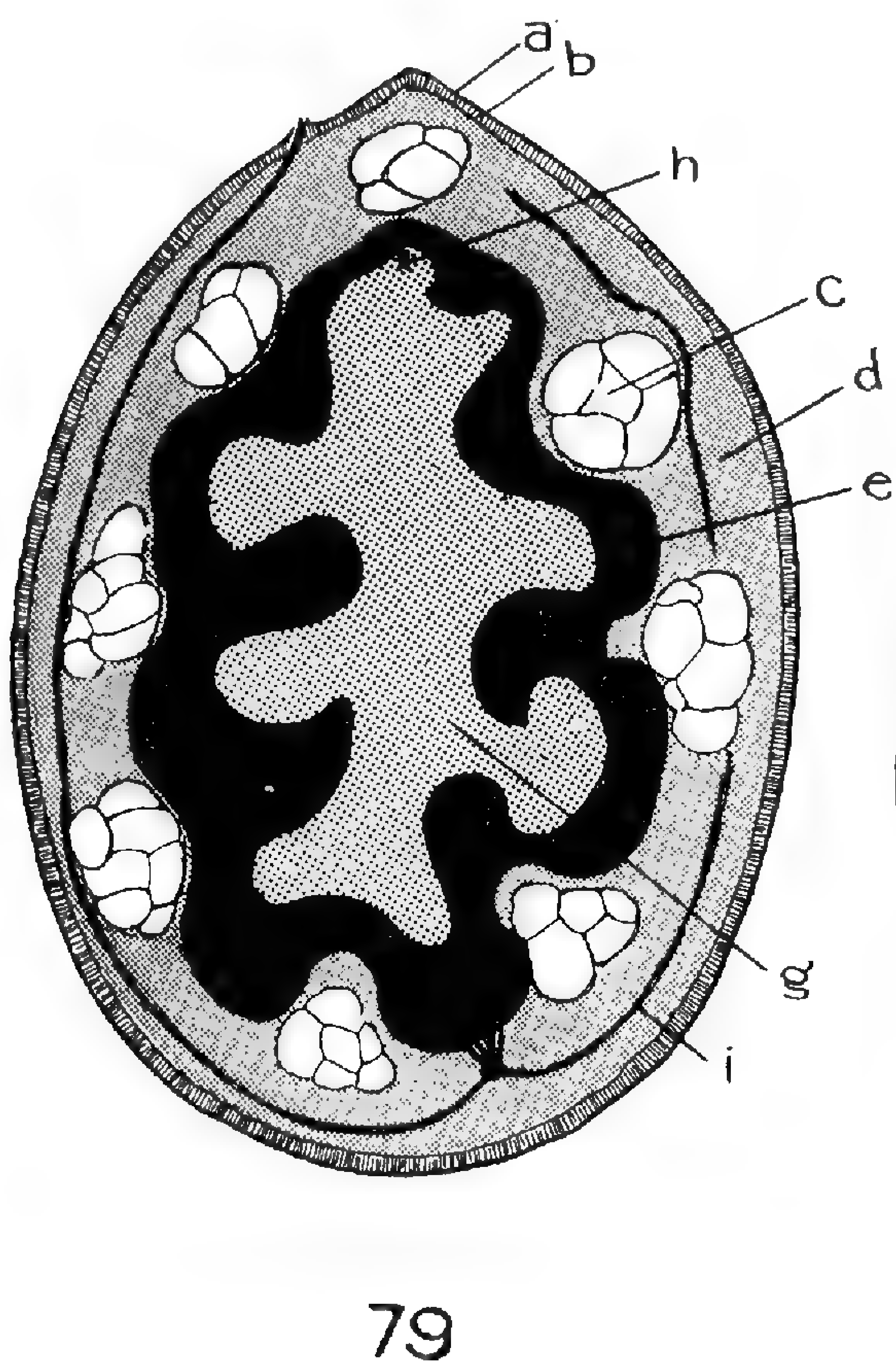
Fertilization affects not only the structures within the embryo sac but also other parts of the ovule. The fertilized ovule undergoes enormous increase in size and the unfertilized ones soon degenerate, *Fig.* 97. In the former, the nucellar cells abutting upon the antipodal end of the embryo sac soon begin to degenerate and stain very deeply, *Fig.* 96. With subsequent growth of the ovule, the mass of degenerating cells becomes compressed in the form of a pad, *Figs.* 57, 98. More and more nucellar cells in the chalazal region become involved and cause an expansion in the width of the pad, *Fig.* 58. During later stages, this structure becomes very prominent and is contacted by the ramifications of the vascular bundle of the ovule, *Figs.* 99, 100. Some of the magnoliaceous genera also exhibit a similar feature in varying degrees.

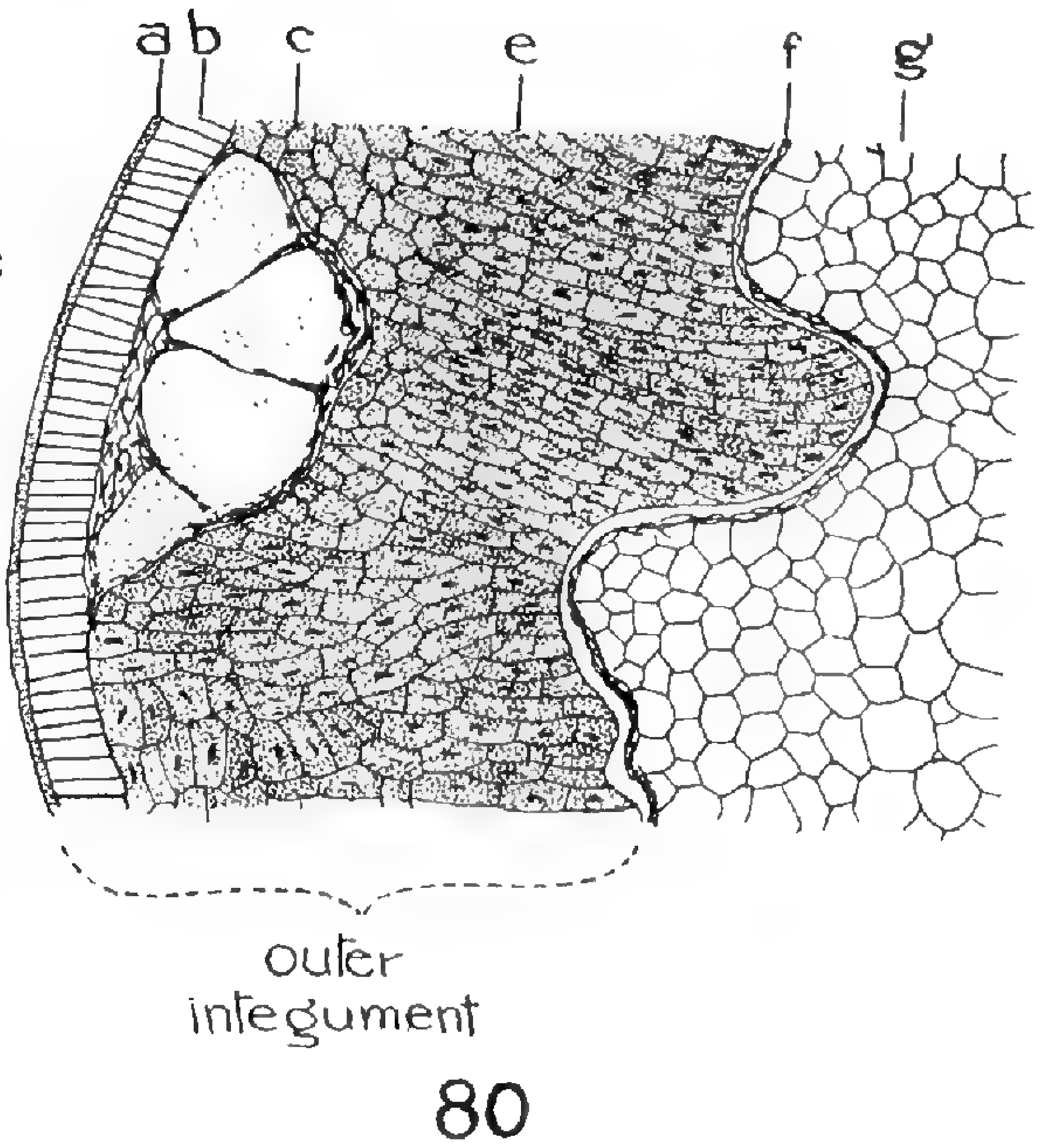
At the time of fertilization, the outer integument consists of about eight layers of cells, all the cells appearing homogeneous. After fertilization, clusters of two to ten cells in the outer layers develop into oil-bearing cells, *Figs.* 57, 58, 99. Some of the walls of the oil cells break down during later stages to result in cyst-like cavities. In the mature seed they become very conspicuous and occupy a more superficial position, *Figs.* 79, 100, 102.

Hand in hand with the early segmentation of the zygote, localized patches of cells from the innermost layers of the outer integument begin rapid divisions largely by tangential walls and grow out in the form of wedges, *Fig.* 102. Thus the entire inner surface of the outer integument is thrown into ridges of varying pitch and the continuously increasing endosperm occupies the contour of this surface. The exterior of the mature endosperm thus becomes irregularly grooved and cleft, *Figs.* 79, 105, and presents all the essential characteristics of a ruminated type.

It must be emphasized that the nature of the rumination in *Degeneria* is less exaggerated than in Annonaceae, Myristicaceae, Palmae, etc. In these families, the ingrowths of the integument penetrate the endosperm far deeper in the form of thin transverse plates, whereas in *Degeneria,* they are more massive and wedge-shaped than plate-like; also, in the families cited above, the partitions are more or less transverse and parallel to one another, or extend in a converging manner from the periphery, thus exhibiting a specialized manifestation, whereas in *Degeneria* the wedges are scattered indiscriminately and the form of the individual wedges is somewhat fluctuating. In some members of the Myristicaceae (6), it is the inner integument that takes part in the organization of the rumination, but in *Degeneria* it is clearly the outer.

The epidermis of the mature seed becomes covered by a thick cuticle and the epidermal cells undergo conspicuous elongation in a radial direction, *Figs.* 79, 80. That part of the outer integument wherein the oil cells are located continues to persist as a succulent outer coat. The inner





FIGS. 79, 80. *Fig. 79.* Diagrammatic representation of a median longitudinal section of a mature seed, the plane of section passing through the vascular bundle, × 20. *Fig. 80.* A portion of the seed coat and endosperm of Fig. 79 enlarged to show the histological details, × 40. *a* — cuticle; *b* — epidermis; *c* — oil-bearing cells; *d* — fleshy coat; *e* — stony coat; *f* — inner integument; *g* — endosperm; *h* — embryo; *i* — vascular bundle.

part together with its ruminated outgrowths undergoes considerable hardening and transforms into an inner stony coat, *Figs.* 79, 80, 102. The process of hardening first commences in the cells of the wedges and gradually works outward. Due to the uneven pattern of hardening, the stony coat becomes irregularly ruminate on its outer surface also, *Figs.* 79, 103.

The inner integument becomes crushed into a membranous covering between the endosperm and the stony coat. The vascular bundle extends to the opposite side of the funicle as far as the micropylar end, *Fig.* 79.

At this point, a reference to the nature of the hardening material in the cells of the stony coat deserves special mention. In *Degeneria,* as also in magnoliaceous genera, the cells become filled with vacuolar substances during development and finally the entire cell contents are rendered excessively hard; the cell walls, however, remain thin and the cells do not increase in size, *Fig.* 80. Thus the hardness in these cases is due to the transformation of the cell contents. On the other hand, in the corresponding tissue of annonaceous genera, the cell walls become heavily lignified and the individual cells elongate in the form of sclerotic fibres; the secondary thickening frequently occludes the cell lumen. Thus the hardening is due to the lignification of the cell walls. This important feature serves to distinguish the seeds of the Magnoliaceae and Degeneriaceae from those of the Annonaceae.

The mature seeds of the families Degeneriaceae, Magnoliaceae and Himantandraceae share several features in common, at the same time showing significant differences in histological details. In all the three families, the inner integument is reduced to a membranous layer and the outer integument increases in thickness during post-fertilization development and takes part in the construction of the seed coat; the vascular bundle becomes extended from the chalazal side toward the micropyle; and the minute embryo is embedded in an extensive endosperm. The seeds of the Degeneriaceae and Magnoliaceae are highly opaque, oval or round with a fleshy exterior, whereas those of the Himantandraceae are decidedly less opaque, suborbicular, greatly compressed and submembranous. The outer integument differentiates into fleshy and stony coats in the former families, whereas in the latter, such a differentiation is wanting; instead, the outer cell layers attain a cartilaginous texture. The fleshy layer in the Degeneriaceae and Magnoliaceae contains the oil-bearing cells. In the former family, their distribution is characteristically in clusters and in the latter, isolated and diffuse. Whether the seed coat of *Himantandra* contains oil cells could not be determined from herbarium specimens. The nature of hardening of the stony coat is essentially similar both in the Degeneriaceae and Magnoliaceae. The epidermal cells lining the exterior of the seed in the Magnoliaceae and Himantandraceae are isodiametric in shape, whereas in *Degeneria* they are conspicuously elongated radially.

FRUIT

Long before anthesis, the carpellary wall differentiates into two regions. The cells of the outer region stand out more prominently with their darkly staining walls and protoplasts in contrast to the faintly staining inner region, *Fig.* 81. After fertilization, important changes occur within each of them. The cells of the outer region appear to be retarded in meristematic activity, numerous spicular cells develop, and the vascular system built by the median trace becomes excessively ramified. On the other hand, the cells of the inner region suddenly step up their meristematic activity and grow into the carpellary cavity in the form of lobes of a spongy consistency. The lobes intrude between the developing ovules, at the same time overtaking the degenerate ones and pushing them to one side, *Fig.* 97. Ultimately the entire capillary cavity is densely packed with the spongy ingrowths, *Figs.* 98, 99, and the interior of the fruit becomes fleshy. The outer region of the carpellary wall, in which the spicular cells and vascular system ramify, becomes increasingly tough and coriaceous.

According to field observations of Dr. Smith, the fruits dehisce along the ventral suture after falling from the tree. The seeds become disseminated through this split, also perhaps facilitated by the decay of the coriaceous wall. In such fruits, the vascular skeleton built by the median and ventral traces appears as a coarse and closely woven mesh, and the supernumerary vascular traces, which have now assumed the form of large cords, clasp the outer surface of the mesh, *Fig.* 29.

The observation of Bailey and Smith (1) that the seeds of one row are strictly sessile, while those of the other row are borne on slender elongated funicles, needs to be amended in view of the large amount of material now available. Although such a condition occurs in a few instances, it is subject to numerous exceptions. Sessile as well as long-funicled seeds are indiscriminately distributed and invariably the former outnumber the latter. Furthermore, the distinction between the two categories is one of degree. The manifestation of these conditions seems to be largely dependent upon the degree and direction of pressure exerted by the invading spongy lobes of the carpellary wall on the developing seeds. The rate of ingrowth is by no means uniform and simultaneous throughout the surface, especially in the early stages. If the activity of the spongy ingrowth in the immediate vicinity of the micropylar end of the seed dominates, it is likely that the ovule in question is carried more towards the interior of the carpel, whereby the funicle also becomes correspondingly stretched. On the other hand, if the activity of the lobes from the opposite direction dominates and tells upon the chalazal region of the ovule, it is possible that the funicle is not subjected to extensive stretching. It may be further noted that such a differential method of growth of the carpellary wall is also responsible for the frequent readjustment or reorientation of the seeds in the mature fruit.

In dried fruits, the fleshy region shrinks and is pressed back against the outer coriaceous wall. The latter becomes very hard, as might be anticipated in view of its high ratio of spicular cells and vascular elements. When the seeds are broken from their points of attachment with the carpellary wall, some of the shrunken spongy tissue also becomes detached and forms a cupule-like appendage on the micropylar end of the seed, as pointed out by Bailey and Smith (1). However, it must be borne in mind that the seed in reality has no true appendages and that what appears to be a cupular appendage is clearly the dried remnants of the spongy ingrowth of the carpellary wall.

RELATIONSHIPS OF THE DEGENERIACEAE

A critical evaluation of the various vegetative and reproductive characteristics of *Degeneria, Himantandra* and the Magnoliaceae (sensu strictu) with regard to their mutual affinities and systematic position has already been published by Bailey and his coworkers (1, 3). Only a few points that are not covered by them will be dealt with here.

The vascularization pattern of the cotyledonary node of *Degeneria* differs from that in most of the investigated species of Magnoliaceae. In *Degeneria,* each of the three or four cotyledons has a trilacunar attachment, whereas in most Magnoliaceae the four lateral strands of the paired cotyledons arise by the bifurcation of two traces, each related to an independent gap. When three cotyledons are formed, the six lateral strands arise by the bifurcation of three independent traces. However, a nodal anatomy resembling that of *Degeneria* has been reported in *Magnolia Soulangeana* (7) and may ultimately be found to occur in seedlings of other representatives of the Magnoliaceae.

The nodal anatomy and the vascularization of the adult petiole follow a characteristic and basically similar plan in the Degeneriaceae, Magnoliaceae and Himantandraceae, a fact that has already been recorded (3). Furthermore, in the case of the Degeneriaceae and Magnoliaceae, there are similar transitions between the trilacunar nodes of the first seedling leaves and the multilacunar nodes of leaves from older plants. The emarginate nature of the first one or two leaves succeeding the cotyledons characterizes *Degeneria* and is of not uncommon occurrence in Magnoliaceae.

During microsporogenesis, the method of differentiation of the parietal and sporogenous tissues, the organization of a binucleate secretory tapetum from the innermost layer of the parietal cells,[4] the simultaneous method of meiosis, the prevalence of a tetragonal arrangement of the microspores at the tetrad stage, the cutting off of the generative cell towards the exterior side of the tetrad, and the two-celled shedding condition of the pollen grains are features shared by both *Degeneria* and the Magnoliaceae. The broad microsporophylls of *Degeneria* and *Himantandra,* bearing long, slender, deeply embedded sporangia have similar counterparts in certain representatives of the Magnoliaceae. However, the stamens of this family differ from those of *Degeneria* and *Himantandra* in having a less typically parenchymatous hypodermal layer.

The origin and differentiation of the nucellus, the thin inner and thick outer integuments, the formation of seven to ten parietal layers in the ovule, the monosporic eight-nucleate embryo sac and the ephemeral nature

[4] Maneval (5) reports that the tapetum in *Magnolia virginiana* is cut off from the sporogenous cells. This observation seems to be erroneous. In *M. Soulangeana, M. stellata,* as well as in *Michelia fuscata* and *Liriodendron tulipifera,* I have seen only a parietal origin of this layer.

of the antipodals of *Degeneria* are present point by point in the Magnoliaceae. The *ab initio* cellular endosperm,[5] the excessive broadening of the chalazal region of the ovule, and the development of the darkly-staining pad of degenerated nucellar cells at the chalaza are again a combination of characters that are common to *Degeneria* and the Magnoliaceae; the presence of the last two characters in *Himantandra* appears to be almost certain, as can be judged from herbarium material. In *Degeneria* the endosperm becomes ruminated, and this feature has no counterpart either in the Magnoliaceae or in *Himantandra.*

The plasticity in the sequence of early cell divisions in the two-celled proembryo, the organization of a massive suspensor which is not clearly delineated from the body of the embryonal mass in the early stages, and the bulbous nature of the hypocotyl in the mature embryo are a set of characters in the magnoliaceous embryogeny. The overwhelming proportion of tricotyledonous embryos appears to be confined to *Degeneria* alone.

The outer integument takes part in the construction of the seed coat and the vascular bundle extends on the opposite side in the seed in all the three families, and the inner integument is reduced to a membranous layer. In *Degeneria* and the Magnoliaceae, the outer integument differentiates into fleshy outer and stony inner coats; such a distinction is absent in *Himantandra,* and instead, some of the outer cell layers become modified so as to render the seed coat cartilaginous. The stony coat of *Degeneria* is ruminate internally as well as externally, whereas that of the Magnoliaceae is smooth; however, the histological nature of hardening in both families is identical. Although the fleshy coat of *Degeneria* and the magnoliaceous genera contains oil cells, the pattern of distribution is different in the two families.

The fruit of *Degeneria* is relatively large as compared with that of *Himantandra* or of the Magnoliaceae. Its interior is packed with fleshy outgrowths of the carpellary tissue and the seeds become embedded in it. In the Magnoliaceae, the fruit is either dry or succulent and in *Himantandra,* fleshy. However, in the fleshy fruits of the latter families, the carpellary wall does not form spongy lobes that embed the seeds as in *Degeneria.*

It will be evident from the brief review presented above that a large number of embryological characters are common to all three families. Nevertheless, the dissimilar characters are seen in specific combinations in each of them. Thus the summation of evidence again points to the

[5] Earle (4) states that in *Magnolia grandiflora,* "The early divisions of the endosperm nucleus are very rapid and the number of free nuclei formed is comparatively small. . . . Wall formation occurs shortly after the appearance of these free nuclei . . .". But in *M. virginiana* (5), *M. Soulangeana, M. stellata, Michelia fuscata* and *Liriodendron tulipifera* (unpublished observations of the author), the endosperm is cellular from inception. The walls of this tissue in the early stages are extremely delicate and hard to see as also in *Degeneria,* unless the sections are counterstained with eosin or fast green. It is very likely that the presence of walls in *Magnolia grandiflora* escaped Earle's notice.

same conclusion already reached by Bailey, Nast and Smith (3) that "in the Degeneriaceae, Himantandraceae and Magnoliaceae we are concerned with three distinct but closely related families."

SUMMARY

Additional information on the anatomy of the secondary xylem, node, petiole, seedling, flower, fruit and seed of *Degeneria vitiensis* is presented.

Ontogenetic and anatomical evidence indicate that the staminodes are sterile microsporophylls in which the development of the sporogenous tissue becomes arrested.

After supplying the vascular traces to the perianth and androecial whorls, a large number of bundles are left over in the floral axis. They reunite into seven to nine larger bundles and enter the carpel. Only three of these behave as true carpellary traces. The remaining traces represent the residual vascular traces that once supplied the now missing carpels. The anatomy of bicarpellate flowers also supports the hypothesis that the ancestral flower of *Degeneria* was multicarpellate.

The ovules derive their vascular supply in part from the branches of the ventral veins, in part from those of the median vein, and in part from the branches of both sets of veins. The stigmatic papillae extend to a considerable distance towards the interior of the ovule-bearing region. The ontogenetic occlusion of the cleft of the carpel is accomplished by the interlocking arrangement of the papillae. The germination of the pollen grain and the path of the pollen tube is largely determined by this papillate surface.

The germinal furrow of the pollen grain develops on its distal face. A summation of evidence from the development of the gametophytes, endosperm and embryo, and the structure of the node, petiole, seed and fruit, confirms the earlier conclusion that in the Degeneriaceae, Himantandraceae and Magnoliaceae we are concerned with three distinct but closely related families.

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EXPLANATION OF PLATES

PLATE I. FIGS. 81–87. *Fig. 81.* Transverse section of a flower bud long before anthesis; perianth removed, × 16. *Figs. 82–85.* Longitudinal sections of flower buds at different stages of development, × 10. *Fig. 86.* Longitudinal section of a young carpel in the plane of conduplication to show the alignment of ovules and the slanting position of the carpellary cavity, × 21. *Fig. 87.* Transverse section of a portion of a carpel at the time of fertilization to show the extension of the papillate epidermis on the inner side of the ovule-bearing region (indicated by arrow), × 50. *m* — micropylar canal occluded by papillae.

PLATE II. FIGS. 88–95. *Figs. 88–91.* Transverse sections of carpels at different stages of development of the papillate epidermis. *Fig. 88.* Very young stage; the adaxial surfaces do not show any papillate differentiation at this stage (detail in Fig. 92). *Fig. 89.* The epidermal cells of the flaring ventral surfaces are beginning to protrude (detail in Fig. 93). *Fig. 90.* The epidermal papillae have developed toward the interior of the carpel and the cleft has become plugged (detail in Fig. 94). *Fig. 91.* At anthesis. The papillae of the flaring ventral surfaces have elongated and a large number of them have become two- or three-celled (detail in Fig. 95). Figs. 88–91, × 21; Figs. 92–95, × 64.

PLATE III. FIGS. 96–102. *Fig. 96.* An ovule after fertilization. Note the degenerated and darkly-staining nucellar cells at the chalazal end of the ovule, × 38. *Fig. 97.* Transverse section of a young fruit to show the ingrowth of the carpellary wall in the form of spongy lobes. Also note the development of spicular cells in the outer layers of the carpel, × 23. *Fig. 98.* A portion of the transverse section of a fruit, slightly older than in Fig. 97. The spongy tissue is invading between the ovules. The darkly-staining chalazal pad is increasing in breadth (compare the seed in Fig. 58, which is from a corresponding stage in development), × 20. *Fig. 99.* Same, at a still later stage. The ovule is cut somewhat obliquely. The characteristic distribution of oil cells, the chalazal pad and its connection with the vascular bundle, and the effect of the ruminate outgrowth of the inner surface of the outer integument on the endosperm, are clearly seen, × 18. *Fig. 100.* Detail of the chalazal region of a young seed at a stage similar to Fig. 99, showing the pad and its relation to the surrounding tissue, × 20. *Fig. 101.* Micropylar region of a young seed (outer integument removed) showing the endosperm and embryo. Note the persistence of parietal cells in contact with the suspensor-end of the embryo, × 40. *Fig. 102.* A portion of a young seed in section showing the wedge-shaped ruminate outgrowths from the inner surface of the outer integument, × 30.

PLATE IV. FIGS. 103–106. *Fig. 103.* External surface of the mature stony coat of the seed, × 10. *Fig. 104.* Internal surface of the same, × 10. *Fig. 105.* Endosperm dissected from an immature seed to show the early stages of rumination, × 10. *Fig. 106.* A group of mature embryos, × 30.

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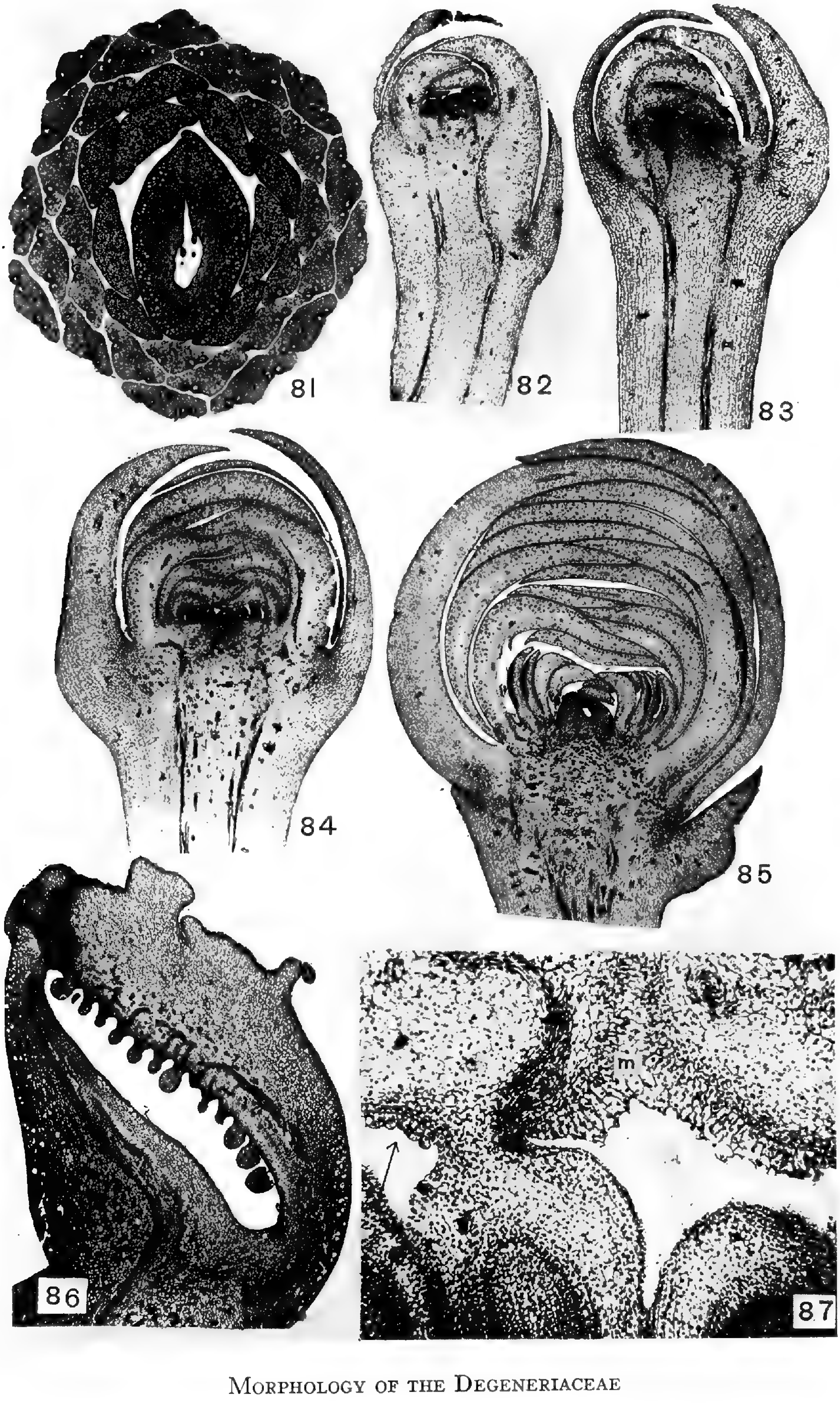
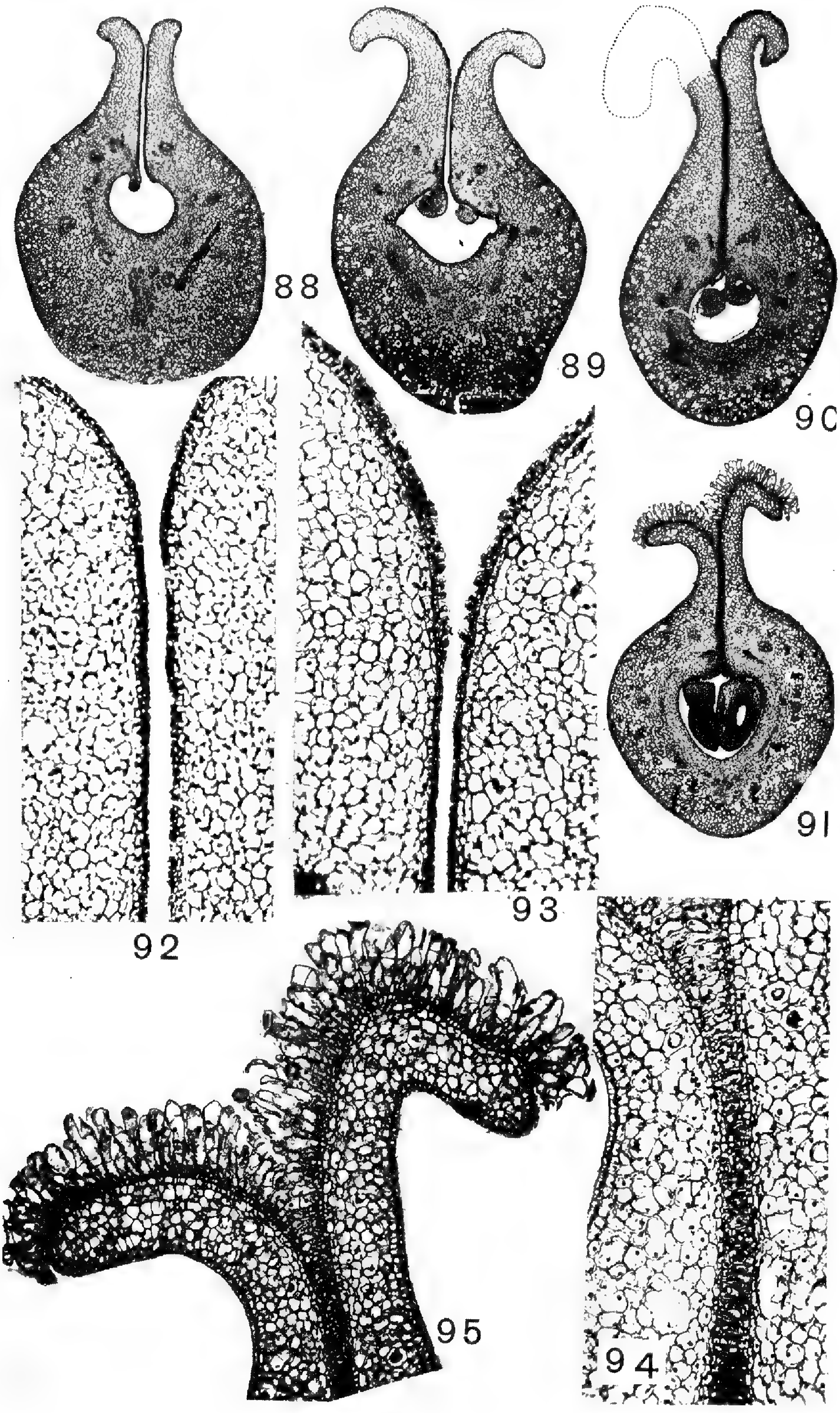


MORPHOLOGY OF THE DEGENERIACEAE



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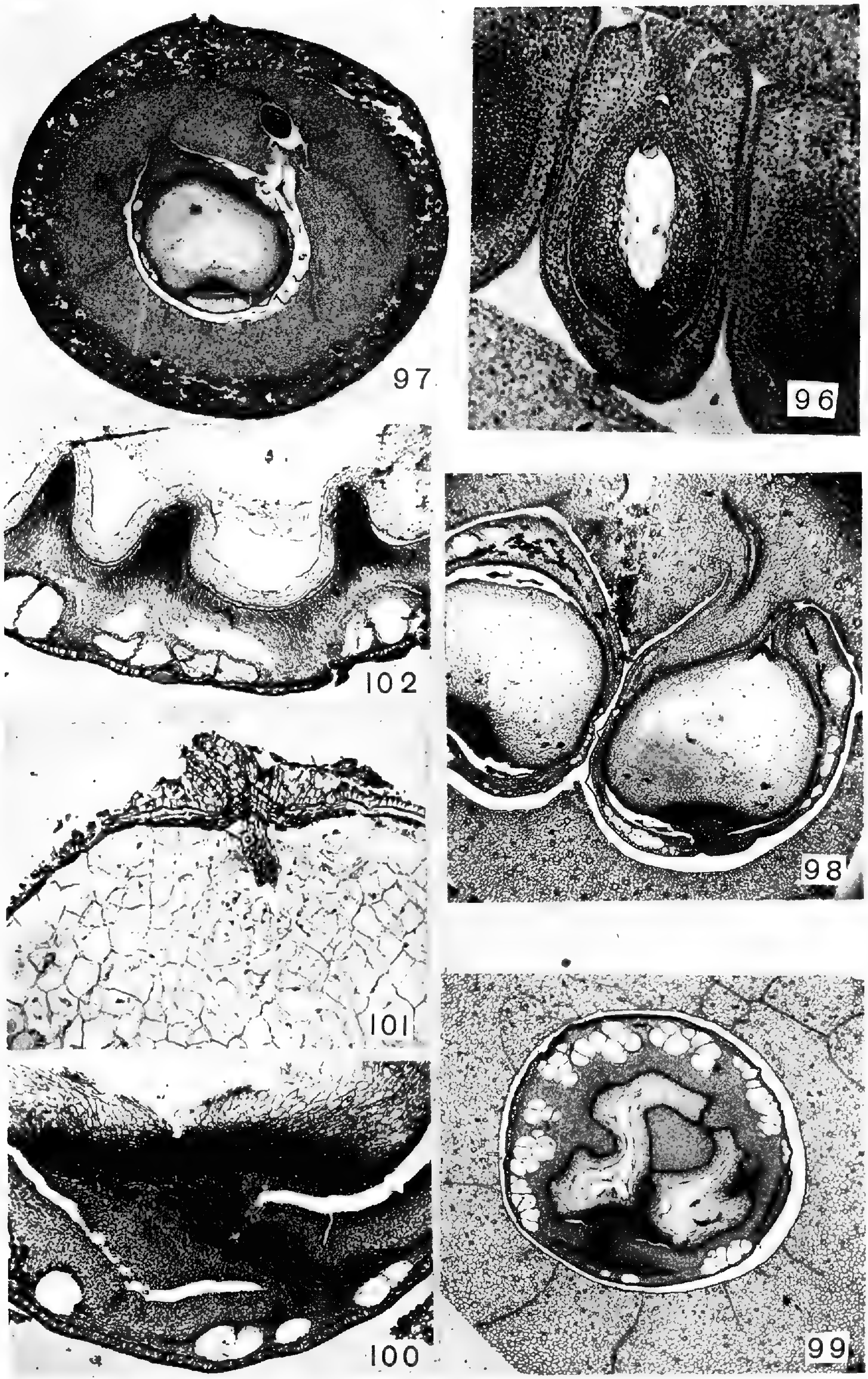
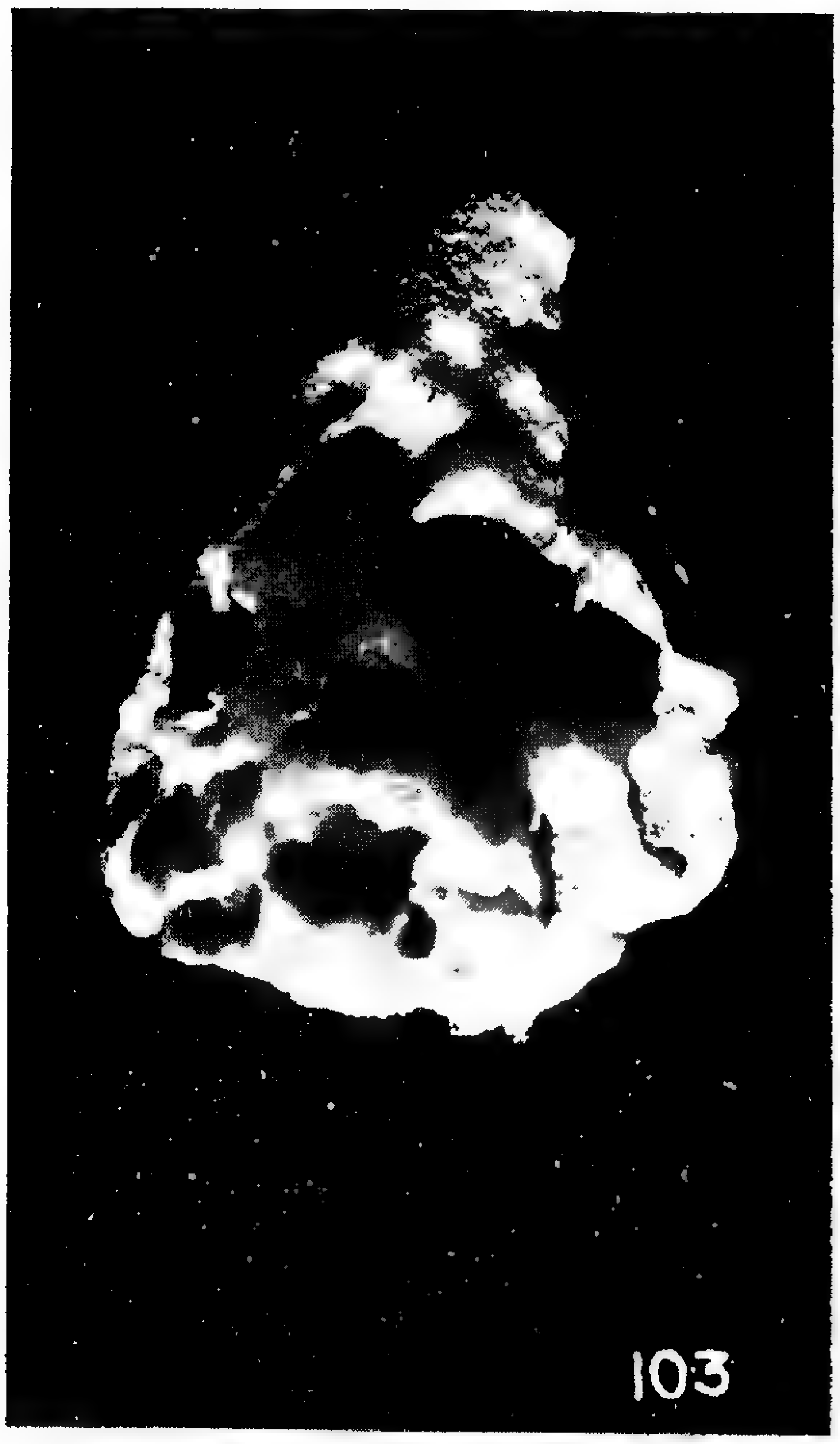
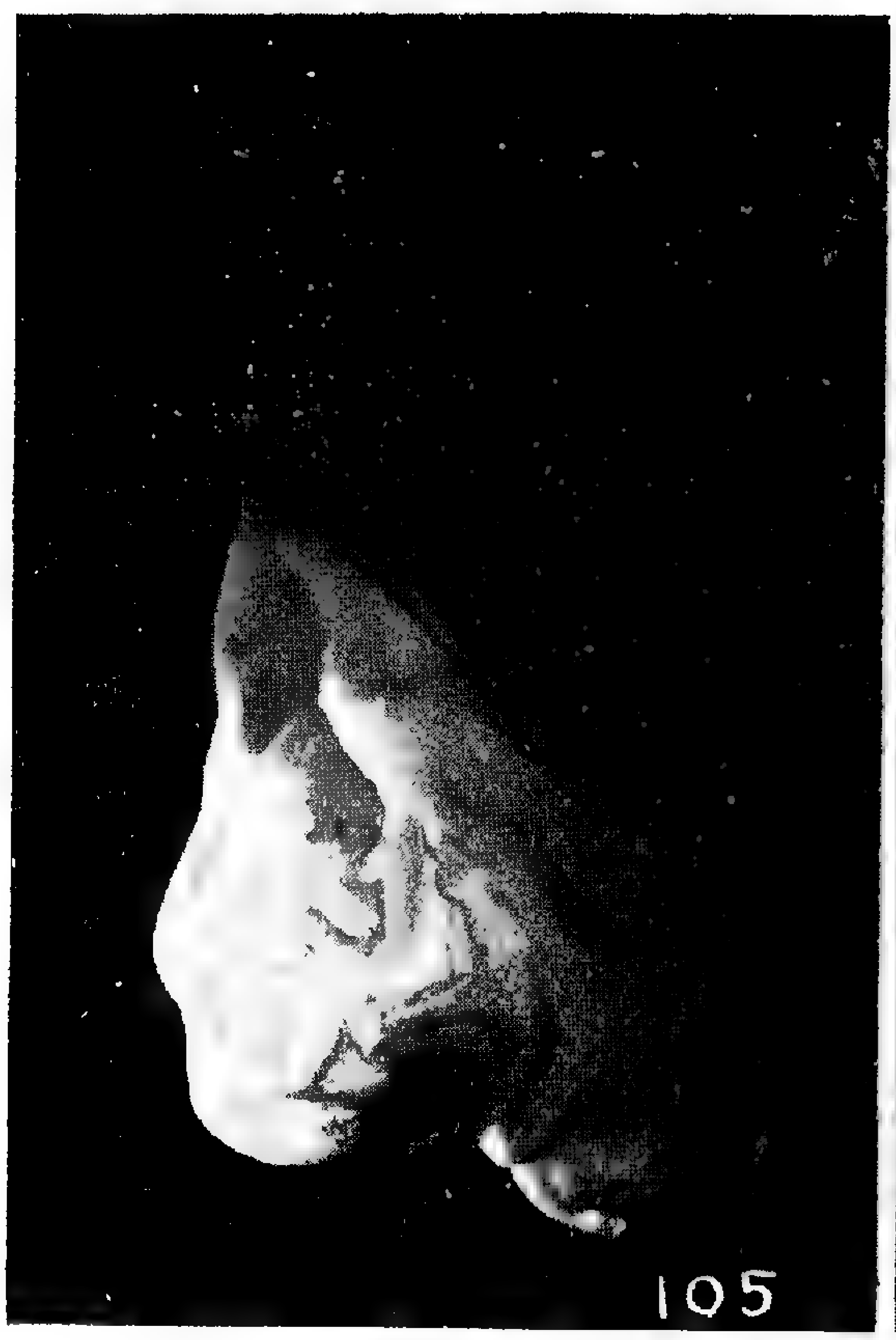
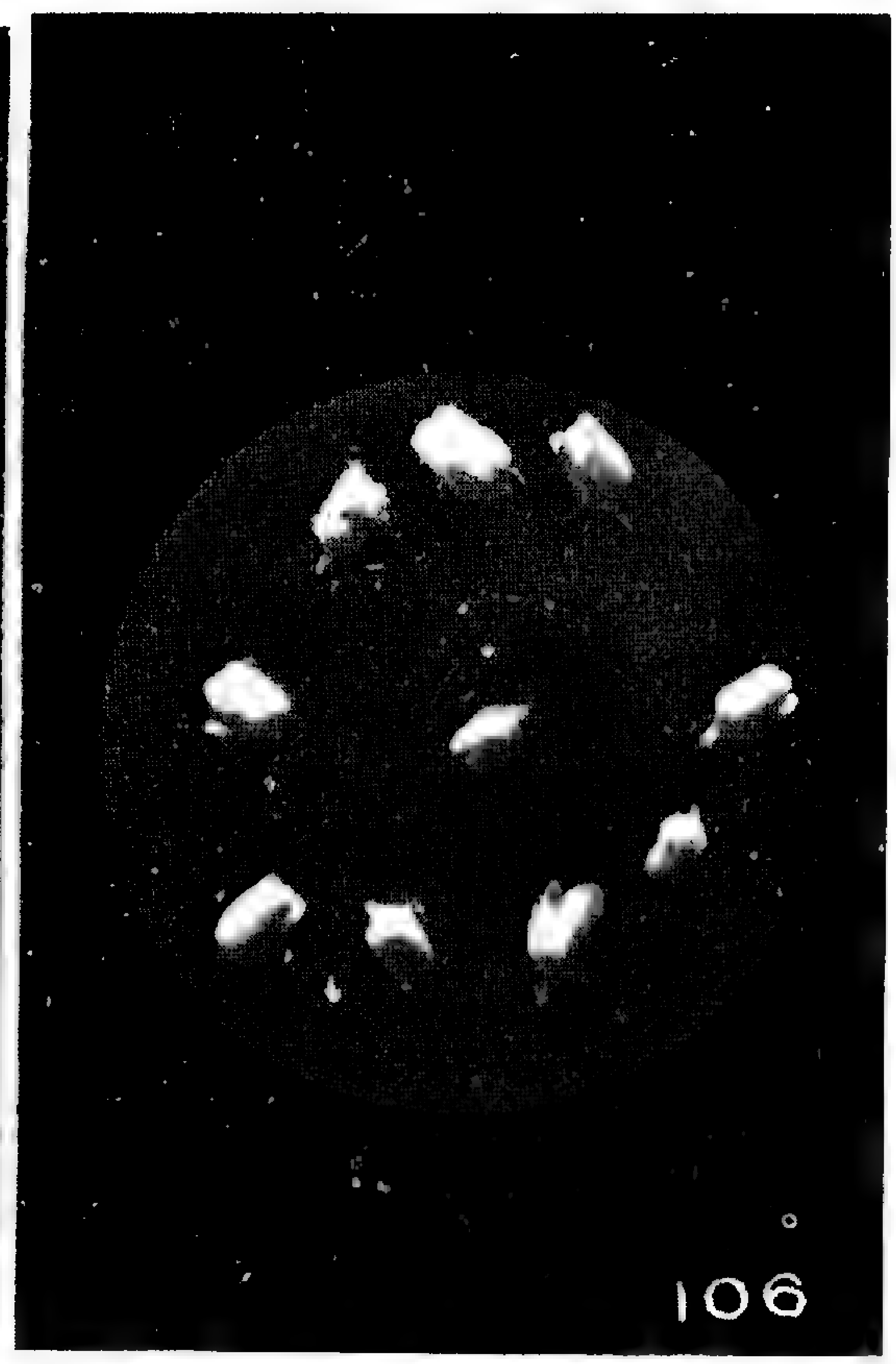


Morphology of the Degeneriaceae







Morphology of the Degeneriaceae

PLANTAE PAPUANAE ARCHBOLDIANAE, XVIII *

E. D. MERRILL and L. M. PERRY

THIS ARTICLE, like the others of this series, is a miscellany. In it we have tried to bring together the misplaced odds and ends of families already named, in addition to our consideration of the Sterculiaceae, Solanaceae, and Cucurbitaceae. Owing to the official retirement of the senior author in June, 1948, this will be the last of these joint papers. For the convenience of those who are particularly interested in New Guinea flora we are adding an index of the families and genera included in this series.

TAXACEAE

Dacrydium xanthandrum Pilger, Bot. Jahrb. 69: 252. 1938.

In addition to the specimens cited by Pilger in the original description, we have the following.

NORTHEAST NEW GUINEA: Ogeramnang, *Clemens 6408,* May 1937, alt. 1750 m.; Yunzaing, *Clemens 6488,* June 1937, alt. 1350 m.

SOLOMON ISLANDS: Bougainville: Kupei Gold Field, *Kajewski 1694, 1709,* April 1930, alt. 950 m., rare in rain-forest (tree up to 25 m. high). Closely allied but perhaps not conspecific with these are the following two specimens from the Solomon Islands: Ysabel: Mt. Sasari, *Brass 3264* (♂), December 1932, alt. 1100 m., found only on summits of highest peaks (thick boled tree seldom more than 15 m. tall; branches spreading, upturned). Guadalcanal: Uulolo, Tutuve Mt., *Kajewski 2652,* May 1931, alt. 1200 m., rare, in gold-mining country.

CARYOPHYLLACEAE

Sagina monticola sp. nov.

Herba perennis; caulibus vetustioribus glabris, novellis puberulo-glanduloso-pilosulis (pilis tenuissimis), breviter sarmentosis vel decumbentibus ad nodos saepe radicantibus et demum plantas novellis evolventibus apice floriferis; foliis inferioribus subcarnosulis subrosulatis, linearibus, mucronatis, usque 3.5 cm. longis, vix 5 mm. latis, basi (2.5 mm. latis) late vaginantibus, margine et subtus costa distanter ciliolatis, supra planis, subtus convexiusculis, utrinque minute pustulatis; foliis superioribus similibus sed minoribus, 3–5 mm. longis; pedicellis tenuibus, 0.6–2 cm. longis, consperse glanduloso-puberulis; floribus pentameris; sepalis glanduloso-puberulis, ellipticis, 3–4 mm. longis, 2 mm. latis, apice late obtusis, e basi 3-nerviis, nervis ramosis; petalis albis, 4–5 mm. longis, oblongis, apice rotundatis; staminibus 10, filamentis exterioribus 2.5 mm. longis, basi glandula insidentibus, interioribus paullo brevioribus eglandulosis; ovario ovoideo 3 mm. longo, 2 mm. lato; stylis 5, ex apice ad medium papilliferis; capsulis 4 mm. longis; seminibus 0.6–0.8 mm. longis, oblique subrotundatis, extus minute muriculatis.

* Botanical results of the Richard Archbold Expeditions. See Jour. Arnold Arb. 27: 193–233. 1946.

NETHERLANDS NEW GUINEA: Bele River, 18 km. northeast of Lake Habbema, *Brass 11569* (TYPE), November 1938, alt. 2350 m., rooting in earthy niches on a sparsely vegetated limestone precipice (flowers white).

This species was published, Jour. Arnold Arb. **23**: 388. 1942, as *Sagina echinosperma* Hayata. Since the war, Dr. Hiroshi Hara, who has done some work on this group, called our attention to the fact that the New Guinean plant is clearly distinct from the Formosan plant which has been proved on further study to be *S. japonica* (Sw.) Ohwi, common in Japan. The latter has short (less than 2 mm. long) petals, smooth leaves, and 5–8 stamens. The habit of this plant is rather distinctive. It suggests a slender short caudex-like stem covered by relatively long leaves with overlapping very much broadened bases, from this stem or stem-like base slender decumbent branches appear to grow, and these eventually develop new plants at the nodes, but may also terminate in an inflorescence. Nothing in the duplicates indicates a tangled mass of branches such as one expects to see in *Sagina*.

AQUIFOLIACEAE

Ilex malaccensis Loesener, Nov. Act. Abh. Leop.-Carol. Akad. Naturf. (Monog. Aquifol.) 78: 432. 1901, var. **stenura** var. nov.

A specie recedit foliis oblongis, 10–17 cm. longis, 2.4–5 cm. latis (uno 8.2 × 2.5 cm.), basi obtusis vel cuneatis, apice caudato-acuminatis, acumine 1.5–2 cm. longo, basi 4 mm. lato, apicem versus ± 1.5 mm. lato, obtuso.

BRITISH NEW GUINEA: Central Division, Mafulu, *Brass 5175* (TYPE of var.), Sept.-Nov. 1933, alt. 1260 m., oak forest undergrowth, common (slender tree or bush 3–4 m. high; small, fleshy purple-black fruit).

Although we have no material with which to compare this collection, according to the description in Loesener's monograph of the Aquifoliaceae it seems to be very close to *Ilex malaccensis* Loes. The fruits are young, but in the one which was cut open there were apparently 14 locules. It differs from the description of the species chiefly in the narrower leaves with longer acumen.

STERCULIACEAE

In the Sterculiaceae of these collections we have the usual widely distributed species of *Abroma, Kleinhovia, Commersonia, Melochia, Helicteres* and *Heritiera*. In addition to the common *Heritiera littoralis*, there is a sterile specimen collected near Bernhard Camp, at 400 m. altitude, a specimen of *Pterygota Forbesii*, a sterile collection of *Pterocymbium*, and one of *Tarrietia*. The last genus does not appear in our Index for New Guinean plants, and as far as we know this is the first record of its occurrence in New Guinea. The specimen was determined at Buitenzorg as *Tarrietia Riedeliana* Oliv. Other species of interest are recorded below.

Sterculia Clemensiae sp. nov.

Arbor magna, trunco 37–45 cm. diametro (fide M. S. Clemens); ramulis 10–15 cm. diam., rugosis, novellis dense pubescentibus; foliorum petiolis 4–7 cm. longis, circiter 1/3 longitudinem laminae aequantibus dense adpresso-tomentosis; laminis ± orbicularibus (omnibus fractis), 12–20 cm. longis latisque, basi cordatis, sinu 0.5–2 cm. alto, 2–4 cm. lato, apice non viso, supra primum consperse stellato-pilosulis deinde costa nervisque pilosulis ceterum glabris, subtus ± dense pilosulis, pilis stellatis et interdum simplicibus intermixtis, basi 7-nerviis, praeter basales nervis lateralibus utrinsecus ± 5 (foliis fractis) angulo ± 45° impositis utrinque prominulis, venis transversis perspicuis, reticulatione sub lente utrinque manifestis; inflorescentiis e ramulis sub apice orientibus, ± 20 cm. longis, dense stellato-tomentellis, pedunculo 3–5 cm., ramis 3–5 cm., pedicellis 2–3 mm. longis; floribus parvis, tantum ♂ visis; calyce campanulato in sicco 3 mm. longo, intus dense hirtello, tubo 2 mm., lobis 1 mm. longis triangularibus acutis; columna ± 1.4 mm. longa, apice penicillata, antheris 5 parallelis in annulum dispositis; mericarpio immaturo, subellipsoideo, 3.5 × 2.5 × 2 cm., apice subapplanato subapiculato haud producto, extus primum stellato-pubescente deinde glabrato, intus ± dense stellato-hirtello; seminibus immaturis atro-fuscis.

NORTHEAST NEW GUINEA: Morobe District, Lae, *Clemens 10452* (TYPE), *10466,* July 1939, in brush near Busu River (big tree, trunk 15 to 18 inches in diameter; inflorescence brick-red-purple; fruits pale yellowish green).

Sterculia Clemensiae appears to belong in the same group with *S. comosa* Wall. Both have very small flowers. The latter however has a shorter smoother pubescence on the lower surface of the leaves giving them a grayish color. It has been reported from Amboina, the Celebes, and Key Islands.

Sterculia oncinocarpa F. v. Muell. & Forbes, Victoria Nat. 3: 48. 1886; Mildbr. Bot. Jahrb. 62: 355. 1929; vel aff.

NETHERLANDS NEW GUINEA: Bernhard Camp, Idenburg River, *Brass & Versteegh 14102,* April 1939, alt. 70 m., occasional in primary forest on edge of flood plain (tree about 30 m. high, 58 cm. diameter; bark 12 mm. thick, black-brown, fairly smooth; wood light brown; flowers yellow).

BRITISH NEW GUINEA: Palmer River, 2 miles below junction Black River, *Brass 7348,* July 1936, alt. 100 m., common canopy tree of lower clayey ridges (± 30 m. high; trunk buttressed and covered with gray lenticellate bark; leaves crowded at the apex of the thickened branchlets; fruit close below the leaves on peduncles 20–25 cm. long).

Among the Papuasian species these two collections are closest to this species and possibly identical with it. In any case it seems best to point out the differences or variations. Mr. A. W. Jessep, Director of the Melbourne Botanic Gardens and National Herbarium, very kindly sent us a photograph of the type and a fragment of the leaf for comparison. The texture of the leaf is very similar to that of *Brass 7348* but the pubescence is much finer and sparser. The stellations are minute. The rays of those on the Brass specimen are at least five times as long as those in the Forbes collection. Again, in the original diagnosis the fruitlet is described as being about four times longer than broad; in the photograph, however, there is one scarcely twice as long as broad. The fruitlet of the Brass collection is approximately 8 × 5 × 4.5 cm., the seeds are olive brown and the surface is reticulate (the other seeds of *Sterculia* species in the herbarium are black; possibly these are not ripe). The collection, *Brass*

& Versteegh 14102, has only very young leaves and flowers. Most of the inflorescences (up to 20 cm. long) appear to be sessile or almost so at the apices of short shoots 3–6.5 cm. long; rhachis, branches, branchlets, pedicels, and flowers are all spreading-hirtellous with hairs ± 1 mm. long; ♂ FLOWER: calyx-tube 3 mm. long, puberulous inside, lobes 1.3 mm. long, ovate, acute, finely pubescent on the upper surface; staminal column 2 mm. long, anthers 5 (4–6), annular; ♀ FLOWER: larger than the staminate and terminal on the branches; calyx-tube 4 mm. and lobes 1–1.5 mm. long, pubescent as in the ♂ flower; ovary 3-lobed, ± 1.5 mm. long, densely hairy, style 1 mm. long, pubescent, stigma capitate. This collection is myrmecophilous.

Sterculia Shillinglawii F. v. Muell. Australas. Jour. Pharm. (Feb.) 1887.
Sterculia Conwentzii K. Schum. Bot. Jahrb. 9: 208. (Nov.) 1887.
Sterculia multinervia Rech. Rep. Sp. Nov. 9: 184. 1912.

BRITISH NEW GUINEA: Lower Fly River, east bank opposite Sturt Island, *Brass 8089,* Oct. 1936, rain forest, on outer ridges (common canopy tree; stem with well developed plank-buttresses; bark gray-brown; flowers yellow-brown, galled flowers pink; fruit red, mericarps narrow and recurved).
NORTHEAST NEW GUINEA: vicinity of Kajabit, Markham Valley, *Clemens 10557, 10857bis,* August 1939, alt. ± 240 m.
BISMARCK ARCHIPELAGO: New Britain: near Blanche Bay, *Parkinson* (TYPE of *S. Shillinglawii*); vicinity of Rabaul, *Kanehira 3994, Waterhouse 424* (large spreading tree, excellent for shade; white flowers; striking red seeds in open fruit).
SOLOMON ISLANDS: Guadalcanal: Berande River, *Kajewski 2411,* sea level, rain forest (a medium-sized buttressed tree; pod red outside, salmon-colored inside, seeds green. A person recovering from a long illness, such as fever, is given a tonic made from the bark of this tree pounded and mixed with water). San Cristoval: Wainamura, *Brass 2843,* Sept. 1932, lowland rain forests, not common (small tree with thick, gray, fairly smooth bark; leaves stiff, glaucous below, midrib and main nerves brown on lower surface; flower yellowish green with red throat, the narrow lobes arched and inflexed).

Mildbraed, in his work on the Sterculiaceae of New Guinea, Bot. Jahrb. 62: 347–367, 1929, hesitated to reduce *S. Conwentzii* K. Schum to *S. Shillinglawii* F. v. Muell., although admitting *S. multinervia* Rech. as a synonym. We are indebted to Mr. Jessep for a photograph and fragment of the type of Mueller's species, the isotype of K. Schumann's species at the Kew Herbarium has been examined by the senior author. There seems to be no doubt that *S. Shillinglawii* is the oldest name for this apparently fairly widespread species. Needless to say, there is some variation in the specimens, but not enough to be of specific value.

Sterculia porphyroclada sp. nov.

Arbor ± 20 m. alta; trunco ± 20 cm. diam.; ramulis novellis 2–2.5 mm. diam., purpureis in sicco longitudinaliter ruguloso-sulcatis, annotinis 4.5 mm. diam., lenticellatis rimosis, sparsim patenti-hirsutis; foliorum petiolis 1.5–6.2 cm. longis, circiter 1/4 longitudinem laminae aequantibus patenti-hirsutis; laminis oblongo-ellipticis, 10–24 cm. longis, 5–11.5 cm. latis, basi paululo retusis vel rotundatis vel obtusis, apice acuminatis, acumine 1–2 cm. longo, obtusiusculo, supra costa et nervis ± dense stellato-pilosis ceterum fere glabris, subtus stellato-pilosis, ima basi trinerviis (in foliis majoribus subquinquenerviis), nervis lateralibus utrinsecus 10–13 marginem versus arcuatim conjunctis, supra distincte manifestis, subtus prominentibus, venis transversis prominulis, reticulatione ultima supra densissima sub lente distincte manifesta, subtus haud conspicua; inflorescentiis non visis; axi in fructu ± 5 cm. longo, 4 mm. diametro; mericarpiis ± 9 cm. longis, 2 cm. diametro, subfalcatis, apicem versus paulo angustatis, apice acutiusculis, extus brevissime et densissime ferrugineo-stellato-tomentellis, intus stellato-pilosulis; seminibus pluribus (8 in uno maricarpio) in sicco atrobrunneis, circiter 15 mm. longis et 7–9 mm. crassis.

NETHERLANDS NEW GUINEA: 6 km. southwest of Bernhard Camp, Idenburg River, *Brass 12765* (TYPE), February 1939, alt. 1200 m., occasional in rain-forest (subsidiary tree 20 m. high and 20 cm. diameter; fruit orange-red, seeds white).

The species appears to be related to *S. malacophylla* K. Schum. It has longish somewhat stiff hairs on the branchlets and petioles, and 4-pronged stellate hairs on the lower surface of the leaves; however, the hairs are not at all crowded and could scarcely be regarded as subtomentose, also they are harsh to the touch rather than soft; the bark on the younger branchlets is dark purple, not yellowish gray; and the leaves have 10–13 pairs of veins as compared with 7–8 in *S. malacophylla* K. Schum.

Sterculia ampla Baker f. Jour. Bot. 61. Suppl.: 5. 1923; White, Jour. Arnold Arb. 10: 240. 1929.

Sterculia coggygria Mildbraed, Bot. Jahrb. 62: 357. 1929.

BRITISH NEW GUINEA: Western Division: Oriomo River, Wuroi, *Brass 5785,* Jan.-Mar. 1934, riverine rain-forest (common erect sparsely branched tree up to about 15 m. high; leaves clustered at branch tips; large red fruit, seeds black); Lake Daviumbu, Middle Fly River, *Brass 7711, 7785,* common in rain-forest (substage or lesser canopy tree; flowers brown-green).

In our herbarium is an isotype of *S. coggygria* Mildbr. which we are unable to distinguish from the earlier described *S. ampla* Baker f. Again, judging by the specimens *Kanehira & Hatusima 11884, 12395,* we are inclined to believe that *S. gigantifolia* sensu Kaneh. & Hatus. in Bot. Mag. Tokyo 55: 389. 1941, also belongs here. The stipules are somewhat larger and coarser than in the Brass collections, and the pubescence varies. It might be worth noting that the inflorescence of *Kanehira & Hatusima 11884* is 60 cm. long.

Sterculia quadrifida R. Brown in Benn. Pl. Jav. Rar. 233. 1844; F. M. Bailey, Queensl. Fl. 1: 136. 1899; Queensl. Agric. Jour. 22: 147. 1909; C. T. White, Proc. Roy. Soc. Queensl. 33: 152. 1921.

BRITISH NEW GUINEA: Western Division: Mabaduan, *Brass 6480, 6503,* common in monsoon forests on granite slopes (tree to 10 m. high; branches flatly spreading; bark rough, brown; fruit generally 4-lobed, red, somewhat rugose; seeds a beautiful velvety-black); Wassi Kussa River, Tarara, *Brass 8414,* common in dry brushy rain-forests (tree 14–15 m. high; bark gray, lenticellate, somewhat scaly; leaves gray underneath; fruit orange-red, seeds velvety-black).

Previously reported by F. M. Bailey from Boku, Papua. These specimens are a reasonably good match for *Brass 2378* collected on the Mowbray River, Queensland. All are finely and closely velvety-tomentose on the under surface of the leaves. In the Queensland collection the fruit is less pointed at the base, a minor difference. There is considerable variation in the length and breadth of the leaves, those of *Brass 8414* are oblong-lanceolate, 7.5–16 cm. long, 3.2–5.3 cm. wide; in the other specimens the leaves are more nearly elliptic or slightly obovate, 5.5–10 cm. long, and 3.5–6 cm. wide.

Keraudrenia J. Gay

Keraudrenia corollata (Steetz) Domin, Bibl. Bot. 22(Heft 89[5]): 974. 1928.
Seringia corollata Steetz in Lehm. Pl. Preiss. 2: 350. 1848.

NETHERLANDS NEW GUINEA: Waren, 60 miles south of Manokwari, *Kanehira & Hatusima 12963, 13205,* March, 1940, alt. 200 300 m., on grassy hill (plant 1 m. tall; flower pink).

This plant agrees very well with a number of Queensland collections placed in this species. *Keraudrenia lanceolata* has been reported once from northern New Guinea, but this seems to be the first record of this species from the island.

PASSIFLORACEAE

Passiflora Linnaeus

Passiflora moluccana Blume Bijdr. Fl. Nederl. Ind. 938. 1826; DC. Prodr. 3: 323. 1828; Rumphia 1: 169. *t. 51.* 1835; Koorders Exkursionsfl. Java 2: 638. 1912; vel aff.

SOLOMON ISLANDS: Bougainville: Kugumaru, Buin, *Kajewski 1913,* July 1930, alt. 150 m., rain forest (common vine on rain forest trees; fruit green, 4.2 cm. long, 4 cm. diameter); Koniguru, Buin, *Kajewski 2076,* October 1930, alt. 950 m., rain forest (vine; fruit globular, 3.9 cm. diameter, slightly flattened top and bottom). Ysabel: Tasia, *Brass 3283,* Dec. 1932, coastal rain forests (large climber; leaves stiff, with pale nerves, glands pale brown; immature fruit about 2.5 cm. diameter, green).

These specimens differ from the description and plate of this species in having somewhat larger leaves (12–17 cm. long, 5.5–8.5 cm. wide) and globose fruits. Since we have no flowering material it seems best to place it here for the present. *Passiflora moluccana* Bl. is a native of the Moluccas.

Hollrungia K. Schumann

Hollrungia aurantioides K. Schum. Bot. Jahrb. 9: 212. 1888; Merr. & Perry, Jour. Arnold Arb. 24: 210. 1943, op. cit. 29: 160. 1948.

BRITISH NEW GUINEA: Central Division, Mafulu, *Brass 5239,* Sept.-Nov. 1933, alt. 1250 m., on edge of forest clearing, only one example seen (large woody climber; leaves smooth and shining; flowers yellow-green; fruit immature).

Our duplicate specimen had lost all its flowers, but it was finally named with the aid of some flowers from the first set in New York. Now we have one or two collections from each political division of New Guinea, indicating the plant is probably wide-spread over the island, but apparently not plentiful anywhere.

GENTIANACEAE

Nymphoides Hill.

Nymphoides hydrocharoides (F. v. Muell.) O. Ktze. Rev. Gen. 2: 429. 1891 (as *Nymphodes hydrocharodes*).

Villarsia hydrocharoides F. v. Muell. Fragm. Phytogr. Austr. 6: 139. 1868.

Limnanthemum hydrocharoides F. v. Muell. ex Bentham Fl. Austr. 4: 380. 1868; F. M. Bailey, Queensl. Fl. 3: 1030. 1900.

BRITISH NEW GUINEA: Wuroi, Oriomo River, *Brass 5871,* Jan.-Mar. 1934, alt. 20 m., plentiful in small pools of a little creek on savannah (leaves reddish underneath; flowers orange-colored).

Through the co-operation of Mr. C. T. White of Brisbane, a duplicate of *Brass 5871* was sent to Melbourne, where it was checked with the type of Mueller's species by Mr. J. H. Willis, who found it to match very well indeed. This appears to be the first record of this Australian species from New Guinea. Its most striking character is found in the comparatively large and minutely pubescent seeds.

Nymphoides parvifolium (Griseb.) O. Ktze. Rev. Gen. 2: 429. 1891 (as *Nymphodes parvifolium*).

Limnanthemum parvifolium Griseb. in DC. Prodr. 9: 141. 1845; F. M. Bailey, Queensl. Fl. 3: 1029. 1900.

BRITISH NEW GUINEA: Mabaduan, *Brass 6534,* April 1936, common in shallow grassy rain pools in savannah forests (very small white flowers). Previously reported from India, Siam, Ceylon, the Malay Peninsula, and Queensland.

SOLANACEAE

In the Solanaceae, as in so many other instances, we have very little authentic material for comparison. Many of our collections differed so widely from the descriptions of the species already reported for that island that we have described them as new. Following the latest work on the Solanaceae by Mr. C. V. Morton, Contrib. U. S. National Herbarium, 29: 54, 55. 1944, we have treated *Lycianthes* as a section of the genus *Solanum.*

Solanum leptacanthum sp. nov.

Frutex ± 1 m. altus; ramulis teretibus, 2–2.5 mm. diametro, consperse stellato-pubescentibus, sparsim aculeatis, aculeis tenuissimis, usque 7 mm. longis basim versus 0.5 mm. diametro, internodiis 2.5–3 cm. longis; foliis alternis membranaceis, lanceolatis, 9–15 cm. longis, 2.5–4.5 cm. latis, apice acuminatis, acumine ± 2 cm. longo, basi interdum inconspicue inaequilateralibus interdum valde obliquis, anguste cuneatis, margine subintegris vel undulatis vel leviter angulatis, nonnumquam non profunde lobatis, utrinque costa et interdum venis primariis aculeatis, aculeis gracilibus 2–8 mm. longis (2–14 per costam), supra fere glabris et olivaceis, subtus leviter pallidioribus et consperse stellato-pubescentibus, venis primariis utrinsecus 5–7 utrinque manifestis, oblique adscendentibus deinde arcuatis, secundariis ± manifestis; petiolo 4–9 mm. longo, sparsim stellato-pubescente; inflorescentiis ± 20-floris, minute stellato-pubescentibus, pedunculo 3–10 mm. longo, rhachi brevi, pedicellis 7(–30 in fructu interdum basi aculeatis) mm. longis; calyce cupulari, 1 mm. longo, 5-dentato, dentibus minutis; corolla 6 mm. longa, tubo 1 mm. longo, lobis lanceolatis, intus glabris; filamentis brevissimis, antheris 4 mm. longis, anguste lanceolatis, apicem versus angustatis, poris apicalibus minimis; ovario ovoideo, 1 mm. longo, stylo gracili, 4 mm. longo; fructibus ovoideis, 1.8 cm. longis, 1.5 cm. diametro, seminibus $\pm$ 20, oblique reniformibus, 6 $\times$ 4.5 $\times$ 0.6 mm., minute reticulatis.

BRITISH NEW GUINEA: Central Division, Ononge Road, Dieni, *Brass 3814* (TYPE), April 1933, alt. 500 m., in rain forest (one plant seen; shrub 1 m. with terminal flat-spreading branches; flowers pink; fruit broadly ovoid, orange-yellow, $\pm$ 1.8 cm. long, 1.5 cm. diameter).

In addition to the above cited collection, we have a specimen from Ihu, Vailala River, *Brass 972,* which agrees very closely with the type except that the calyx has very definite lobes and is about 3 mm. long, the fruit is very much like that described above in color and size of seeds, the plant is described as a weed in rain forest clearings. Unfortunately there are not very many flowers on any of the specimens, in fact only about a single open one on each, and several buds on the type, hence it is difficult to estimate the amount of variation in the character of the calyx.

Solanum oligolobum sp. nov.

Frutex magnus; ramulis teretibus 3–6 mm. diametro, aculeatis, primum stellato-tomentosis demum paullo glabratis, pilis sessilibus vel stipitatis apice stellatis grossis, flavidis, aculeis $\pm$ crebris, rectis, 5–10 mm. longis basi 1–2 mm. latis, internodiis 2.5–5.5 cm. longis; foliis alternis vel superioribus plerumque geminatis vel parum inter se distantibus, paullo inaequalibus, tenuiter chartaceis fragilibus, ambitu lanceolatis, apice acutis vel sensim acuminatis, basi inaequilateralibus, obtusis, margine grosse 3–4-lobatis (lobis obtusis vel acutis interdum mucronatis, sinubus plerumque late subrotundatis in foliis minorum fere planis), utrinque costa et venis primariis (utrinsecus $\pm$ 6 inconspicuis) aculeatis (aculeis paucis usque 1.5 cm. longis), supra $\pm$ dense tomentosis (pilis stellatis stipitatis sessilibusque) interdum consperse glandularibus, atro-olivaceis, subtus dense tomentosis et glandularibus paullo pallidioribus, lamina majorum 11–21 cm. longa, 4–13 cm. lata, petiolo 3–5 cm. longo, tomentoso et aculeato (aculeis usque 2.2 cm. longis), minorum 5–13 cm. longa, 2–5.5 cm. lata, petiolo 1.5–2 cm. longo; inflorescentiis dense tomentosis, primum fere terminalibus, serius in latus coactis, $\pm$ 12-floris; pedunculo 2–10 mm. longo, rhachibus simplicibus vel furcatis, pedicellis 1 (–1.5 in fructu) cm. longis interdum aculeatis, aculeis paucis usque 4 mm. longis vel nullis; calyce 3.5–4 mm. longo, campanulato, 5-lobato, lobis in dentes lineari-subulatos vix 1.5 mm. longos abrupte angustatis; corolla violacea, rostrata, tubo $\pm$ 2 mm. longo, lobis 8–9 mm. longis, extus margine lato excepto stellato-tomentosis; staminibus 5 (interdum 6), circiter 1 mm. corollae basim supra insertis, filamentis vix 2 mm. longis, antheris 3–3.5 mm. longis, apicem versus angustatis; ovario ovoideo, 1.5 mm. longo, apicem versus glandulis paucis breviter stipitatis instructis, stylo $\pm$ 4 mm. longo; fructibus $\pm$ 1 cm. diametro, glabris, seminibus numerosis, 2.5 $\times$ 2 $\times$ 0.4 mm., minute reticulatis.

NETHERLANDS NEW GUINEA: 9 km. NE. of Lake Habbema, *Brass 10876* (TYPE), Oct. 1938, alt. 2650 m., sunny situation at base of landslip (large shrub with violet flowers).

In the outline of the leaves and the straight prickles this species suggests *S. Gibbsiae* J. R. Drummond; in *S. oligolobum*, however, the leaves are very much larger, the prickles fewer, the tomentum denser and, particularly on the lower leaf-surface, mixed with stipitate glands, the inflorescence compound, and the fruit has many more seeds. The stalked coarse hairs forming a thick and loose tomentum give the impression of a thicker leaf than where the hairs are sessile (and usually finer); at the same time both leaves may be similar in texture and thickness.

Solanum trichostylum sp. nov.

Frutex usque 2 m. altus; ramis sensim glabratis, ± 4 mm. diametro; ramulis novellis dense tomentosis (pilis stellatis, parvis, sessilibus), aculeolatis (aculeolis vix 2 mm. longis, basi 2 mm. latis, lateraliter compressis), ± 2 mm. diametro, internodiis 1–5 cm. longis; foliis alternis, firme chartaceis, 3–9 cm. longis, 1.5–4 cm. latis, ovatis, apice acuminatis vel acutis, basi saepe inaequilateralibus, cuneatis, margine subintegris vel repandis vel interdum sublobatis, utrinque costa et interdum venis aculeatis (aculeis remotis paucisque 2–6 mm. longis, rectis) vel fere inermibus, supra olivaceis et sparsim, subtus subflavidis et dense stellato-tomentosis, venis primariis utrinsecus 6–8 supra impressis, subtus prominulentibus, rete supra impresso subtus prominulente; petiolo 1–2 cm. longo, dense stellato-tomentoso interdum 1–3-aculeato; inflorescentiis 6–10-floris, dense stellato-tomentosis in sicco subflavidis, primum fere terminalibus serius in latus coactis; pedunculo 5–10 mm. longo, rhachi brevi, pedicellis ± 1 cm. longis; calyce 4 mm. longo, subcampanulato, 5-lobato, lobis vix 2 mm. longis, subtruncatis, apiculatis, apiculo 0.5 mm. longo; corolla 5-lobato, circiter 1 cm. longo, lobis late ovatis apice leviter cucullatis, utrinque stellato-pubescentibus margine tantum glabris; staminibus supra corollae basim 1.5 mm. insertis, filamentis 2 mm. longis, antheris lanceolatis, basi 2 mm. apice 0.6 mm. latis, poris apicalibus parvis extrorsis; stylo 7 mm. longo, in dimidio inferiore stellato-pubescente; ovario subgloboso 1.5 mm. diametro, glabro; fructibus ± 1 cm. diametro, apiculatis, seminibus oblique subreniformibus, 4 × 3.5 × 0.5 mm., margine minute reticulatis.

BRITISH NEW GUINEA: Central Division, Mount Tafa, *Brass 4934* (TYPE), Sept. 1933, alt. 2400 m., plentiful on clearings in the forest in the vicinity of the road (slender shrub up to 2 m. high; branches, petioles, peduncles, and pedicels purple-tinged; pale dull leaves; bright purple flowers; ripe fruit yellow); Wharton Range, Murray Pass, *Brass 4539*, July 1933, alt. 2840 m., a weed plant on forest borders damaged by fire (sparsely branched shrub 1–1.5 m. high; leaves pale; corolla purple, anthers bright yellow; soft, globose, black fruit about 1 cm. diameter).

Solanum torvoideum sp. nov.

Frutex altus vel arbor parva; ramulis teretibus ± 5 mm. diametro, novellis densissime stellato-tomentosis deinde glabratis, pilis stipitatis vel sessilibus grossis flavidis, aculeis paucis, vix 1 mm. longis, inconspicuis, internodiis 2.5–5.5 cm. longis; foliis inermibus alternis vel interdum superioribus geminatis (uno minore), fragilibus, tenuiter chartaceis ambitu lanceolatis vel lanceolato-ellipticis (5.5 –)7–16.5 cm. longis, (1.5 –)3–9 cm. latis, basi tantum leviter inaequalibus obtuse cuneatis, apice longe acutis, margine sinuatis vel irregulariter et remote lobatis, supra fulvo-brunneis, subtus leviter pallidioribus, utrinque densissime stellato-tomentosis, pilis saepissime stipitatis, venis primariis utrinsecus ± 5, supra manifestis, subtus latioribus et prominulis, oblique adscendentibus marginem versus arcuatis, rete laxo tantum subtus in foliis majoribus manifesto; petiolo 1.2–2.5 cm. longo densissime stellato-tomentoso; inflorescentiis (in fructu 7–8 cm. longis) primum fere terminalibus serius in latus coactis, ± 20-floris, dense stellato-tomentosis, serius glabratis; pedunculo 7–15 mm. longo, furcato, rhachibus et pedicellis (1–2 cm. longis) etiam ± glandulosis; calyce campanulato, tubo 2 mm. longo, lobis 4 mm. longis, lanceolatis apice 2 mm. subulatis, corolla ± 10 mm. longa, lobis intus apice tantum pubescentibus leviter cucullatis vel apiculatis; staminibus 1 mm. supra corollae basim insertis, filamentis 1.5 mm. longis, antheris 4 mm. longis, lanceolatis sursum angustatis; ovario subgloboso minute glanduloso, stylo 6 mm. longo; fructibus globosis, ± 1 cm. diametro glabris; seminibus numerosis, 2 × 1.8 × 0.5 mm., ovalibus, fere levibus.

BRITISH NEW GUINEA: Central Division, Mafulu, *Brass 5411* (TYPE), Oct. 1933, alt. 1250 m., forest regrowths (tall bush or small tree; very few small prickles on branches; flowers white; fruit orange-brown).

This collection differs from what we take to be typical *S. torvum* Sw. in the coarse thick tomentum on both surfaces of the leaves which gives the plant a yellowish brown appearance when dry rather than pale or cinereous green which is characteristic of typical *S. torvum* Sw.; the leaves also are only slightly inequilateral at the base, and the pedicels are more robust; in the specimens at hand there are also many less flowers in the flower-cluster.

Solanum inaequilaterale Merr. Philip. Jour. Sci. 1, Suppl.: 236. 1906; Enum. Philip. Fl. Pl. 3: 426. 1923.

NETHERLANDS NEW GUINEA: Bele River, 18 km. NE. of Lake Habbema, *Brass 11590,* Nov. 1938, alt. 2200 m., occasional in open grassy second growths (spreading tree 1.5–2 m. high; flowers lavender; fruit yellow).

This specimen is a very good match for the Philippine material of this species, and both come from the same altitude.

Solanum Schefferi F. v. Mueller, Descr. Notes Papuan Pl. 1: 44. 1876.
Solanum incanum Scheffer, Ann. Jard. Bot. Buitenz. 1: 39. 1876, non Linn.
Solanum smilacocladum Bitter, Bot. Jahrb. 55: 79. 1917.

In citing the Buitenzorg Herbarium specimen *no. 9853!* (sub. nom. *S. incanum* Scheff.) we believe that Bitter was citing the type of Scheffer's *Solanum incanum,* hence the first valid name for the species is *S. Schefferi* F. v. Muell., rather than *S. smilacocladum* Bitter, even though the description is emended.

Solanum heteracanthum sp. nov.

Planta suffruticosa ± 1.5 m. alta; ramis aculeatis et fere glabris, ramulis primum pilis stellatis dense tomentosis demum glabratis, aculeatis, aculeis 5–7 mm. longis, ad basin 5 mm. attingentibus, recurvis, a latere compressis; foliis alternis vel saepe ad nodos binis et inaequalibus, 5–12.5 cm. longis, 1.8–5 cm. latis, margine angulato-sinuatis vel interdum subintegris, basi plerumque inaequaliter cuneatis vel obtusis, apice longe et sensim acuminatis, supra maturis in sicco atro-olivaceis glabris, novellis costa et venisque stellato-pubescentibus, subtus fulvo-cinerascentibus dense stellato-tomentosis, costa venisque consperse aculeatis, aculeis paucis rectis vel leviter recurvis usque 9 mm. longis ad basin 1–1.5 mm. latis; petiolo 7–9 mm. longo, tomentoso; inflorescentiis extra-axillaribus usque 14-floris, pedunculo ± 5 mm. longo, furcato, rhachibus 2–5 mm. longis, pedicellis confertis, 7–10(–17 in fructu) mm. longis apicem versus incrassatis et angulatis, sicut pedunculo et rhachibus stellato-pubescentibus; alabastris dense stellato-tomentosis; calyce campanulato, tubo vix 2 mm. longo, lobis 3 mm. longis, abrupte obtusis apiculatis; corolla rotata, ± 11 mm. longa, 5-lobata, lobis lanceolatis extus dense stellato-tomentosis in dimidio inferiore membranis glabris conjunctis et marginatis, intus in parte superiore venae mediae interdum pilis stellatis obsitis; staminibus 5, ± 1.5 mm. supra corollae basin insertis, filamentis 2 mm. longis glabris, antheris anguste lanceolatis 6 mm. longis basi 1 mm. latis, fere a basi subcordata apicem versus sensim angustatis, poris apicalibus parvis; ovario ovoideo 1 mm. longo, glabro, stylo 8 mm. longo; fructu immaturo subgloboso, 1 cm. diametro, seminibus ± 16 reniformibus lateraliter compressis, 4 × 3 mm., margine 0.6 mm. circumdatis, minute reticulatis.

NETHERLANDS NEW GUINEA: 9 km. NE. of Lake Habbema, *Brass 10764* (TYPE), Oct. 1938, alt. 2700 m., rain forest of valley bottom (weak shrub 1.5 m. high, in a native clearing; flowers purple; fruit unripe); Bele River, 18 km. NE. of Lake Habbema, *Brass 11505,* Nov. 1938, alt. 2200 m., scrambling on an open land-slip (flowers purple; fruit immature).

Among the descriptions of the New Guinean species of *Solanum* this is perhaps related to *S. Gibbsiae* J. R. Drummond; but in the latter the spines are straight, and the inflorescence 1–3-flowered. Among the species which we have seen, it is most like *S. dimorphispinum* C. T. White of Queensland. The latter, however, is larger in most dimensions, the leaves are only repand, the inflorescence is much more open, and the pubescence more compact. Our species seems best characterized by the strongly recurved prickles with broad bases on the branchlets, the angled sinuate margins of the leaves, the longer and practically straight prickles with narrow bases on the leaves (on the midrib and main primary veins of the upper surface, usually confined to the midrib on the lower surface), and the rather compact inflorescence; whether the thin margin of the seed is a good diagnostic character or only on account of its immaturity we cannot say.

Solanum acuminatissimum sp. nov. § LYCIANTHES

Frutex 60 cm. alta; ramulis sparsim pilosulis vel puberulis, internodiis 2–3.5 cm. longis; foliis geminatis inaequalibus, tenuiter chartaceis; majoribus 6.5–16 cm. longis, 2.8–7 cm. latis, ovato-ellipticis utrinque angustatis, basi oblique cuneatis, apice longe acuminatis, acumine 1.2–3 cm. longo, basi 7 mm. lato, lineari-lanceolato ± falcato, margine undulatis vel subintegris, utrinque glabris, supra olivaceis, subtus pallidioribus, venis lateralibus utrinsecus ± 6 oblique adscendentibus prope marginem arcuatis, utrinque perspicuis, rete laxo ± manifesto; petiolo sparsim pilosulo vel puberulo, 1–1.3 cm. longo; foliis minoribus 2–5.5 cm. longis, 1.3–3.5 cm. latis, petiolo 3–5 mm. longo; inflorescentiis axillaribus 2–3-floris, glabris, pedicellis 2–2.5 cm. longis; calyce (cupulari) in fructu patenti, truncato, infra marginem dentibus 3–5 obtusis, 0.5–1 mm. longis, oriundis; baccis globosis, circiter 1 cm. diametro; seminibus satis numerosis, reniformibus, in sicco vix 3 × 3 × 1 mm., distincte reticulatis.

NETHERLANDS NEW GUINEA: 15 km. SW. of Bernhard Camp, Idenburg River, *Brass 12290* (TYPE), Jan. 1939, alt. 1800 m., one example on a small clearing in mossy forest (shrub 60 cm. high; fruit green; pedicels, calyx, and lower surface of leaves tinged with purple).

This species is perhaps best distinguished by the thinly chartaceous ± sinuate-margined larger leaves with a long slender somewhat falcate acumen, the few-flowered inflorescence, and the thin calyx. It is very much like *Solanum banahaense* Elmer in that both have calyces with minute teeth (or lobes) developing just below the margin. In the Philippine material (which also has entire leaves of firmer texture) this character appears to be fairly constant, the teeth originating from 4 angles or ribs; in the New Guinean collection the character is variable, sometimes only 3 teeth are developed, and sometimes 5.

Solanum multifolium sp. nov. § LYCIANTHES

Frutex gracilis, 2–3 m. altus; ramulis 1–2 mm. diametro, teretibus, pubescentibus, pilis brevibus apice incurvis, internodiis 0.7–3 cm. longis; foliis membranaceis, plerumque geminatis interdum solitariis; majoribus (1.2–)4–9 cm. longis, 1.5–3.7 cm. latis, lanceolatis, utrinque angustatis, basi cuneatis inconspicue obliquis, apice acutis interdum obtusiusculis vel obtusis, margine integris, supra glabris, subtus costa et venis tantum pilis paucis insertis, venis primariis utrinsecus 5–7 supra inconspicuis, subtus manifestis, rete sub lente laxo manifesto; petiolo (1.5–)4–7 mm. longo sicut ramulis adscendenti-pubescente; foliis minoribus 0.5–1.5 cm. longis, 0.4–0.8 cm. latis, lanceolato-ovatis vel suborbicularibus, obtusis; petiolo brevissimo vel usque 2.5 mm. longo; floribus solitariis vel geminatis, glabris, pedicellis 0.7–1.8 cm. longis, alabastro uno tantum viso, 5 mm. longo; calyce cupulari, 2.5 mm. longo, apice 3 mm. diametro; corollae lobis 5, apice leviter cucullatis et puberulis; filamentis brevibus, antheris 3 mm. longis, lineari-lanceolatis; pistillo minuto; fructibus globosis, ± 7 mm. diametro, seminibus ± 15, 2.5–3 mm. longis latisque, 1.5 mm. crassis.

NETHERLANDS NEW GUINEA: 6 km. SW. of Bernhard Camp, Idenburg River, *Brass 12907* (TYPE), Feb. 1939, alt. 1150 m., common in a rain forest gully (very slender tree 2–3 m. high; fruit red; one white flower-bud).

A species easily recognized by its relatively small and very thin leaves, short internodes, and mostly solitary flowers.

Solanum belense sp. nov. § LYCIANTHES

Frutex parvus; ramis cinereis, glabris, ramulis novellis dense puberulis demum glabratis, 1.5–3 mm. diametro, internodiis 1.5–3 cm. longis; foliis tenuiter chartaceis, plerumque geminatis suboppositis, interdum solitariis, majoribus 4.5–15.5 cm. longis, 2.5–5.5 cm. latis, late lanceolatis, apice obtuse vel acute acuminatis, basi oblique cuneatis, margine integris, utrinque glabris, novellis subtus costa venisque puberulis mox glabratis, venis primariis utrinsecus 6–8 supra manifestis, subtus prominulis, adscendentibus, marginem versus arcuatis, rete laxo supra inconspicuo subtus distincte manifesto; petiolo 0.5–1.5 cm. longo, ± puberulo; foliis minoribus 1–3.5 cm. longis, 0.5–1.8 cm. latis, lanceolatis vel elliptico-lanceolatis, basi plerumque obliquis, apice obtusis vel acutis, glabris, venis primariis ± 4; petiolo 3–5 mm. longo; inflorescentiis inter bases petiolorum insertis, glabris; floribus solitariis vel 2–6-fasciculatis, fasciculis interdum pedunculo brevissimo vel pulvillo insertis, pedicellis usque 2 cm. longis; calyce cupulari, 3 mm. longo, apice 3 mm. diametro; corollae tubo 5 mm. longo, lobis ± 1 cm. longis, 4 mm. latis, acutis, extus apice cucullato et margine dense puberulis; staminibus tubi corollae apicem prope insertis, filamentis 1.5–2 mm. longis, antheris 3 mm. longis, oblongis apice tantum paullo angustatis; ovario ovoideo, 1.5 mm. longo, stylo 7 mm. longo; fructu non viso.

NETHERLANDS NEW GUINEA: Bele River, 18 km. NE. of Lake Habbema, *Brass 11223* (TYPE), Nov. 1938, alt. 2300 m., Fagaceae forest, common in moist semi-shade (small shrub; pedicel and calyx violet; corolla white).

Only one branch seems to have any perfect flowers, the rest are all staminate; in the latter the filaments are a little longer than in the perfect ones.

Solanum acuminatissimum, S. belense, and *S. multifolium* are all closely related. The first appears to be easily separable on its somewhat undulate, long-acuminate leaves, and slightly dentate calyx, the latter character is not present in either of the other species. For the most part, *S. belense* has more pubescent branchlets, entire, narrower and more shortly acuminate leaves, and more flowers in a fascicle. These are fastened to a slight swelling or a very short peduncle situated between the bases of the petioles of each pair of leaves. *Solanum multifolium* has very short internodes, and on the average much smaller leaves than the other two. All three species have thin leaves and calyces, but in the last species the leaves are seemingly more translucent than in the other two.

Solanum rostellatum sp. nov. § LYCIANTHES

Planta suffruticosa, ± 1 m. alta; ramulis teretibus, glabratis, 1–3 mm. diametro, novellis dense hirtellis, pilis simplicibus pluri-cellularibus, internodiis 1.5–3 cm. longis; foliis saepe majoribus cum foliis minutis geminatis, majoribus 4–9 cm. longis, 1–3.5 cm. latis, chartaceis, late oblongis vel lanceolatis, basi ± oblique cuneatis vel obtusis, apice subabrupte acuminatis vel rostellatis, acumine 8–15 mm. longo basi 4–5 mm. lato, integris, in sicco atro-olivaceis, supra glabris, subtus costa et venis primariis ± hirtellis, venis primariis utrinsecus 5–6 curvatim adscendentibus prope marginem arcuatim conjunctis, rete utrinque manifesto; petiolo 5–9 mm. longo, ± hirtello; foliis minutis 4–8 mm. longis, 2–4 mm. latis, suborbicularibus, subsessilibus; inflorescentiis axillaribus, 1–2-floris, pedicellis usque 2 cm. longis, sparsim hirtellis vel fere glabris; calyce cupulari, truncato, 2 mm. longo, apice 3 mm. diametro, consperse pilosulo vel glabro; corolla glabra, tubo 2 mm. longo, lobis 5, ± 5 mm. longis, 1.2–1.5 mm. latis, apice subacutis, margine (in alabastris) minutissime papillatis; filamentis latis et brevissimis, sub apice tubi corollae insertis, antheris lineari-lanceolatis, 4 mm. longis, basi 1 mm., apice 0.5 mm. latis, poris apicalibus parvis; ovario ovoideo, stylo 5 mm. longo; baccis non visis.

BRITISH NEW GUINEA: Central Division, East Mt. Tafa, *Brass 4135* (TYPE), May 1933, alt. 2100 m., common on roadside in tall foothill forest (weak shrub about 1 m. high; leaves dull green on purple petioles; corolla purple, anthers bright yellow).

This species might be compared to *Solanum cladotrichum* Bitt., but the latter is a high-climbing liane with gradually acuminate leaves, considerable pubescence and small flowers; our species is a small shrub with somewhat abruptly acuminate leaves, the pubescence (unbranched hairs) is scanty occurring chiefly on the younger branchlets, the midrib and veins of the lower surface of the leaves, and very few hairs on the pedicels and calyx. The flowers are larger than those described for Bitter's species.

Solanum Rechingeri Witasek, Rep. Nov. Sp. 5: 165. 1908, Denkschr. Math.-Nat. Kl. Akad. Wiss. Wien 89: 602. 1913; Bitter, Bot. Jahrb. 55: 102. 1917.

Lycianthes Rechingeri (Witasek) Bitter, Abhandl. Nat. Ver. Bremen 24: 504. 1920.

SOLOMON ISLANDS: Bougainville: Kugimaru, Buin, *Kajewski 1800*, June 1930, alt. 150 m., rain forest, common (small tree with white trunk; petioles of leaves blue, darker near the base; petals blue, stamens yellow); same locality, *Kajewski 1863* (fruit 1.4 cm. long, 1.2 cm. diameter, light green-blue when ripe); Siwai, *Waterhouse 66* (small tree). Guadalcanal: Berande River, *Kajewski 2388*, June 1930, rain forest (small tree up to 10 m. high; purple petals, yellow stamens). Ysabel: Tiratona, *Brass 3314*, Dec. 1932, alt. 600 m., rain forests, common (slender tree up to 10 m. tall; pale brown bark; small bright red fruits).

This species is closely related to *S. vitiense* Seem. Just about the time of anthesis the flower-bud is 8 mm. long, and 3.5 mm. diameter (in the dried specimen); the calyx is cupular, 2 mm. high, the margin ± tufted puberulous-ciliolate, as is also the margin of the corolla-lobes; in the full-blown flower the corolla-lobes are about 8 mm. long, the tube 4 mm.; the filaments are 2.5 mm. long, the anthers 3 mm. long; the style 2 mm. long. In *S. vitiense* Seem. the flower-buds are broader in proportion to the length, and the inflorescence does not show any tendency to become racemose in fruit, as is the case in *S. Rechingeri* Witasek. In the latter species the leaf-bases are both symmetrical and unsymmetrical in the specimens cited.

Solanum impar Warburg, Bot. Jahrb. 13: 415. 1891; Bitter, Bot. Jahrb. 55: 109. 1917.

Lycianthes impar (Warb.) Bitter, Abhandl. Nat. Ver. Bremen 24: 504. 1920.

BRITISH NEW GUINEA: Fly River, 528 mile Camp, *Brass 6796*, May 1936, alt. 80 m., climbing on undergrowth trees in the river flood-bank forests (attractive purple flowers and blue fruit in axillary fascicles, fruiting calyx white).

This specimen seems to fit the description of Warburg's species reasonably well; the leaves are chartaceous and vary a little more in size (15–32.5 cm. × 5–8 cm.), the peduncle does not exceed the length of a centimeter, and the berries are oblong or slightly ovoid (7–8 mm. × 5 mm.). The calyx is cup-shaped, truncate or slightly undulate, 2–3 mm. high; the corolla tube is about the same length, the lobes 5(–6), about 3.5 mm. long, 1 mm. broad, apex slightly cucullate and very slightly puberulous; filaments inserted near the top of the corolla-tube, 1 mm. long, glabrous, anthers oblong, 2.5 mm. long; pistil sometimes minute (as described in *S. Ledermannii* Bitter) or aborted, or again normal with the style protruding beyond the stamens about 1.5 mm.

PLANTAGINACEAE

Plantago Linnaeus

In van Steenis's article, "On the origin of the Malaysian mountain flora," Bull. Jard. Bot. Buitenz. III. 13: 235. 1934, we find concerning *Plantago* that "no species seems to be indigenous in Malaysia." Since then four species have been collected in the high mountains of New Guinea during the Archbold Expeditions. The first, from British New Guinea, reported by Pilger in 1935, was originally described from New Zealand. Now this same species (at least in a broad interpretation) and three others also with southern affinities are reported here.

Plantago trichophora sp. nov. § MESEMBRYNIA

Planta, ut videtur perennis, acaulis vel caudex brevis crassiusculus; foliis fragilibus, usque 13 cm. longis (parte superiore 3–7 cm. longa, 0.5–1 cm. lata), deorsum sensim angustatis in petiolum 2–5 cm. longum, 1.5–2 mm. latum, crispe pilosum, transeuntibus, basi paulo dilatatis ibique lana longa fulva involutis, apicem versus angustatis, apice ipso obtusiusculis, integris, trinerviis, supra consperse pilosis vel fere glabris, pilis longis, subtus nervis sparsim, costa praecipue basin versus dense pilosis; inflorescentiis usque 20, pedunculis longitudine variantibus (7–17 cm. longis), teretibus, pilosis, pilis longis, basin versus pedunculi conspersis, crispis, ± patentibus, apicem versus infra spicam adscendentibus et densis; spica 2–4 cm. longa, 5 mm. lata, densa; bracteis vix 2 mm. longis, late ovatis, obtusis, obtuse carinatis, glabris, margine sparsim ciliatis, intus basi ± pilosis; sepalis 3 mm. longis, posticis ellipticis, valde concavis, apice vix angustatis, carina crassiuscula prominula, anticis paulo angustioribus, parum inaequilateralibus, glabris vel interdum sparsim et consperse ciliolatis; corollae tubo 2 mm. longo, lobis 1.5 mm. longis, rotundato-ovatis; capsulis ellipsoideis, apice ad basim styli induratis, circiter 4 mm. longis (parte superiore 2.5–3 mm., inferiore 1.5 mm.), seminibus 4–5, fuscis, ambitu ovato-oblongis, crassis, fere 2 mm. longis, subtiliter punctatis, facie hili convexis.

BRITISH NEW GUINEA: Mount Albert Edward, *Brass 4352* (TYPE), June 1933, alt. 3680 m., common; wet slopes of alpine grasslands (leaves flat, spreading, concave, margins red).

This plant belongs to the section MESEMBRYNIA Decaisne. From the descriptions at hand we are unable to suggest a closely related species.

Plantago lanigera Hook. f. Handb. New Zeal. Fl. 227. 1864; Pilger, Bot. Jahrb. 67: 236. 1935; Pflanzenr. 102(IV. 269): 120. 1937.

NETHERLANDS NEW GUINEA: Lake Habbema, *Brass 9457,* Aug. 1938, alt. 3225 m., filling the spaces between scattered grass-tussocks on marshy slopes; 11 km. northeast of Wilhelmina-top, *Brass & Meyer-Drees 9819,* Sept. 1938, alt. 3400 m., alpine grassland, occasional flat rosettes on sandy banks of a stream; 2 km. east of Wilhelmina-top, *Brass & Meyer-Drees 10220,* Sept. 1938, alt. 3800 m., alpine grassland, scattered along banks of a stream.

In reporting *Brass 4646,* Pilger pointed out that it varied somewhat from the New Zealand material. These collections vary even more, particularly in size. The plants are 4.5–16.5 cm. in diameter with leaves 1.5–8 cm. long, and 0.4–1.8 cm. broad; the pubescence of the leaves is variable, in some plants appearing only on the lower surface. We have considered *P. lanigera* var. *Petriei* Cheeseman for these collections, but the leaves are even larger than described there, and numerous. In the collection from Lake Habbema the peduncles are glabrescent, sometimes having only a few scattered hairs.

Plantago stenophylla sp. nov. § OLIGANTHOS

Planta parva, acaulis; rhizomate valde verticali, crasso vel crassiusculo, radice primaria non visa (probabiliter demum nulla), radicellis robustis, elongatis (usque ad 8 cm. longis); foliis numerosis, rosulatis, sub-erectis vel adscendentibus, anguste linearibus, 1.5–4 cm. longis, 0.7–2 mm. latis, integris vel remote et minute dentatis, margine ± revolutis, apice obtusis, glabris, crassiusculis, supra costa impressa, subtus prominula, basi paullo dilatatis ibique lana longa flavescente instructis; inflorescentiis axillaribus, primum breviter (2 mm.), demum longe (2 cm.) pedunculatis, pedunculo glabro; spicis plerumque 1-floris; bracteis ± 1 mm. longis, rotundatis, concavis, basi intus longiuscule pilosis; sepalis oblongo-lanceolatis, 2–2.5 mm. longis, obtusis, obtuse carinatis, glabris; corollae tubo 2 mm. longo, lobis lanceolatis, 1.2 mm. longis; staminibus 4, antheris non visis; capsulis ellipsoideis, 8–10-spermis, circiter medio circumscissis; seminibus fuscis, 3–4-angulatis.

NETHERLANDS NEW GUINEA: Lake Habbema, *Brass 9456* (TYPE), Aug. 1938, alt. 3225 m., alpine grassland (common bog herb); 7 km. northeast of Wilhelmina-top, *Brass & Meyer-Drees 9920,* Sept. 1938, alt. 3720 m., abundant in alpine bog turf.

NORTHEAST NEW GUINEA: Mt. Sarawaket, *Clemens, s.n.* May 1939, alt. about 3300 m., forming sod around pond margins with *Potentilla, Gentiana* and *Carex* (flower wine-purple, minute).

Plantago depauperata sp. nov. § OLIGANTHOS

Planta pulvinata; rosulis parvis, 1–3 cm. diametro, multifoliatis, aggregatis; foliis crassiusculis, 6–15 mm. longis, 1–1.5 mm. latis, linearibus, apicem versus angustatis obtusiusculis, basi sensim dilatatis ibique lana longa fulva involutis, ceterum glabris, integris, margine angustissimo translucentibus, supra punctulatis, costa supra paullo impressis; spica ad florem unicum reducta; pedunculo 5 mm. longo; floribus perfectis; bracteis 2, ± flore vaginatim circumdantibus, basi intus pilis longis tenuibus bracteis fere aequantibus instructis, ceterum glabris, triangulari-ovatis, vix 4 mm. longis, sursum angustatis, apice obtusiusculis, obtuse carinatis, costa ± brunnescente; sepalis ovato-lanceolatis, 3 mm. longis, acutis, glabris, teneris, obtuse carinatis; corollae tubo 2 mm. longo, lobis lanceolatis, 1.5 mm. longis, ± reflexis; antheris longe exsertis; stigmate longe exserto; capsulae parte inferiore valde elongata, ± 5 mm. longa, anguste obconica, parte superiore conica, ± 2 mm. longa; seminibus 4–8, parvis, angulatis, subtiliter impresso-punctatis.

NETHERLANDS NEW GUINEA: Lake Habbema, *Brass 9199* (TYPE), Aug. 1938, alt. 3225 m., plentiful in open boggy ground (gregarious, each plant forming a separate tuft ± 1 cm. high; leaves blue-gray); 7 km. northeast of Wilhelmina-top, *Brass & Meyer-Drees 9921,* Sept. 1938, alt. 3800 m., gray-green rosettes forming the bulk of the sparse herbaceous cover on shallow soil of sandstone summits; northern slopes of Mount Wilhelmina, *Brass & Meyer-Drees 10135,* Sept. 1938, alt. 4150 m., often the chief plant on black sandstone heights.

Both this and the preceding species belong to section OLIGANTHOS Barneoud. In *P. depauperata* the capsule seems to answer the description of that of *P. barbata* var. *monanthos* (D'Urv.) Pilger; however, on comparison with scanty herbarium material from the Falkland Islands, we find the plants of the latter much coarser and of much more open habit than the New Guinean material. Whether the Falkland Islands material is properly named we cannot say, but certainly the Archbold collections are not conspecific with it.

RUBIACEAE

Maschalodesme simplex Merr. & Perry, Jour. Arnold Arb. 25: 197. 1944.

BRITISH NEW GUINEA: Vailala River, Ihu, *Brass 914,* Feb. 9, 1926, rain forest (erect unbranched bush 5 feet high; leaves shining above; large acute stipules; inflorescence in supra-axillary clusters; fruit red, eight-angled).

At the time this species was described this specimen was unavailable for examination. Since the genus has not been reported in fruit before, it seems worth while to add a brief note. Two fruits are available, one of which has been opened. It contains 16 seeds, eight to a locule, biseriately arranged and imbricating upward. Dry fruit elliptic, 8-costate, 3–3.5 cm. long, 1.5–2 cm. diameter, minutely puberulous. Seed after being soaked irregularly subobtrigonous or subrhomboid, more or less angled, somewhat flattened and curved, hardly 1 cm. long, about 5 mm. wide at its greatest width, attached at the inner base and here somewhat pointed; radicle superior scarcely 3 mm. long, cotyledons ovate, about 2 $\times$ 1.5 mm., embryo straight; albumen thick, somewhat cartilaginous.

VALERIANACEAE

Triplostegia repens Hemsl. Kew Bull. 1899: 101. 1899; Diels, Bot. Jahrb. 62: 493. 1929; van Steenis, Bull. Jard. Bot. Buitenz. III. 13: 257. 1934.

NETHERLANDS NEW GUINEA: Lake Habbema, *Brass 9208,* Aug. 1938, alt. 3225 m., locally common on open boggy ground (flowers white).

NORTHEAST NEW GUINEA: Sarawaket, *Clemens 6325,* April 1937, alt. 1800–2400 m.; Morobe District, Upper Camp A, *Clemens 10085bis,* Mar. 1939; Ulap Trail, *Clemens 41133,* April 1940 (flowers white).

The two previous records of the New Guinean species of *Triplostegia* were based on fragmentary material. Hemsley described the plant as having repent stems, but the radical leaves were not seen. Diels indicated that, although in the plant from Sarawaket the stem was upright and much shorter than in the original which he had examined, he was of the opinion that it belonged to the same species. In the light of the material cited above we believe it is clear that the habit of the plant is closely adapted to its environmental conditions. If the roots are fairly close to the surface of the substratum, the basal part of the shoot is very short, and a pseudo-rosette of leaves develops at the surface. On the other hand, if the roots are deeply buried in the substratum the basal part of the shoot is longer depending on the distance it has to travel before reaching light and developing leaves. Possibly if the plant is in the shade longer internodes develop, the longest in the specimens at hand is 1.5 cm., but mostly they are very short (2–5 mm.); above the cluster of leaves the stem becomes scape-like with a pair of reduced leaves half way between the substratum and the inflorescence. There is considerable variation in the number of glands on the inflorescence, perhaps depending on the stage of development. The genus is known only from the Himalayas, Yunnan and New Guinea. We have reported similar ranges for *Stellaria saxatilis*

Buch.-Ham. in Don, and *Potentilla* of the *P. leuconota* complex, but the last two are also found in intermediate localities.

CUCURBITACEAE

Neoalsomitra Hutchinson

In a brief article published in the Annals of Botany, n. ser. 6: 95–102. 1942, Dr. J. Hutchinson has clearly shown that *Macrozanonia* Cogniaux is only a synonym of *Alsomitra* Roemer, both having been established on the same type-species. He proposed the new genus *Neoalsomitra* Hutchinson to take care of the rest of the species later included in *Alsomitra* Roemer.

Neoalsomitra Schultzei (Cogn.) Hutchinson in Ann. Bot. n. ser. 6: 98. 1942.
Alsomitra Schultzei Cogniaux, Pflanzenr. 66(IV. 275. I): 12. 1916.

BRITISH NEW GUINEA: Lower Fly River, east bank opposite Sturt Island, *Brass 8149,* Oct. 1936, climbing in reed swamps (flowers yellow; fruit green, indehiscent).

This appears to be the first record of this species since it was originally described on a specimen collected on the Augusta River, Northeast New Guinea.

Neoalsomitra integrifoliola (Cogn.) Hutchinson in Ann. Bot. n. ser. 6: 99. 1942.
Gynostemma integrifoliola Cogn. in DC. Monog. Phan. 3: 916. 1881.
Alsomitra integrifoliola Hayata, Jour. Coll. Sci. Tokyo 30: 121. 1911, Ic. Pl. Formosa 1: *t. 38, 39.* 1911; Cogn. Pflanzenr. 66(IV. 275. I): 17. 1916.

BRITISH NEW GUINEA: Central Division: Laloki R., Rona, *Brass 3606,* Mar. 1933, alt. 450 m., edge of rain forest, common (slender spreading climber; upper surface of leaves dull, lower shining; flowers very pale yellow). Western Division: Lower Fly River, east bank opposite Sturt Island, *Brass 8116,* rain forest, common on trees bordering swamps (liane; branchlets glaucous; leaves somewhat fleshy; flowers green). Reported by Hutchinson from Formosa, the Philippines, and Fiji.

Melothria Linnaeus

Melothria scabridula sp. nov.

Monoica, scandens; caulibus gracilibus, sulcatis, nodis sparsim pubescentibus exceptis, glabris; foliorum petiolo 1.5–3 cm. longo, supra canaliculato et marginibus minute pubescentibus, ceterum glabro; lamina tenuiter chartacea, 3–5-partita, margine subinciso-dentata, dentibus apiculatis, supra in sicco fusco-olivacea, consperse albido-scabridula et venis minute pubescente, subtus paullo pallidiora, levi, glabra vel novella venis minute pubescente, lobo terminali lanceolato, apice longiuscule acuminato, 4–8.5 cm. longo, ad basin 0.5–1 cm., in medio 1–2.3 cm. lato, lobis lateralibus 2.5–3 cm. longis, 1.5–2 cm. latis, sinu basilari late triangulari (5 mm. longo, 15 mm. lato) vel laminarum basi fere truncata; cirrhis simplicibus, gracilibus minute pubescentibus; ♂ inflorescentibus racemosis vel subcorymbosis, paucifloris (2–5-floris), pedunculo 1–1.5 cm. longo, minute pubescente; pedicellis usque 5 mm. longis; calyce campanulato, 3 mm. longo, glabro, dentibus 1 mm. longis, triangulari-subulatis; corolla 6 mm. longa, extus granulari-puberula, lobis rotundatis; staminum filamentis 2.5 mm. longis, puberulis, apice curvatis; antheris ellipticis, connectivo apice leviter producto; ♀ solitariis in eadem axilla cum masculis dispositis; pedunculo 1.5–4 cm. longo; ovario subgloboso; calyce et corolla maris; staminodiis consperse et breviter pilosulis; stylo 3 mm. longo, basi disco cupulari; stigmatibus 3, 1 mm. longis, apice expansis complanatis, bilobatis; fructibus ± globosis, 1 cm. diametro; seminibus stramineis, obovoideis, circiter 4 mm. longis, 3 mm. latis, basi angustatis, ± complanatis, immarginatis, scrobiculatis.

NETHERLANDS NEW GUINEA: 9 km. NE. of Lake Habbema, *Brass 10621* (TYPE), Oct. 1938, alt. 2800 m., mossy forest, climbing over a stump on forest path; Bele River, 18 km. NE. of Lake Habbema, *Brass 11046,* Nov. 1938, alt. 2200 m., small climber in forest clearings (flowers yellow; fruit red).

This species is easily recognized by the deeply cut leaves, and the scrobiculate seeds, a character obvious even in the dried fruit.

Melothria belensis sp. nov. § EUMELOTHRIA

Monoica scandens; caulibus gracilibus, sulcatis, scabridulis, breviter et sparsim pilosulis vel puberulis; foliorum petiolo 1 cm. longo, gracili, densiuscule adpresse pubescente; lamina tenuiter chartacea, 4–10 cm. longa, 3.5–5 cm. lata, integra, cordata vel subhastata, apice acuminata vel interdum acuta, margine denticulata (dentibus inter se 4–15 mm. remotis) in sicco supra olivacea, scaberrima, subtus paullo pallidiore, praecipue venis scabridula vel fere levi, sinu basilari latissimo concavo, 3–6 mm. profundo vel fere nullo; cirrhis filiformibus basin versus sparsim et breviter pilosulis; ♂ racemis simplicibus vel interdum ramosis, 7–23-floris, pedunculo communi 1.8–3 cm. longo, puberulo, pedicellis 7–9 mm. longis, pubescentibus, inter se 2–4 mm. distantibus; calyce campanulato, 4–5 mm. longo et lato, dentibus triangularibus, acutis, 1 mm. longis, basi paullo latioribus, ± nervatis; corolla 5–6 mm. longa, utrinque minute pubescente vel puberula, 5-lobata, lobis late ovatis; staminum filamentis 3 mm. longis, antheris subquadratis, bilocularibus, 2 mm. longis, vix 2 mm. latis, loculis rectis, connectivo latiusculo, obtuso, ± ciliato; ♀ floribus solitariis, pedunculatis, pedunculo usque 4 cm. longo, puberulo, filiformi; calyce et corolla quam mare paullo majoribus; staminodiis 3; ovario oblongo, 5 mm. longo, 2 mm. diametro, basi angustato, apice breviter rostrato; stylo 5 mm. longo, basi disco cupulari (non annulariformi); stigmatibus 3, 3 mm. longo, apice subtriangularibus; fructibus tantum immaturis visis.

NETHERLANDS NEW GUINEA: Bele River, 18 km. NE. of Lake Habbema, *Brass 11082* (TYPE), Nov. 1938, alt. 2200 m., common in open grassy second growth forest (flowers yellow).

Melothria idenburgensis sp. nov. § EUMELOTHRIA

Monoica, scandens; caulibus glabris vel novellis consperse puberulis, sulcatis, nodis ± puberulis; foliorum petiolo 1–2.5 cm. longo, ± puberulo; lamina submembranacea, ovata, sagittata vel subhastata, 5–11 cm. longa, 2–6 cm. lata, apice acuta vel leviter acuminata, lobis basilaribus obtusis, margine remote et minute denticulata, supra scabriuscula, subtus levi, utrinque costa et nervis sparsim et consperse pilosulis, sinu basilari 1–2 cm. profundo, plerumque late triangulari; cirrhis simplicibus glabris, tenuibus; ♂ floribus solitariis vel geminatis, 5–10 mm. pedicellatis; calyce campanulato, 2 mm. longo, lobis subulatis, 1 mm. longis; corolla fauce pilosula, lobis extus ± puberulis, ovatis, acutis, 3 mm. longis; staminum filamentis brevibus; antheris subquadratis, loculis rectis, margine dorsali minute ciliatis, connectivo latiusculo, apice brevissime producto; ♀ floribus solitariis vel interdum geminatis, pedunculo ± 1 cm. longo; ovario fusiformi; fructu ovoideo, apice breviter acuminato, circiter 1.7 cm. longo, 1 cm. diametro, in sicco longitudinaliter et irregulariter rugoso; seminibus oblongis basi paullo angustatis, 5 mm. longis, incl. 1 mm. alato-appendiculatis, 2 mm. latis.

NETHERLANDS NEW GUINEA: Bernhard Camp, Idenburg River, *Brass 14100* (TYPE), April 1939, alt. 50 m., rain forest, occasional in fringe vegetation along streams (flowers white; fruit unripe).

A species showing some similarity to the description of *M. Thwaitesii* Schweinf. (*M. zeylanica* C. B. Clarke) but fruits not angled-costate.

Melothria aff. **leucocarpa** (Bl.) Cogn. in DC. Monog. Phan. 3: 601. 1881; Cogn. Pflanzenr. 66(IV. 275. I): 101. 1916.

Bryonia leucocarpa Blume, Bijdr. 924. 1826.

BRITISH NEW GUINEA: Lower Fly River, east bank opposite Sturt Island, *Brass 8104,* Oct. 1936, in low second growths on riverbank (flowers greenish; fruit soft, red).

This collection looks very much like the scanty material we have at hand of *Melothria leucocarpa* (Bl.) Cogn., but the fruits are red, not white.

Trichosanthes Linnaeus

Trichosanthes Pulleana Cogniaux ex Harms, Bot. Jahrb. 60: 160. 1925, vel aff.

Trichosanthes papuana Pulle, Nova Guin. Bot. 8(2): 406. 1910, non F. M. Bailey (1900).

BRITISH NEW GUINEA: Central Division, Mafulu, *Brass 5347,* Oct. 1933, alt. 1250 m., climbing in low regrowth forest (numerous pendent large red fruits about 20 cm. long, 8 cm. diameter, yellow inside, seeds black).

The above cited collection (in fruit only) agrees with the original description of this species in the general shape of the leaf and the glands near the insertion of the petiole. The petiole is 4–12 cm. long, the upper surface of the leaf is scabrous; the fruit is somewhat oblong-obovoid with a smooth surface; the seeds are a little more than 1 cm. long, 5 mm. wide, flattened, slightly narrowed at one end and shallowly emarginate at the other.

Trichosanthes mafuluensis sp. nov.

Caules graciles angulato-sulcati, ± puberuli demum glabrati; foliis membranaceis, supra parce puberulis et scabriusculis, subtus molliter puberulis, interdum hic illic glandulis parvis conspersis; petiolo 3–5 cm. longo, pubescente; lamina ovata, profunde cordata, 9–20 cm. longa, 6–14.5 cm. lata, apice breviter acuminata, margine ± remote serrato-denticulata, sinu basali 2–5 cm. profundo, 1.5–2 cm. lato, truncato-obtuso, medio ob lobos basiles paullo angustato; cirrhis sulcatis ± pubescentibus, 2–3-fidis; racemis ♂ 4–8 cm. pedunculatis, plurifloris (± 15), pubescentibus et ± minute glandulosis; bracteis sub pedicellis lineari-lanceolatis, circiter 8 mm. longis, integris, pedicellis gracilibus sub anthesi erectis, ad articulationem ± 5–7 mm. longis; calycis tubo anguste infundibulari ± 2 cm. longo, puberulo, lobis 4 mm. longis, lanceolatis, integris, acutis; corollae lobis oblongis, 7–8 mm. longis, obtusiusculis, granulo-puberulis, ciliis fimbriatis; filamentis brevissimis, glabris; antherarum capitulo 3 mm. longo, faucem attingente non exserto; floribus ♀ non visis.

BRITISH NEW GUINEA: Central Division, Mafulu, *Brass 5257* (TYPE), Oct. 1933, alt. 1250 m., climbing in forest regrowth brush (corolla white).

Trichosanthes dieniensis sp. nov.

Caules gracillimi, novelli puberuli demum glabrati, angulato-sulcati; foliis membranaceis, supra scabriusculis, subtus glabris; petiolo 2–4.5 cm. longo, glabro; lamina ovata, cordata, 4.5–12 cm. longa, 2.5–8 cm. lata, apice breviter acuminata, margine inconspicue et remote glanduloso-denticulata, sinu basali 0.7–2 cm. profundo, 1.3–3 cm. lato, obtuso vel subrotundato; cirrhis gracilibus bifidis, glabris; racemis ♂ 3–5.5 cm. pedunculatis, elongatis (9 cm. longis) ± 7-floris; bracteis sub pedicellis obovato-oblongis, 3–5-lobatis vel incisis; pedicellis erectis, ad articulationem vix 3 mm. longis; calycis tubo anguste infundibulari, 4.5–7.5 cm. longo, glabro, lobis circiter 1 cm. longis, lineari-subulatis, basim versus 1–3-denticulatis; corollae lobis ± 1 cm. longis, ramoso-fimbriatis, fimbriis circiter 2 cm. longis, utrinque puberulis, fauce ± puberulo-pilosulo; filamentis brevibus gracilibus; antherarum capitulo 6 mm. longo, novello glabro, sub anthesi puberulo; floribus ♀ non visis.

BRITISH NEW GUINEA: Ononge Road, Dieni, *Brass 3898* (TYPE), April 1933, alt. 500 m., massed on a dead tree trunk (flowers white).

CAMPANULACEAE

Pratia Archboldiana sp. nov.

Planta in sicco habitu rosulata, acaulescens vel caulibus brevissimis (2–4 mm. longis); foliis approximatis petiolatis, petiolo 3–7 mm. longo, piloso vel glabrato, lamina ovato-rotundata vel subrotundata, 0.5–1.5 cm. longa lataque, membranacea vel chartacea, margine undulata vel minute dentata, supra consperse pilosa, subtus glabra; floribus solitariis, axillaribus, pedunculatis, pedunculo 2–4 mm. longo, pilosulo; ovario piloso, circiter 3 mm. diametro; calycis lobis lineari-lanceolatis, 3 mm. longis, pilosulis; corollae tubo 2.5 mm. longo, lobis 3 mm. longis, lanceolato-linearibus; antheris in tubum connatis, anticis breviter aristulatis; baccis globosis, ± 3 mm. diametro, calyce et interdum corolla marcescente coronatis; seminibus brunneis, nitidis, levibus, obovoideis, circiter 0.8 mm. longis.

BRITISH NEW GUINEA: Murray Pass, Wharton Range, *Brass 4943* (TYPE), Aug. 1933, alt. 2840 m., under a rock wall on grassy bank of a creek, very rare (flowers red).

This specimen consists of a half dozen small plants, the largest of which is between 3 and 4 cm. diameter. Most of them are in fruit with the withered corolla still adhering to the apex, one flower-bud was found, and in this we found the anthers united in an oblique ring around the style, which character gave us the clue to the family. The species may possibly be related to *P. irrigua* (R. Br.) Benth., a native of Tasmania.

Lobelia conferta sp. nov.

Planta prostrata, parva, carnosula, glabra; ramis brevibus; foliis alternis, integris, oblongo-lanceolatis, 4–5 mm. longis, 1–2 mm. latis, apice rotundatis vel obtusis, sessilibus, basi decurrentibus, confertis; floribus in axillis foliorum superiorum solitariis; pedicellis 3–5 mm. longis, ebracteolatis; hypanthio brevi, calycis lobis lineari-lanceolatis, 1–1.4 mm. longis, acutiusculis; corollae tubo 2 mm. longo, lobis 2 superioribus vix 2 mm. longis, inferioribus 3 vix 2.5 mm. longis, lanceolatis; filamentis in parte inferioribus liberis, superiore connatis, glabris; antherarum tubo 1.4 mm. longo, antheris 2 inferioribus apice sparsim et minute barbatis et appendiculato minuto instructis; capsula non visa.

BRITISH NEW GUINEA: Mt. Albert Edward, southwest slope, *Brass 4417* (TYPE), July 1933, alt. 3680 m., on wet grassland (prostrate plant, very rare; leaves smooth, shining; flowers very pale purple).

This species, if it is a *Lobelia,* belongs to section HEMIPOGON, but we are unable to suggest any near relationships. It may possibly belong to *Pratia,* but without fruit it is difficult to say.

GOODENIACEAE

Leschenaultia filiformis R. Br. Prodr. 581. 1810; F. v. Muell. Fragm. Phytogr. Austr. 6: 9. *t. 48.* 1868; F. M. Bailey, Queensl. Fl. 3: 892. 1900; Krause, Pflanzenr. 54(IV. 277): 108. 1912.

BRITISH NEW GUINEA: Tarara, Wassi Kussa River, *Brass 8387,* Dec. 1936, savannah forest (common herb on acid gray soil; flowers pale blue). Queensland and northern Australia.

INDEX TO GENERA AND FAMILIES CONTAINED IN PLANTAE PAPUANAE ARCHBOLDIANAE, I–XVIII, AND FOUR SMALL PAPERS WITH SOME NEW GUINEAN SPECIES

In each instance the number preceding the colon represents the volume number of the Journal of the Arnold Arboretum and the one following the colon is the page on which the name first appears.

ARNOLD ARBORETUM,
HARVARD UNIVERSITY.

ORIGIN OF THE ANGIOSPERMS: NEED FOR A BROADENED OUTLOOK [1]

I. W. BAILEY

WE ARE HEARING more and more of late, in various fields of human endeavor, regarding the significance of a "New Look." Much is being spoken and written regarding the necessity for a "New Systematics" and for a "New Morphology." All of us will, I believe, readily admit the need for new methodologies and for new points of view in the development of botanical science. However, if real progress is to be made, it is essential to analyze trends of putative originality to determine whether they are soundly conceived and of productive potentialities. This is particularly true in dealing with such complex and difficult problems as to how, when, and where the angiosperms originated, how they became so highly diversified and so widely distributed, and how they should be classified in a system of truly natural relationships.

The "New Morphology" commonly involves the basic assumption — to quote a recent exponent [2] — that a comparison of the organs of angiosperms and of lower plants only makes sense if the former are abandoned as a starting point and if we allow ourselves to be guided only by paleobotanical evidence in the direction of evolutionary development. Is the sweeping generalization that we should be guided in the study of angiospermic phylogeny and classification solely by paleobotanical evidence a sound one? When shorn of its psilophytalian halo, the "New Morphology" frequently consists in practice of highly speculative attempts to homologize specific parts — even teratological ones — of a few selected angiosperms with those of ancient land plants. In so doing, scant attention is given to long stretches of geological time during which profound morphological changes are likely to have occurred. Furthermore, the fact that many salient trends of morphological specialization are adequately preserved in the huge assemblage of surviving angiosperms is overlooked or ignored. This procedure of the "New Morphology" is not new, since it is essentially similar to that utilized in the past, for example, in interpreting the Magnoliaceae in terms of the Bennettitales and the Amentiferae in homology with the Gnetales.

It is not my intention to belittle the great contributions that the study of the Psilophytales and of other ancient land plants have made to a clearer understanding of the stem and of its appendages, but rather to

[1] Invitation paper read before the Paleobotanical Section of the Botanical Society of America, Sept. 13, 1948.

[2] LAM, H. J. Classification and the New Morphology. Acta Biotheoretica 8: 109. 1948.

emphasize the necessity for much broadened outlooks in discussion of the origin and the relationships of the angiosperms. We need "new looks," but they should be comprehensive, rather than narrow and excessively speculative ones. There are as grave dangers in indiscriminately interpreting selected structures of living angiosperms solely in terms of ancient Land Plants as there formerly were in studying fossil plants with excessive dependence upon the classical concept of the stem and leaf.

For example, recent attempts to establish the Sarcopodaceae as a new family of gymnosperms, and to utilize it as support of a stachyosporous line of angiosperms provide cogent evidence of inherent dangers in the methodologies of the "New Morphology." The authors [3] of the new family have been forced to admit that *Sarcopus aberrans* is a species of the santalaceous genus *Exocarpus* and to change the name of the family to Exocarpaceae. If the Exocarpaceae are to be removed from the Santalaceae and placed in closer relationship to the gymnosperms such a transfer should be based, not solely upon superficial examinations of the flower of a single species, but upon comprehensive cytological, embryological, anatomical and general morphological studies of *Exocarpus* in comparison with other genera of the Santalaceae and of other families of the Olacales. In addition, phylogenetic conclusions should be in harmony with salient trends of morphological specialization in the angiosperms as a whole. In the case of *Exocarpus,* even an examination of the pollen and the xylem afford pertinent evidence in refutation of such premature phylogenetic generalizations. Similar objections apply in the use of selected parts of such genera as *Casuarina, Salix, Ricinus, Portulaca, Calothamnus,* etc. when divorced from their context in the dicotyledons as a whole.

It should be emphasized in these connections that diversified investigations of surviving angiosperms provide the only available means at present of morphologically characterizing this great group of the vascular plants, and for recognizing and of accurately identifying ancestral forms when found. Each botanical discipline, Taxonomy, Paleobotany, Phytogeography, Cytology, Embryology, Anatomy, Developmental Morphology, Genetics, etc., has important contributions to make in the ultimate solution of various aspects of the great central mysteries, but the limitations of each field of research in the solution of specific problems of phylogeny and relationship should be clearly visualized and freely admitted.

The Land Plants from the Psilophytales onward are aptly designated by some the Tracheophyta, since they are characterized throughout by the formation of tracheary tissue. The constituent cells of this tissue obviously perform two fundamentally important functions, 1) the conduction of water and solutes from the absorbing to the transpiring parts of the plant, and 2) the provision of mechanical strength in parts where they occur. The former function is facilitated by peculiarities in the

[3] Gagnepain, F. & Ed. Boureau. Une nouvelle famille de Gymnospermes: les Sarcopodacées. Bull. Soc. Bot. France. **93**: 313–320. 1946.

——— & ———. Nouvelles considérations systématiques à propos du *Sarcopus aberrans* Gagnepain. Bull. Soc. Bot. France. **94**: 182–185. 1947.

form of the cells and by the loss of their cytoplasmic contents at maturity, the latter function by the remarkable physical structure and the chemical composition of their cell walls. The major trends of phylogenetic modification of the tracheary tissue of the Land Plants are associated with changes of equilibrium between these two fundamentally important physiological functions. In the case of most dicotyledons, there is a striking division of labor within the vascular tissues, certain linear series of tracheids becoming modified to form vessel members, whereas others assume an increasingly fiberlike form and may at times take on a storage function in addition to an exaggerated mechanical one. These salient trends of evolutionary specialization of the tracheary tissues are largely unidirectional and irreversible, and are fully and adequately preserved in surviving angiosperms. There fortunately are no serious missing links in these phylogenetic chains and it is not essential, for example, to search geological strata for vesselless pro-angiosperms since ancestral types of primitive xylem occur in living representatives of both the dicotyledons and the monocotyledons.

Before discussing the significance and the limitations of these phylogenies in the study of plant relationships, it is essential to comment briefly upon the character of the evidence upon which they are based. Large collections of materials of woody dicotyledons have gradually been accumulated at Yale, Oxford, Harvard and many other institutions. These collections when supplemented by herbarium specimens have afforded material for the study of many genera of *all* of the principal families of the angiosperms. In addition, sufficient developmental investigations have been made so that it now is possible to visualize salient trends of specialization of the xylem in terms of a phylogeny of successively modified ontogenies. In other words, the evolutionary picture has emerged, and has become increasingly distinct, as larger and larger volumes of data have been analyzed from the angiosperms and the gymnosperms as a whole. It has crystallized solely from the study of the vascular tissues themselves, and entirely independently of assumptions regarding the putative primitiveness of specific representatives of the dicotyledons or monocotyledons. Furthermore, these particular trends of evolutionary specialization cannot be read in a reverse direction, since no one is likely to argue, in the light of our present knowledge of the Tracheophyta, that tracheids originated from the dissociated members of vessels.

What then are some of the more important contributions that a knowledge of these unusually extensive and reliable vascular phylogenies can make in discussions of the origin and the relationships of the angiosperms? Obviously it would be possible to arrange the angiosperms according to a system of increasing specialization of the vascular tissues, but such a system of classification would prove to be as unsatisfactory as others that have been based primarily upon the study of restricted parts of plants. If a truly natural classification is to be attained, it must be based upon the analysis and the harmonization of evidence from *all* organs, tissues and parts. This is due to the fact that the morphological specializations of different structures commonly are not synchronized. The flower or one of its parts may be changing rapidly at the time when the vascular tissues exhibit morphological stability or *vice versa*. In studying plant relationships, evidence from the vascular tissues is in general more significant in negations than in affirmative conclusions. This is due to the frequent occurrence of parallel trends of evolution in the various organs and tissues of the Land Plants. Thus, although it is impossible to derive truly primitive forms of xylem from highly specialized ones, close structural similarities may be due to parallel or convergent development rather than necessarily to close genetic relationship.

In illustration of these basic considerations, let us turn to a specific discussion of the present revival of assumptions regarding the possibility of deriving the angiosperms from the Coniferales, Gnetales, Bennettitales or Williamsoniales.

The Lycopsida, Sphenopsida, and most of the Pteropsida are characterized by having essentially similar ontogenetic sequences in the development of their tracheary tissue. In a fully elongated axis, as seen in radial longitudinal sections, the earlier formed tracheary cells have loosely coiled helical thickenings, although they may be preceded at times by tracheids with annular thickenings. These cells are succeeded by tracheary cells having compactly coiled helical thickenings of very low pitch, and these in turn by elements exhibiting transitions between scalariformly reticulate and scalariformly bordered pitted walls. In certain groups of Land Plants, e.g., many Lycopsida, Sphenopsida, and ferns, the subsequently formed tracheids have dominantly scalariform pitting, whereas in other groups, e.g., many seed ferns, Cordaitales and Cycadales, there are subsequent transitions between scalariform bordered pits and approximately circular ones of varying number and distributional patterns.

In the Ginkgoales, Coniferales, and Gnetales, this *normal* ontogenetic sequence, characteristic of a vast majority of the Land Plants, is profoundly modified. True scalariform bordered pitting is eliminated and circular bordered pits are formed in the earlier stages of the ontogenetic sequence, even in the first-formed tracheary cells with loosely coiled helical thickenings. This modification of the primary vascular tissues is firmly established in the Coniferales and Gnetales and is indicative of an ancient trend of drastic anatomical specialization. In the latter order, vessels developed from tracheids having circular bordered pits. On the contrary, in the stems of angiosperms, which have retained a primitive type of vesselless xylem, the ontogenetic sequence is of the normal type, and vessels have developed in both dicotyledons and monocotyledons, as in *Pteridium*, by the modification of tracheids with scalariform bordered pitting. Such fundamentally significant anatomical differences form an insuperable barrier to a derivation of the angiosperms from the Coniferales or the Gnetales. Thus, the presence of vessels in both the Gnetales and the angiosperms, which has so frequently been cited as evidence of relationship, actually negates such relationship. There are similarities between the end products of tracheary specialization in *Gnetum* and certain of the dicotyledons, but they have arisen by entirely different developmental changes.

What then are the possibilities of deriving the angiosperms from the Bennettitales or Williamsoniales? Here the evidence from the vascular tissues alone is inconclusive. Although similar transitions between tracheids with scalariform and circular bordered pitting occur in the secondary xylem of vesselless dicotyledons and of certain cycadeoideas, the similarity is not indicative necessarily of close relationship, since it may be due to parallel evolutionary development. Furthermore, the possibility of deriving the angiosperms from the Bennettitales or Williamsoniales, as also from the Corystospermaceae or Caytoniales, appears to be negated by evidence from other parts of the plants, particularly the reproductive ones.

It is essential at this point to digress briefly for comment upon a recent attempt to derive certain ranalian families from the Bennettitales, and to arrange them in a linear evolutionary series.[4] This effort is based largely upon the reported discovery of a new type of tracheary element in the Magnolicaeae and supposedly related families, and affords a pertinent illustration of inherent dangers in a narrow anatomical look. The cells in question are of a well known tracheary type which was fully discussed at meetings of the Committee on Nomenclature of the International Association of Wood Anatomists. They are new only through changes in terminology.[5] A broad anatomical look at the vascular plants as a whole reveals the fact that tracheids with a similar configuration of bordered pitting occur, not only in the Bennettitales but also in other gymnosperms, and in many orders of the dicotyledons as well as in certain families of the Ranales. Furthermore, the true significance of the configurations cannot be fully understood without reference to accumulated data regarding the physical structure of the walls of tracheary cells. It should be emphasized in passing that it is such sweeping generalizations, based upon limited and inadequate data, that have raised uncertainties and doubts in the minds of many botanists regarding the value and the reliability of anatomical evidence in the study of phylogeny.

Up to this point, I may have given the impression of an excessively pessimistic look at the problem of the origin of the angiosperms, in which the only certainties are negations and in which potential ancestors of the angiosperms are successively eliminated. However, if real progress is to be made in the solution of the great mystery, it is essential periodically to differentiate the *wheat* of reliable cumulative evidence from the *chaff* of excessive speculation. As a matter of fact, I am quite optimistic regarding advances that can be made in the near future, provided investigators in various botanical disciplines cooperate more actively in providing essential data for a well coordinated attack along a broad morphological front.

[4] LEMESLE, ROBERT. Les divers types de fibres a ponctuations aréolées chez les dicotylédones apocarpiques les plus archaiques et leur rôle dans la phylogénie. Ann. Sci. Nat. Bot. et Biol. Végétale 7: 19–40. 1946.

[5] BAILEY, I. W. The problem of differentiating and classifying tracheids, fiber-tracheids, and libriform wood fibers. Tropical Woods 45: 18–23. 1936.

Our knowledge of the vascular tissues of Land Plants has advanced to a position where it can aid materially in planning such a campaign, in avoiding serious pitfalls, and in restraining fruitless sorties in haphazard directions. Thus, the tracheary phylogenies, that are so clearly and fully preserved in surviving angiosperms, provide us with significant clues regarding the general habit of growth of ancestral dicotyledons. This is due to the fact that, in the various dicotyledonous families, herbs, vines, lianas, succulents, aquatics and extreme xerophytes exhibit a high degree of specialization of the vascular tissues, whereas vesselless xylem and the less modified forms of vessel-bearing xylem occur in large woody perennials, viz. shrubs or trees. Such facts negate the possibility not only of deriving structurally primitive types of arboreal dicotyledons from herbaceous ancestors, but also of deriving the monocotyledons from herbaceous dicotyledons, e.g., the Ranunculaceae. If the angiosperms are monophyletic, the monocotyledons and the dicotyledons must have diverged at an early date, since vessels have developed independently in the two groups.

Of the nearly 100 species of living dicotyledons, which have a primitive vesselless type of both primary and secondary xylem, all occur within the order Ranales, as broadly conceived by Engler and Prantl. Furthermore, an unusually complete record of the origin of vessels and of salient trends of specialization of the xylem is preserved within this order. That these occurrences are not purely fortuitous, and may have significant implications, is suggested by accumulating data regarding the pollen morphology of seed-bearing plants. Most of the families and orders of the dicotyledons are characterized by having tricolpate pollen or types of pollen that appear to have been derived phylogenetically from such grains. Tricolpate pollen is not known to occur in any other group of seed-bearing plants and therefore is indicative of a highly distinctive trend of specialization in pollen morphology. Monocolpate pollen, which is characteristic of so many seed ferns, Bennettitales, Cycadales and Ginkgoales, is of common occurrence in monocotyledons, but is largely confined in the dicotyledons to a number of the more woody families of the Ranales. In other words, insofar as I have been able to determine, the Ranales are the only order of the angiosperms in which both monocolpate and tricolpate pollen occur.

However, it was the remarkable carpels and stamens of a previously undescribed family of the Ranales, viz. the Degeneriaceae, which induced Dr. A. C. Smith and myself to initiate a series of comprehensive coordinated investigations of ranalian families, in which others are now actively cooperating. I have already reported, earlier in these meetings, upon the primitive, unsealed, conduplicate ranalian carpel and concerning its salient trends of specialization in different ranalian families. There are equally significant transitions in the Ranales between broad microsporophylls and stamens of a more conventional form. These investigations at least justify a "New Look" at the flower of the angiosperms as a whole. Comprehensive studies of the various orders and families of living angiosperms should eventually provide adequate accumulations of evidence for determining whether the putative lines of stachyosporous dicotyledons actually are such or have been derived from a phyllosporous one such as characterizes the Ranales. It should be noted in this connection that detailed and extensive investigations of other parts of living angiosperms, viz. the leaf, fruit, seed, embryo-sac, seedling, etc. are essential in synthesizing a picture of a primitive angiosperm or angiosperms to serve as a guide to paleobotanists in their search for pro-angiosperms.

Allow me to conclude my remarks with a few brief comments upon those parts of the Earth's surface which appear to me to offer the most promising fields for future explorations. It is the living floras of northern Australia, New Guinea, New Caledonia, and Fiji and adjacent regions northward to southern China that have yielded and are continuing to yield the richest crop of missing links in the chains of angiospermic phylogenies. For example, of the nine known genera of primitive vesselless dicotyledons, five occur on New Caledonia and three are endemic on that island. Only a beginning has been made in the exploration of many of these floras and a continuous flow of significant new plants may be anticipated for some time to come as more and more complete collections are assembled. Furthermore, these living floras of southern latitudes have already yielded more structurally primitive dicotyledons than have all of the known fossil floras of northern latitudes. Therefore, I am inclined to question the assumption of a northern origin for the angiosperms at least until the Tertiary and Mesozoic rocks of these southern lands have been adequately explored. It should be emphasized, in addition, that comparatively little is known regarding the seed-ferns of the Glossopteris flora. Here again is a field in need of detailed exploration.

In conclusion, I may be permitted, as one who is approaching the terminal stages of his career, to offer a word of friendly advice to those of the younger generation of taxonomists, paleobotanists and morphologists who may become interested in the origin of the angiosperms: Look West young man toward the remnants of Gondwana Land!

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VALIDATING BOTANICAL NAMES BY REFERENCE TO PRE-1753 LITERATURE

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In the past, botanical names were considered validly published when they were accompanied by a reference to previously and effectively published literature. In many cases such literature was published before 1753. Furtado (Gard. Bull. Str. Settlm. **10**: 170–71. 1939) has suggested that this method is wrong, and that such publication does not validate the names. This view appears to be contradictory to the existing practice and it seems necessary to discuss the subject with a view to clarifying this point.

Furtado's views summarised by himself are as follows (*l. c.*):—

"iv. No *Botanical Name* can be admitted as *valid* unless (*1*) it satisfies the conditions laid down as essential for the word or words constituting the name itself, and (*2*) it is accompanied by either (*a*) a valid description, or (*b*) a valid reference (*see* below v) . . .

"v. A reference is *valid* when it refers to a description published both in valid literature, and in accordance with the rules laid down as essential for the words constituting the description.

"vi. Consequently all references to invalid literature, even when they include plates, should be *inadmissible* under the Rules.

"vii. Several Names (formerly ignored but recently resurrected and made the bases of many nomenclatural changes) whose sole claim for validity is that they were referred to a plate or description in invalid literature should be *invalid*: e.g.

"(*1*) In O. Stickman's Dissertation on Rumphius's *Herbarium Amboinense* eds. 1754 and 1759, accepted as valid by Dr. E. D. Merrill (*Interpr.* Rumph. *Herb. Amboin.* 1917).

"(*2*) In Burmann's *Index* to Rumphius's *Herbarium Amboinense* eds. 1755 and 1769, accepted as valid by Dr. Merrill (*cf. op. cit.*).

"(*3*) In Roxburgh's *Hortus Bengalensis* (1814), accepted as valid by the late Dr. C. B. Robinson (*Philipp. Journ. Sci.* VII, 1912, pp. 411–419) because Roxburgh had referred under the names to plates in Rumphius's *Herb. Amb.*

"(*4*) In Moon's *Catalogue of Indigenous and Exotic Plants of Ceylon* (1824) accepted as valid by Mr. A. H. G. Alston (*Ann. Roy. Bot. Gard. Peradeniya* XI, 1929 pp. 203–205) because they contain references to the plates or descriptions either in Rheede's *Hortus Malabaricus* or in Rumphius's *Herbarium Amboinense.*

"(*5*) Several generic and specific names listed in nomenclators and *Index Kewensis* with references to invalid descriptions, whether or not published in valid publications."

It should be noted that Furtado has introduced a few unfamiliar terms in the above summary such as "valid and invalid literature," "invalid description," etc. By "invalid literature" Furtado means all botanical literature published before 1753. This is evident from his statement (*l. c.* 165), "*Epipogium* and *Pterocarpus* are said to have been validated by a reference to pre-1753 literature; but Art. 20 invalidates this literature." It should be pointed out that Art. 20 reads as follows: "Legitimate botanical nomenclature begins for the different groups of plants at the following dates (a) *Phanerogramae* and *Pteridophyta,* 1753 (Linnaeus, *Species Plantarum* ed. 1)." This article essentially refers to botanical nomenclature and *not* to botanical literature. The suggestion to describe all botanical literature published before 1753 as "invalid" appears to be due to a misinterpretation of Art. 20. Botanical literature containing descriptions or plates of plants is effectively published when it is printed and distributed to botanical institutions. So far as the descriptions and plates are concerned they should be regarded as validly published irrespective of the year 1753. But the validity of binomial names used in these publications will be considered only from 1753.

Unless this interpretation is accepted we have to reject a large number of names from Linnaeus's Species Plantarum. For example, the name *Plumbago zeylanica* L., is published in Species Plantarum 151 (1753), with references to Hortus Cliffortianus 53 (1737), Hortus Upsaliensis 43 (1748), Flora Zeylanica 73 (1747), etc. The only description available in the Species Plantarum is "foliis petiolatis," which is an exact repetition of what is available in Hortus Cliffortianus. It is evident that the two words constituting the description are indeed insufficient and an adequate idea of the plant can only be obtained by reference to other effectively published descriptions in earlier literature. In a large measure, therefore, Linnaeus validated the name *Plumbago zeylanica* L. by reference to pre-1753 literature. Similar examples are also available from other names like *Jasminum officinale* L., *Justicia echioides* L., *Nyctanthes Sambac* L. and *Salvia pinnata* L. In the case of *Plumbago zeylanica* L., the repetition of the two words from Hortus Cliffortianus conveyed no additional information, as the reference itself was enough. What Linnaeus did, in this case, was to publish a binomial and validate it by reference to a previously and effectively published description in pre-1753 literature. This implication should be clearly understood.

In the above cases Linnaeus had actual specimens as well as previously published descriptions of these plants. There are, however, quite a number of cases where binomials were published and validated by Linnaeus solely on the basis of descriptions or plates in pre-1753 literature. Svenson's interesting paper on the descriptive method of Linnaeus (Rhodora 47: 278. 1945) shows that a large number of species described in his Species Plantarum were based on "Figures such as those of Plukenet and of Cornut's *Canadensium Plantarum Historia* 1635, and Sloane's *History of Jamaica,* of which Linnaeus had seen no herbarium specimens." A random examination of one hundred specific names from Linnaeus's Species Plantarum shows that about fifteen of these were based solely on such descriptions or plates in pre-1753 literature, and no herbarium specimens of these species are to be found in the Linnaean Herbarium. This very rough estimate may give some idea of the total number of species described by Linnaeus on this principle. The name *Cyclamen indicum* L. may serve as an example in this connection. The name was validated in the Species Plantarum by a reference to Flora Zeylanica 401, 1747, which was based on two drawings by Hermann (Zeyl. 50–57). It is almost certain that Linnaeus did not see any specimen of this species and no specimen is available in the Linnaean Herbarium. It may be pointed out, in passing, that as a result, the correct identity of this plant is still very obscure.* Even if some of these names are still, and probably will always remain obscure, because they were based on such pre-1753 literature, that is no reason for rejecting this type of publication. The existing rules of nomenclature do not prevent others from following the practice initiated by Linnaeus. The first author on East Asiatic Botany who followed this principle and validated a binomial by reference to pre-1753 literature appears to have been Prain. He published the name *Sindora galedupa* Prain (Jour. As. Soc. Beng. 66: 483. 1897) by reference to Rhumphius's Herb. Amboinense (2: 59, tab. 13. 1750). Furtado appears to have missed Prain's name in his list of Robinson, Merrill and Alston (*l. c.*).

From a consideration of these cases it will be understood that this practice of validating names by reference to pre-1753 literature is indeed an old one, starting in fact in 1753 with Species Plantarum itself. These names cannot be regarded as invalid, as argued by Furtado. The fallacy in Furtado's discussions lies in his assumption of all pre-1753 literature as "invalid literature." It appears to me that he has also failed to interpret correctly Articles 20, 36 and 37 of the rules of botanical nomenclature. Further, he has unfortunately confused the two phrases "effective publication" and "valid publication," and in all probability considered them as synonymous. It is admitted that "valid publication" of botanical names started from 1753, but the "effective publication" of botanical literature started much earlier, perhaps with the art of printing. A proper and logical interpretation of the rules would only lead us to accept these works (botanical literature) as effectively published. It is unfortunate that by misinterpreting the rules, Furtado has coined such terms as "invalid literature" and "invalid description." † In my opinion, this practice of validating new binomials by reference to pre-1753 literature is perfectly legitimate and in accordance with the existing rules. Such names are therefore to be regarded as valid names.

This subject was discussed at the Symposium of botanical nomenclature held at Utrecht (June, 1948) and there was general agreement to the view expressed by the writer in this paper.

* In Pflanzenreich — Primulaceae 4, 237: 248. 1905, Pax and Knuth wrongly considered *Cyclamen indicum* L. as a synonym of *Cyclamen persicum* Mill. Bailey, apparently following Pax and Knuth, has adopted *Cyclamen indicum* L. as the valid name of the commonly cultivated *Cyclamen* on grounds of priority (Hortus Second 227, 1941). From the original description of *Cyclamen indicum* L. it is evident that the plant is very different from *Cyclamen persicum* Mill., and the difference is so pronounced that *Cyclamen indicum* L. may ultimately prove not to be a *Cyclamen* at all.

† In Gard. Bull. Str. Settlm. 11: 1. 1939, Furtado has introduced such other unfamiliar terms as "priorable" and "impriorable" names, "typonymous formal homonyms" (*l. c.* 27), etc.!!

A few individual members also suggested that the practice referred to above, although perfectly legitimate, should be discouraged in future. There are two grounds for abandoning this practice, viz. (i) our present conception of a species has greatly changed from that of Linnaeus and other earlier authors. By supplying a binomial and referring to a description in pre-1753 literature, we indirectly admit that our conception of the species is the same as that of these early authors; (ii) the main object of publication is to clarify and amplify existing knowledge. The description of a plant should present a clearer idea of the species than could be had by reference to some of these early works. Furthermore, these works are becoming very rare; hence many herbariums do not have them. It is therefore desirable to give a description to validate new binomials. On these two considerations, I suggest the following recommendation to Art. 36:—

From 1950 onward, botanists are recommended to discontinue the practice of validating new binomials solely by reference to descriptions or plates in pre-1753 literature. This modification shall not affect binomials which are already published and validated by such reference.

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NOTES ON SOME FIJIAN WEEDS AND INTRODUCED PLANTS

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A NUMBER of interesting weeds and introduced plants have been found in Fiji in regions other than the leeward coasts and so were mentioned only briefly in my previous articles on this general subject (Proc. Linn. Soc. **154**: 92–106. 1943; Jour. Arnold Arb. **25**: 397–405. 1944). In the present article notes on some of these plants are given. Some records of weeds common to both the dry and wet zones in Fiji are also given, but no attempt has been made to list all the weeds noticed or collected during various trips outside the dry zones. Some hitherto unpublished records for Fiji are also included. In most such cases the records are based upon specimens which are deposited in the herbarium of either the Royal Botanic Gardens, Kew, the Arnold Arboretum, or the Gray Herbarium.

In the articles mentioned above, published in 1943 and 1944, about 80 records new to Fiji were published; A. C. Smith has also listed new records of weeds and introduced plants in Sargentia **1**: 1–148. 1942, and in Bull. Torrey Bot. Club 70: 533–549. 1943. From these records one might conclude that the number of weeds and introduced plants in Fiji is increasing rapidly, but I do not believe this to be the case. Many of the new records of recent years are from southeastern Viti Levu in the coastal portions of Serua, Namosi, Rewa, Naitasiri, and Tailevu Provinces, especially near the towns of Navua, Nasinu, and Nausori. Although the plants discussed may have been established for years, these districts have not previously been visited by anyone sufficiently interested in the weeds to collect and identify them and to publish the records.

In this paper families are discussed in the order of Bentham & Hooker's Genera Plantarum. Collection numbers found in the text italicized and in parentheses refer to the writer's specimens; these numbers are inserted only when the species has not previously been reported from Fiji. Some of the plants discussed were identified by members of the staff of the Royal Botanic Gardens, Kew, to whom I am grateful. Dr. E. D. Merrill and Dr. A. C. Smith, of the Arnold Arboretum, have identified most of the new records and have assisted me in the preparation of this article.

PORTULACACEAE

Talinum paniculatum (Jacq.) Gaertn.

In Bull. Torrey Bot. Club 70: 537. 1943, Smith states that this species has been recorded, in Fiji, only from the island of Ovalau. During 30 years' collecting in Fiji I have never seen it except in this one locality, near Levuka. Why this weed should have failed to spread, after its introduction into Fiji at least 80 years ago, and why it should have persisted around Levuka are interesting questions.

MALVACEAE

Sida acuta Burm. f.

This species has increased rapidly in recent years in Mba and Ra Provinces, Viti Levu, especially in open hilly country and sometimes to the exclusion of everything else. What would appear to be the earliest collection of this plant in Fiji is *Greenwood 99,* collected at Lautoka, Viti Levu, and identified and deposited at the Royal Botanic Gardens, Kew.

LEGUMINOSAE

Albizzia Lebbeck (L.) Benth.

Vanua Mbalavu; collected by Mrs. J. D. Tothill.

Acacia sp.

Near Varoko, Mba Province, Viti Levu (*1182*). This is apparently a recent arrival in the Colony and, as far as I know, occurs only at this one locality, where efforts are being made to eradicate it before it spreads. It grows to 12 feet high and is armed with strong spines.

Desmanthus virgatus (L.) Willd.

Lautoka, Mba Province, Viti Levu, near sea-level.

Cassia Leschenaultiana DC.

Near Tawarau, road from Lautoka to Rarawai, Mba Province, Viti Levu (*1183*); also near Lautoka, alt. about 180 m. (*1183A*). This species attains a height of 5 feet and appears to prefer well-drained, sloping ground.

Desmodium triflorum (L.) DC.

Near Nasinu, Naitasiri Province, Viti Levu. Also seen in several places in Tailevu Province but not collected there.

Alysicarpus vaginalis (L.) DC.

Near Nasinu, Naitasiri Province, Viti Levu.

Lourea vespertilionis (L.f.) Desv.

Mango and Lakemba Islands. The only previous Fijian record (Greenwood in Proc. Linn. Soc. 154: 96. 1943) is from Penang, Ra Province, Viti Levu. The specimens from Mango and Lakemba were collected by Mrs. J. D. Tothill and identified at Kew.

ROSACEAE

Chrysobalanus Icaco L.

Fairly plentiful in parts of Naitasiri Province, Viti Levu, especially between Nasinu and Nausori; also just above high-water mark in sand, Naitonitoni Beach, Serua Province, Viti Levu. This is one of the plants which A. de Candolle considered as probably being spread by ocean currents (Hemsley, Bot. Voy. Challenger 1 (4): 279. 1885).

CRASSULACEAE

Bryophyllum pinnatum (Lam.) Kurz.

On flat top of large rock near creek, alt. about 1800 ft., western slopes of Mt. Evans Range, Mba [formerly Lautoka] Province, Viti Levu; no specimen collected.

MYRTACEAE

Psidium littorale Raddi.

Near sea-level on flat land between the Navua River and the Serua hills, Serua Province, Viti Levu. Since first recording this species, in Jour. Arnold Arb. 25: 397. 1944, I have heard that it was originally planted in the mentioned locality. However, it was quite naturalized when collected there in 1943.

TURNERACEAE

Turnera ulmifolia L.

Mango Island: *R. J. Lever.* Mr. Lever, Government Entomologist, collected this material in 1945; he informed me that he had also seen this species at Levukà, Ovalau. The only other published Fijian record is from Thakaundrove on Vanua Levu (Sargentia 1: 64. 1942).

CUCURBITACEAE

Momordica Charantia L.

Waste places, Navua, Serua Province, Viti Levu.

Coccinea cordifolia (L.) Cogn.

First recorded from Fiji in Jour. Arnold Arb. 25: 400. 1944, from the Lautoka district. Although it has not yet been noticed elsewhere, this species is starting to spread in the vicinity of Lautoka, Mba Province, Viti Levu. It prefers open sunny places, where it covers shrubs and small trees. It may become a pest in the cane-fields by smothering the cane or causing it to fall, as do *Quamoclit coccinea* (L.) Moench and *Q. pennata* (Desr.) Boj.

CACTACEAE

Opuntia vulgaris Mill.

Seashore near Tavua, Mba Province, Viti Levu. Recorded by Mr. B. E. V. Parham in Agric. Jour. Fiji 18: 56. 1947, where it is stated that all existing stands have been eradicated.

RUBIACEAE

Borreria laevis (Lam.) Griseb.

In damp open grassland at Nandarivatu, Mba [formerly Tholo North] Province, Viti Levu, alt. about 2700 ft.; also at Nasinu, Naitasiri Province, Viti Levu.

COMPOSITAE

Synedrella nodiflora (L.) Gaertn.

Navua, Serua Province, and also near Nasinu, Naitasiri Province, Viti Levu.

Cosmos caudatus H. B. K.

Near Nasinu, Naitasiri Province, Viti Levu.

Tithonia diversifolia (Hemsl.) A. Gray

Waste places, Navua, Serua Province, Viti Levu.

Erigeron pusillus Nutt.

In coral sand in depressions just behind the coast near Saweni, near Lautoka, Mba Province, Viti Levu; on open steep grassy western slopes of Mt. Evans Range, alt. about 2500 ft., Mba [formerly Lautoka] Province, Viti Levu.

Erigeron floribundus (H. B. K.) Sch.-Bip.

In Proc. Linn. Soc. **154**: 99. 1943, I recorded this plant as growing up to 1000 ft. elevation. Actually it occurs up to 2700 ft. and is very common at about 2000 ft. on ground used by the Fijians for crops in the Lautoka section of Mba Province, Viti Levu.

Elephantopus mollis H. B. K.

Nandarivatu, Mba [formerly Tholo North] Province, Viti Levu, alt. about 3000 ft. In open sunny places and also in thick forest wherever a clearing occurs or the track is wide enough to admit a certain amount of sunlight.

Distreptus spicatus (Aubl.) Cass.

Sandy soils near coast, Lautoka, Mba Province, Viti Levu (*1132*).

Spilanthes acmella (L.) Murr.

Along roadside on lower slopes, Serua hills, Serua Province, Viti Levu; waste land near Nausori, Tailevu Province, Viti Levu. The only previous record for Fiji (Sargentia 1: 141. 1942) is from Thakaundrove Province, Vanua Levu.

Taraxacum officinale Weber.

Open grassland, Nandarivatu, Mba [formerly Tholo North] Province, Viti Levu (*1172*).

Struchium sparganophorum (L.) Kuntze.

In low-lying wet places near Nasinu, alt. about 100 ft., Naitasiri Province, Viti Levu (*1107*).

LOBELIACEAE

Isotoma longiflora (L.) Presl.

Damp places in Rewa, Tailevu, and Naitasiri Provinces, Viti Levu; also at Nandarivatu, alt. about 2700 ft., Mba [formerly Tholo North] Province, Viti Levu.

Lobelia zeylanica L.

Damp shady places, near road hills between Navua and Suva in Namosi Province, Viti Levu; shady places, Serua hills, Serua Province, Viti Levu; in wet places, sometimes in standing water, near Nasinu, Naitasiri Province, Viti Levu. When not in flower, this plant somewhat resembles *Cardamine sarmentosa* Forst., which also grows in water and other very wet places and is gathered and eaten as a water-cress in Fiji.

APOCYNACEAE

Allamanda cathartica L.

Open sunny places near Nasinu, alt. about 100 ft., Naitasiri Province, Viti Levu (*1195*). This commonly cultivated garden plant was found covering several acres near Nasinu, where there had evidently been a house at one time. It was covering the clearing and climbing over small trees near by, appearing quite naturalized.

CONVOLVULACEAE

Ipomoea obscura (L.) Ker.

In shady places near sea-level, Lautoka, Mba Province, Viti Levu (*821*). First noticed by me about 1935, this species thus far shows no tendency to spread or to become a bad weed.

Cuscuta australis R. Br.

The Director, Royal Botanic Gardens, Kew, informs me (in litt.) that the record of *C. densiflora* Hook. f. given by Miss Gibbs from Nandarivatu refers to this species.

SOLANACEAE

Browallia americana L.

Near Nasinu, Naitasiri Province, Viti Levu (*1116*). A garden escape, found semi-naturalized about European houses in several places in Naitasiri and Tailevu Provinces. It was also seen as a weed in gardens at Nandarivatu, alt. about 2700 ft., Mba [formerly Tholo North] Province, Viti Levu.

SCROPHULARIACEAE[1]

Scoparia dulcis L.

Near Nasinu, Naitasiri Province, and near Nausori, Tailevu Province, Viti Levu.

Bonnaya veronicaefolia (Retz.) Spreng.

Nausori, in damp places, Tailevu Province, Viti Levu; collected by Mr. R. Veitch (*330*). I am indebted to the Director, Royal Botanic Gardens, Kew, for the identification of this plant, which was collected in May, 1921. I did not see it during a visit to Nausori a few years ago, and the record was overlooked when I prepared the previous weed articles.

Lindernia anagallis (Burm.f.) Pennell.

Near Nasinu, Naitasiri Province, Viti Levu, in wet places. The only other record for Fiji (Jour. Arnold Arb. **25**: 397. 1944) is from Serua Province, Viti Levu.

Lindernia diffusa (L.) Wettst.

Covering wet banks at side of road, hills between Navua and Suva in Namosi Province, Viti Levu.

Lindernia microcalyx Pennell & Stehlé.

In wet places and sometimes in standing water, near Nasinu, Naitasiri Province, Viti Levu (*1110*).

[1] Dr. F. W. Pennell, of the Academy of Natural Sciences, Philadelphia, has kindly provided several of the identifications listed in this family.

Torenia polygonoides Benth.

Damp shady places near Nasinu, Naitasiri Province, Viti Levu (*1099*).

Mazus japonicus (Thunb.) Kuntze.

Damp shady banks near Nausori, Tailevu Province, Viti Levu (*1105*).

Angelonia angustifolia Benth.

Damp open sunny places between Mulamula and Yavuna, alt. about 500 ft., Mba [formerly Nandi] Province, Viti Levu; open hillsides between Lautoka and Mt. Evans, alt. about 1800 ft., Mba [formerly Lautoka] Province, Viti Levu (*25*). This plant is commonly grown in gardens in Fiji by Europeans, Fijians, and Indians. *Greenwood 25* was collected in 1920 and identified at Kew, but I did not see the plant again in this locality and therefore did not include it in my articles on the weeds and adventive flora of the leeward coasts. However, in June, 1947, I observed the species flowering well and apparently naturalized at two places several miles apart inland from Nandi, and therefore it should doubtless be recorded here.

ACANTHACEAE

Asystasia gangetica (L.) T. Anders.

Near Nasinu, Naitasiri Province, Viti Levu. First noticed in Fiji at Levuka, Ovalau, in 1927.

Thunbergia alata Boj.

Near Thuvu, Nandronga & Navosa Province, Viti Levu. Commonly called Black-eyed Susan, this creeper has a corolla of which the throat is sometimes black and sometimes not.

Blechum pyramidatum (Lam.) Urb. [*B. Brownei* (Sw.) Juss.]

Near Nasinu, Naitasiri Province, Viti Levu.

LABIATAE

Hyptis pectinata (L.) Poit.

Open places on hills, road from Navua to Suva in Namosi Province, Viti Levu. During a trip around Viti Levu by car this species was not noticed in Serua Province, but it occurs from the cited locality in Namosi Province through Rewa, Naitasiri, and Tailevu Provinces where the road passes. During such a trip in 1945 the northernmost plants along the road were seen about two miles south of the turn-off to Ellington Wharf, Ra Province.

Salvia coccinea Juss. ex Murr.

Listed by Gibbs (in Jour. Linn. Soc. Bot. 39: 161. 1909) from the Nandrau Valley, alt. about 1000 ft., Nandronga & Navosa [formerly Tholo North] Province, Viti Levu. The species does not otherwise appear to have been recorded from Fiji.

PLANTAGINACEAE

Plantago major L.

Nandarivatu, alt. about 2700 ft., Mba [formerly Tholo North] Province, Viti Levu. Seemann, in Flora Vitiensis, notes this species as common, but during the past 30 years I have seen it only at Nandarivatu and Suva. It has not been noticed on the leeward coasts of Viti Levu or Vanua Levu.

AMARANTHACEAE

Iresine Herbstii Hook.

This is another species listed by Gibbs (in Jour. Linn. Soc. Bot. 39: 161. 1909) from the general vicinity of Nandarivatu, Viti Levu, which appears not to have been collected — or at least not recorded — since her report.

CHENOPODIACEAE

Chenopodium ambrosioides L.

Nandi, Mba [formerly Nandi] Province, Viti Levu. Mr. B. E. V. Parham has published an interesting note on this species in Agric. Jour. Fiji 17: 24. 1946. Here the plant is noted as a new record for Fiji, but it was earlier listed by Horne (A Year in Fiji, 259. 1881) without discussion. At present it appears to be confined to the Nandi district.

PIPERACEAE

Peperomia pellucida (L.) H. B. K.

In shady places near Nasinu, Naitasiri Province, Viti Levu.

EUPHORBIACEAE

Phyllanthus urinaria L.

Near Navua, Serua Province, Nasinu, Naitasiri Province, and Nausori, Tailevu Province, Viti Levu. Formerly recorded from Nandarivatu, in Sargentia 1: 46. 1942.

Phyllanthus Niruri L.

Near Navua, Serua Province, Viti Levu.

Euphorbia Peplus L.

Nandarivatu, alt. about 2700 ft., Mba [formerly Tholo North] Province, Viti Levu (*1171*). A weed in gardens and on cultivated ground.

URTICACEAE

Pilea microphylla (L.) Liebm.

Along roadside in shade, hills between Navua and Suva, Namosi Province, Viti Levu; Nandarivatu, alt. about 2700 ft., Mba [formerly Tholo North] Province, Viti Levu; Lautoka, near sea-level, Mba Province, Viti Levu.

SALICACEAE

Salix sp.

On bank of sand and stones at edge of river a few miles below Tumbenasolo, Mba [formerly Nandi] Province, Viti Levu (*1191*). The family has apparently not previously been recorded from Fiji.

IRIDACEAE

Sisyrinchium micranthum Cav.

F. M. Bailey (Weeds and suspected poisonous plants of Queensland,

192. 1907) states that this species is believed to be poisonous and that it causes violent scouring in stock. The plant is very small and, when not in flower, is difficult to discern among grasses. It is recorded thus far in Fiji only from the vicinity of Nandarivatu (in Bull. Torrey Bot. Club 70: 535. 1943), but it may be expected to spread over some coastal pastures by means of flood waters.

AMARYLLIDACEAE

Agave sisalina Perr.

Open hillsides at about 500 ft., near Thuvu, Nandronga & Navosa Province, Viti Levu.

PONTEDERIACEAE

Monochoria hastata (L.) Solms.

Mr. B. E. V. Parham records this plant (as *M. hastaefolia*) for the first time from Fiji, in Agric. Jour. Fiji 18: 39. 1947. He states that it occurs throughout the Navua district, in all parts of the lower Rewa, and in rice fields between Samabula and Suva Point. It was pointed out to me by Mr. Parham at Nanduruloulou and I also saw it near Nasinu (both in Naitasiri Province, Viti Levu), but specimens were not collected.

CYPERACEAE

Cyperus Iria L.

Lautoka, Mba [formerly Lautoka] Province (*806*), and Wangandra, Mba [formerly Nandi] Province (*806A*), Viti Levu. This species was first noticed by me at Wangandra in 1932 and near Lautoka in 1940. It is a bad weed in rice fields in the Lautoka and Nandi districts, springing up and dying down during the wet season. It has been seen at about 1000 ft. elevation on hills near Lautoka.

Cyperus difformis L.

In standing water near Nasinu, Naitasiri Province, Viti Levu.

Cyperus compressus L.

The annual form of this, mentioned in Proc. Linn. Soc. 154: 105. 1943, appears to be confined in Fiji to the vicinity of Lautoka, in my observation. A perennial form, up to 10 or 12 inches high, is found in Mba [Lautoka], Nandronga & Navosa, Naitasiri, and Tailevu Provinces, Viti Levu, usually in damp or wet grassland.

Cyperus alternifolius subsp. **flabelliformis** (Rottb.) Kükenth.

Banks of Navua River near Navua, Serua Province, Viti Levu.

Cyperus Haspan L.

Common in drains and other wet places in Naitasiri and Tailevu Provinces, Viti Levu.

Cyperus distans L. f.

Near Nausori, Tailevu Province, Viti Levu.

Scirpus Purshianus Fernald [*S. debilis* Pursh, non Lam.]

In standing water in drains near Navua, Serua Province, Viti Levu

(*980*). During a month's visit at Navua this species was observed at only one place and was not plentiful there.

Eleocharis geniculata (L.) R. & S.

In coral sand in depressions just behind the coast near Saweni, near Lautoka, Mba Province, Viti Levu.

Fimbristylis miliacea (L.) Vahl.

In standing water in drains, near Nasinu, Naitasiri Province, Viti Levu.

GRAMINEAE[2]

Ischaemum aristatum L. [*I. ciliare* Retz.].

Near Nasinu, Naitasiri Province, Viti Levu.

Ischaemum timorense Kunth.

The record of this species in Fiji, noted in Bull. Torrey Bot. Club 70: 534. 1943, was based on *Greenwood 817,* collected in 1939 from roadside on the Navua flats between Navua and Suva in Serua [not Rewa as previously stated] Province, Viti Levu. In May, 1943, the species was collected all along these flats, on the banks of the Navua River (Serua Province), and also on the hills along the road from Navua to Suva in Namosi Province.

Ischaemum rugosum var. **distachyum** (Cav.) Merr.

In soak area near creek in open, western slopes of Mt. Evans Range, Mba [formerly Lautoka] Province, Viti Levu (*1038B*).

Sorghum halepense (L.) Pers.

Lambasa district, Mathuata Province, Vanua Levu. This record should have been included in my earlier articles but it was overlooked. The species has been present near Lambasa for over 30 years.

Themeda quadrivalvis (L.) Kuntze.

Roadside between Lautoka and Rarawai, Mba Province; hills at about 1200 ft. alt., between Lautoka and Mt. Evans Range, Mba [formerly Lautoka] Province, Viti Levu.

Brachiaria subquadriparia (Trin.) Hitchc.

Damp places near sea-level, Lautoka, Mba Province (*93A*), and near Nausori, Tailevu Province (*93B*), Viti Levu. This species has been combined by some botanists with *B. distachya* Stapf; I am indebted to Mrs. Chase for pointing out the differences. She writes: "It is related to *B. distachya* Stapf but has more numerous racemes and slightly longer spikelets. It is more frequent in the islands than is *B. distachya,* to which it has commonly been referred." Much of the material listed by Summerhayes & Hubbard (Kew Bull. 1927: 32; 1930: 256) under *B. distachya* will prove to represent *B. subquadriparia.* Apparently *B. distachya* prefers damper places than *B. subquadriparia* and has a more compact growth of a lighter green color.

[2] For some of the listed identifications of grasses I am indebted to Mrs. Agnes Chase and Mr. J. R. Swallen, of the U. S. National Herbarium.

Brachiaria erucaeformis (J. E. Sm.) Griseb.

On banks of sand and stones along creek in open, alt. about 200 ft., Lautoka, Mba Province, Viti Levu (*1081*, depauperate). Previously known, in the Pacific, from only the Philippines and Guam, according to Mrs. Chase.

Axonopus compressus (Sw.) Beauv.

Fairly common near Navua, Serua Province, near Nasinu, Naitasiri Province, and near Nausori, Tailevu Province, Viti Levu.

Echinochloa stagnina (Retz.) Beauv.

In drains, near Nausori, Tailevu Province, Viti Levu. The only previous record from Fiji (Jour. Arnold Arb. **25**: 397. 1944) was from drains near Navua, Serua Province, Viti Levu.

Cyrtococcum oxyphyllum (Hochst. ex Steud.) Stapf.

In open places in forest along road between Navua and Suva, Namosi Province, and in shady places near Nasinu, Naitasiri Province, Viti Levu.

Setaria barbata Kunth.

Levuka, Ovalau, in shady places. Although the species was apparently quite common at Levuka when I was there in 1932, it has been previously recorded, in Fiji, only from Koro (Kew Bull. 1930: 260).

Setaria geniculata (Lam.) Beauv.

On open flat rock at extreme western end of Mt. Evans Range, alt. about 3400 ft., Mba Province, Viti Levu (*962, 962A*). The only previous record of this species in Fiji (in Sargentia 1: 6. 1942) is based on *Degener & Ordonez 13514*, which I believe to represent *S. pallidifusca* (Schumacher) Stapf & Hubbard, a tall annual grass; *S. geniculata* is perennial.

Setaria pallidifusca (Schumacher) Stapf & Hubbard.

Near sea-level near Navua, Serua Province, Viti Levu.

Isachne dispar Trin.

In wet ground in open beside creek, alt. about 2700 ft., Nandarivatu, Mba [formerly Tholo North] Province, Viti Levu (*1178*).

Eragrostis pilosa (L.) Beauv.

Navai, near Nandarivatu, alt. about 2500 ft., Mba [formerly Tholo North] Province, Viti Levu.

Arundo Donax L.

Along road, hills between Navua and Suva, Namosi Province, Viti Levu; along creek, lower western slopes of Mt. Evans Range, alt. about 1800 ft., Mba [formerly Lautoka] Province, Viti Levu.

COLONIAL SUGAR REFINING CO.,
LAUTOKA, VITI LEVU, FIJI.

STUDIES IN THE BORAGINACEAE, XVII

IVAN M. JOHNSTON

A. CORDIA SECTION VARRONIA IN MEXICO AND CENTRAL AMERICA

WHILE PREPARING AN ACCOUNT of the Boraginaceae for the southern West Indies it became necessary to typify the *Cordias* proposed by Linnaeus and also to re-examine the definition of certain widely ranging species. The results of these investigations came to involve a goodly proportion of the *Varronias* growing in Mexico and Central America. Since a discussion of them would be out of place in a paper dealing with the Antillean flora, they have been brought together and, with other observations, presented as a preliminary synopsis of the group for the region mentioned. Some of the species, e.g., *Cordia oaxacana, C. Pringlei, C. coyucana, C. curassavica,* and *C. spinescens,* have been treated cursorily and conservatively. They need much further study.

A few words are needed regarding the history, definition, and typification of *Varronia.* The name was coined and first used by Browne, Hist. Jam. 172 (1756), in describing Jamaican plants later called *C. globosa* and *C. curassavica.* Linnaeus was the first to use it in a strictly binomial classification, Syst. ed. 10, 916 (1759). He referred two species to it, *Varronia lineata* L. and *V. bullata* L. These two, both treated in the present paper, obviously belong to *Varronia* as usually defined. The group is, however, only a well-marked section of *Cordia.* It is confined to America and is best distinguished by fruiting structures. The fruit is usually matured in a cup-shaped calyx and is drupaceous. When ripe it has a conspicuous, thin, fleshy, usually cherry-red mesocarp which shrinks and fades and seems to disappear when the fruit is dried. The bony endocarp at maturity is usually single-seeded, irregularly ellipsoidal, and generally coarsely and irregularly tuberculate. The corolla in most *Varronias* has lobes much broader than long. The inflorescence is an open cyme in some species, but in most is either a dense head or a spike that matures its terminal flower first. In habit the plants are shrubs, woody scrambling climbers, or small trees. Many of them produce tiny aromatic granules on the herbage that give them a characteristic sagy odor. *Cordia parvifolia* DC. (*C. Greggii* Torr.; *C. Watsonii* Rose), although placed in *Varronia* by some authors, is accordingly here excluded. Among Mexican species *C. parvifolia* is actually most closely related to *C. elaeagnoides* DC. Note should be made of the treatment of *Varronia* by Friesen, Bull. Soc. Bot. Genève sér. 2, 24: 115–201 (1933). That author not only treats *Varronia* as a genus, but has even broken it up into a number of segregate genera. Personally I am entirely unable to find any justification for treating the Mexican and Central American species under four distinct genera, *Varronia, Montjolya, Ulmarronia,* and *Cordiopsis,* as Friesen proposes.

KEY TO SPECIES

Corolla large, 1–3 cm. long, pure white, salverform or funnelform.
  Calyx clothed with abundant spreading hairs; tip of lobes conspicuously prolonged, filiform, 2–5 mm. long............................1. *C. oaxacana.*
  Calyx clothed with straight appressed hairs, tip of lobes weakly or not at all prolonged (less than 2 mm. long).
    Corolla 2–3 cm. long, with a slender elongate tube much exserted from the calyx; leaves ovate to elliptic, 2–3 times as long as broad; calyx-lobes prolonged into free tips 1–2 mm. long....................2. *C. limicola.*
    Corolla 1–2 cm. long, its proper tube short and barely exserted from the calyx; leaves lanceolate, 3–5 times as long as broad; calyx-lobes with tips scarcely prolonged...............................3. *C. podocephala.*
Corolla much smaller.
  Foliage clothed with stellate hairs.
    Calyx-lobes with well-developed very elongate linear tips 2–5 mm. in length; heads in bud 2–3 cm. in diameter.......................4. *C. Pringlei.*
    Calyx-lobes with inconspicuous or scarcely if at all developed free tips; heads in bud 10–18 mm. in diameter..........................5. *C. stellata.*
  Foliage bearing simple hairs only.
    Flowers borne in a forking cyme.
      Leaves firm, usually broadest at or above middle, the upper surface distinctly scabrous from an abundance of short stiff appressed hairs; calyx-lobes abruptly short-acuminate, their apices free and forming a short but distinct tip on the unopened calyx..........6. *C. foliosa.*
      Leaves not very firm, usually broadest at or below middle, the upper surface bearing only widely scattered strongly appressed hairs; calyx-lobes acute; unopened calyx with unappendaged apex.............
      ....7. *C. bifurcata.*
    Flowers borne in heads or spikes.
      Flower-clusters capitate.
        Peduncles mostly axillary.........................8. *C. lineata.*
        Peduncles never axillary, but terminal or internodal.
          Calyx-lobes with apex acute or with prolonged tips only 1 mm. long or less.
            Heads ellipsoidal, somewhat longer than broad, 10–15 mm. thick; mature fruit enclosed by a loose papery accrescent calyx and eventually freed by the break-up of the latter...............................9. *C. coyucana.*
            Heads globose, not longer than broad, mostly 10 mm. or less thick.
              Calyx at anthesis 4–6 mm. long, glabrous or with only scattered relatively coarse appressed hairs; calyx-lobes distinctly attenuate, the tips 0.5–1 mm. long, free and usually spreading in the bud; corolla flaring, about 5 mm. long; leaves lance-ovate, ovate, or elliptic, 2–6 cm. broad, upper surface with branches of veins usually evident.............10. *C. ambigua.*
              Calyx at anthesis 1.5–3 mm. long, clothed with abundant minute usually appressed hairs, lobes deltoid, the acute apices not free in the bud; corolla tubular, 2.5–4 mm. long; leaves usually lanceolate or ob-

lanceolate and 1–2 cm. broad but occasionally becoming lance-ovate to elliptic and up to 5 cm. broad, upper surface with branches of veins rarely if at all evident........................11. *C. inermis.*

Calyx-lobes with prolonged free linear tips 2–4 mm. long.

Leaves firm, thickish, with sharp teeth and a sharply acute apex, lower surface with a prominent reticulum of repeatedly branched and anastomosing veins, and with one or more small, well-defined concave or obconic depressions in many of the vein-areoles; upper leaf-surface usually verrucose, with short stiff ascending or nearly erect hairs arising from bulbose bases; peduncles usually elongating, usually over 2 cm. long; corolla 4–6 mm. long, usually hardly surpassing the calyx, the tube expanding into a subcampanulate throat...12. *C. bullata.*

Leaves thinner, usually with rounded teeth and obtusish at the tip, lower surface with simple veins or these sparsely and inconspicuously branched and anastomosing, rarely developing any small concave depressions; upper leaf-surface more or less strigose, the hairs arising from unthickened or from flat or merely convex pustulate bases; peduncles usually less than 2 cm. long; corolla 5–9 mm. long, usually surpassing the calyx, funnelform, the tube expanded into a broadly obconic throat...... ....13. *C. globosa.*

Flower-clusters elongating, spikes.

Base of petiole not decurrent on the subtended axillary shoot, at most only the basal 1–2 mm. hardening and persisting on defoliated branches; plant an erect shrub bearing no axillary inflorescences; spikes borne singly, either terminal or springing from naked internodes along leafy stems.................14. *C. curassavica.*

Base of petiole decurrent for 5–10 mm. on the subtended axillary shoot or peduncle, usually persisting as a conspicuous indurate decurved spur on defoliated branches; plant a scrambling shrub, producing most of its spikes (singly or in panicles) from the axils along leafy stems, only those first produced by the stem being terminal.

Calyx-lobes with short free tips forming a short but distinct apical prolongation on the unopened calyx; spikes borne in terminal and axillary panicles..........15. *C. costaricensis.*

Calyx-lobes without free tips, the unopened calyx with a rounded unappendaged apex; spikes rarely paniculate, most of them springing singly from the leaf-axils along the stems.. ....16. *C. spinescens.*

1. **Cordia oaxacana** DC. Prodr. 9: 497 (1845).—near Tololapa, Oaxaca, *Andrieux 203.*

Varronia oaxacana (DC.) Friesen, Bull. Soc. Bot. Genève sér. 2, 24: 175 (1933).

Cordia appendiculata Greenm. Field Mus. Pub. Bot. 2: 338 (1912).—Cañon de Tomellin, Oaxaca, *Conzatti 2218.*

Varronia oaxacana var. *appendiculata* (Greenm.) Friesen, Bull. Soc. Bot. Genève sér. 2, 24: 176, t. 1, f. 8 (1933).

Cordia perlonga Fernald, Proc. Am. Acad. 33: 90 (1897).—Acapulco, *Palmer 70.*

Cordia urticacea Standley, Contr. U. S. Nat. Herb. 23: 1222 (1924).—Real de Guadalupe, Guerrero, *Langlassé 355.*

Varronia urticacea (Standl.) Friesen, Bull. Soc. Bot. Genève sér. 2, 24: 174 (1933).

MEXICO: Aguas Calientes, 1837, *Hartweg 181* (G); Zacuapan, Vera Cruz, *Purpus 8477* (G, US); Lake Chapala, Jalisco, *Hitchcock & Stanford 7174* (G, US); Zitacuaro to Coyota, Michoacan, tree 3 m., *Hinton 13153* (G, US); Acapulco, Guerrero, 1895, *Palmer 70* (G, TYPE of *C. perlonga;* US); San Antonio, Guerrero, shrub 1.5–2 m., *Hinton 10256* (G, US) and *10542* (G, US); Real de Guadalupe, Guerrero, shrub 2 m., *Langlassé 355* (US, TYPE); Picacho to San Geronimo, Oaxaca, *Purpus 6692* (G, US); Rio de los Vueltos, Oaxaca, *Liebmann 15158* (G); Cuesta de Quiotepec, Oaxaca, *Smith 700* (G) and *Conzatti 4027½* (G, US); Tomellin Canyon, Oaxaca, 3–4.5 m. tall, *Pringle 4630* (G, US); between San Geronimo and La Venta, Oaxaca, *Nelson 2785* (G, US); San Geronimo, Oaxaca, *Mell 2133* (US); Ixtepec, Oaxaca, *Fisher 35250* (US); Salina Cruz, Oaxaca, *Fisher 35492* (US); Tehuantepec, Oaxaca, *Matuda 244* (US).

The species is confined to southern Mexico and appears to be very variable. Specimens referred to it are rather diverse in appearance, but until more collections of it accumulate and more is learned of its behavior in the wild, I believe it had best be given the broad definition here accepted. From plant to plant the corolla may be moderate-sized or large and differ greatly in the length of corolla-tube protruded from the calyx. These differences, however, may possibly be associated with heterostyly. Leaf-form is variable, and so also is the type of hairs on twigs and foliage. The leaves are usually ovate or elliptic and rounded or obtuse at the base. The plant described as *C. perlonga,* however, has very elongate leaves that are acute or attenuate at the base and very scantily pubescent beneath. Its peduncles, also, are unusually elongate. The plant described as *C. urticacea* has the twigs and peduncles bristly with spreading brownish hairs. Hinton's two collections from Guerrero (nos. *10256* and *10542*) show that it is not sharply distinct from other forms of the species.

2. **Cordia limicola** Brandeg. Univ. Cal. Pub. Bot. 6: 502 (1919). — Corral de Piedras, Vera Cruz, *Purpus 8017*.
Varronia limicola (Brandeg.) Friesen, Bull. Soc. Bot. Genève sér. 2, 24: 148 (1933).
Cordia passa Johnston, Jour. Arnold Arb. 29: 227 (1948). — Jacala, Hidalgo, *Chase 7461.*

MEXICO: near San Lucas, Jaumave, Tamaulipas, *Rozynski 563* (G); Jacala, Hidalgo, *Chase 7461* (G, TYPE of *C. passa*) and *Moore 1823* (G); Corral de Piedras, Zacuapan, Vera Cruz, *Purpus 8017* (G, US, ISOTYPE of *C. limicola*) and *Purpus 7491* (G, US); Mirador, Vera Cruz, 1857, *Mohr* (US); Rio Talvá, Aug. 1842, *Liebmann 12718* (US).

A well-marked species known only from middle eastern Mexico. Its closest relatives are *C. podocephala* Torr. of northeastern Mexico and *C. mirabiloides* (Jacq.) R. & S. of Cuba and Haiti. Typical *C. passa* differs from typical *C. limicola* only in having smaller, more hairy leaves, and is obviously only an ecological form of the latter.

3. **Cordia podocephala** Torr. Bot. Report U. S. & Mex. Bound. Survey 135 (1859).
Varronia longifolia Sessé & Moc. Fl. Mex. 48 (1893), ed. 2, 44 (1894) — Type from "Praedio de la Punta."

TEXAS: Eagle Pass, Maverick Co., *Havard 10* (G); Montell Creek, Uvalde Co., *Cory 14902* (G), 26 mi. north of Uvalde, *Cory 49398* (G); George West, Live Oak Co., *Skiller 898* (US); near Dinero, Live Oak Co., 1940, *Highway Dept.* (G); Bee Co., 1940, *Tharp* (G); San Patricio Co., 1941, *Tharp* (G); 11 mi. northwest of Falfurrias, Duval Co., *Cory 14751* (G); "Blanco Canyon, rich bottom land," *Reverchon 1562* (US).

MEXICO: 11 mi. south of Allende, Coahuila, weak shrub 1–1.5 m. tall, *Johnston 7023* (G); Hacienda Mariposa, Coahuila, *Wynd & Mueller 240* (G); Musquiz, Coahuila, *Marsh 140* (G); Soledad, southwest of Monclova, Coahuila, 1880, *Palmer 1024* (G); Cañon Bocatoche, Coahuila, *Muller 3112* (G); Monterrey, Nuevo Leon, *Pringle 1877* (G, US), *11639* (G, US), and *Mueller 322* (G); Victoria, Tamaulipas, 1907, *Palmer 453* (G, US); Cerro Tamaulipeca, Tamaulipas, *Bartlett 10631* (G, US); Jaumave, Tamaulipas, *Viereck 319* (US).

A very well marked species which is closely related only to *C. limicola*. It ranges just north of the latter species in Tamaulipas, Nuevo Leon, Coahuila, and in adjoining Texas.

4. **Cordia Pringlei** Robins. Proc. Am. Acad. 26: 169 (1891). — Las Palmas, San Luis Potosi, *Pringle 3091*.

Varronia Pringlei (Robins.) Friesen, Bull. Soc. Bot. Genève sér. 2, 24: 168 (1933).

Cordia Pringlei var. *altatensis* Brandeg. Zoe 5: 219 (1904). — Yerba Buena near Altata, Sinaloa, *Brandegee*.

Cordia asterothrix Killip, Jour. Wash. Acad. 17: 330 (1927). — Rio Limon, Venezuela, *Curran & Haman 808*.

Cordia Storkii Standley, Pub. Field Mus. Bot. 18: 984 (1938). — Catalina, Guanacaste, Costa Rica, *Stork 2758*.

The species ranges in the drier parts of Mexico, Central America and northern Colombia and Venezuela.

MEXICO: Victoria, Tamaulipas, 1933, *Fisher* (G); Las Palmas, San Luis Potosi, shrub 3–4.5 m. tall, *Pringle 3091* (G, TYPE of *C. Pringlei;* US) and *4058* (US); 100 mi. north of Tamazunchale, San Luis Potosi, 1–1.5 m. tall, *Hitchcock & Stanford 6898* (G, US); State of San Luis Potosi, *Seler 596* (G); Buenavista, June 1841, *Liebmann 12714* (US); Acasonica, Vera Cruz, *Purpus 8484* (G, US); Topolobampo, Sinaloa, 1897, *Palmer 182* (US); Yerba Buena near Altata, Sinaloa, 1904, *Brandegee* (G, US, ISOTYPES var. *altatensis*); Mazatlan, Sinaloa, *Ortega 5616* (US); Cerro Llano Redondo west of Caymanero, Sinaloa, 8–15 m. tall, *Gentry 7091* (G) and *7091A* (G); Buena Vista, Apatzingan, Michoacan, shrub 4 m., *Hinton 12072* (G, US).

GUATEMALA: near Estanzuela, dept. Zacapa, 7–9 dm. tall, *Steyermark 29102* (G); between Zacapa and Chiquimula, 2–3 m. tall, *Standley 73784* (G) and *74448* (G); near Jutiapa, 2 m. tall, *Standley 74969* (G).

NICARAGUA: Managua, *Garnier 1084* (US); indefinite, *Wright* (G, US).

COSTA RICA: Bebedero, Guanacaste, *Brenes 12546* (G, FM); Catalina, Guanacaste, 5 m. tall, *Stork 2758* (FM, TYPE of *C. Storkii*); Puerto Jesus, Nicoya, 1903, *Cook & Doyle 747* (US); Estero de Puerto Jesus, 1903, *Pittier 16690* (US).

COLOMBIA: between Quebrada de Angeles and Rio Cabrera, dept. Huila, *Rusby & Pennell 333* (G).

VENEZUELA: Rio Limon, *Curran & Haman 808* (US, TYPE of *C. asterothrix;* G).

The species is most closely related to *C. stellata* of Mexico and to *C. macrocephala* (Desv.) HBK. of Peru and *C. polyantha* Benth. of Ecuador and northern Peru.

5. **Cordia stellata** Greenm. Proc. Am. Acad. 39: 86 (1903). — Cuicatlan, Oaxaca, *Smith 147*.

MEXICO: Cameron, Vera Cruz, *Purpus 8715* (G, US); near San Luis Tultitlanapa, Puebla, *Purpus 3242* (G, US); Cuicatlan, Oaxaca, *Smith 147* (G, TYPE) and *Gonzales 983* (G); Cuesta de Quiotepec, dist. Cuicatlan, *Conzatti 2461* (G); Cuesta de Coyula, dist. Cuicatlan, *Conzatti 4136* (US); 6 mi. above Dominguillo, Oaxaca, *Nelson 1646* (G, US); Cerros Teotitlan, Oaxaca, *Conzatti 3456* (G); Rio Vuelto, Oaxaca, July 1842, *Liebmann 12715* (US).

The plant is very closely related to *C. Pringlei,* but it is always distinguishable by its smaller heads and very short or inconspicuous tips on the calyx lobes.

6. **Cordia foliosa** Mart. & Gal. Bull. Acad. Brux. 11²: 330 (1844). — Zacuapan, Vera Cruz, *Galeotti 7094.*

Cordia chiapensis Fernald, Proc. Am. Acad. 40: 52 (1904). — Ocuilapa, Chiapas, *Nelson 3003.*

MEXICO: Corral de Piedras, Vera Cruz, *Purpus 8062* (G); Zacuapan, Vera Cruz, *Purpus 10785* (G, US) and *10811* (G, US); La Palmilla, *Purpus 16410* (G); Mirador, Vera Cruz, *Liebmann 12703* (G, US); Hacienda de la Laguna, Vera Cruz, *Schiede 146* (NY); Ocuilapa, Chiapas, *Nelson 3003* (G, TYPE of *C. chiapensis;* US); Monserrate, Chiapas, *Purpus 14* (US).

GUATEMALA: Puebla viejo Quen Santo, Huehuetenango, *Seler 3011* (G); northwest of Cuilco, Huehuetenango, *Steyermark 50806* (G).

A very well marked species and the only *Varronia* with loose, distinctly forked cymes known from Mexico and northernmost Central America.

7. **Cordia bifurcata** R. & S. Syst. 4: 466 (1819). — Based on *V. dichotoma* R. & P.; not *Cordia dichotoma* Forst. (1786).

Varronia dichotoma R. & P. Fl. Peruv. 2: 23, t. 146 (1799). — Type from Chachahuasi, Peru.

Atlantic slopes of Costa Rica and Panama and from there south along the Andes of South America.

COSTA RICA: La Colombiana Farm, prov. Limon, 2–3 m. tall, *Standley 36641* (US); near Carmen Station, prov. Limon, 15–30 dm. tall, *Standley & Valerio 48379* (US); Pejivalle, prov. Cartago, 1.5 m. tall, *Standley & Valerio 46904* (US); Rio Turrialba, prov. Cartago, *J. D. Smith 6698* (G, US); Turrialba, *Cook & Doyle 370* (US); Juan Viñas, prov. Cartago, *Cook & Doyle 302* (US); Valle Tuis, basin of Rio Reventazon, prov. Cartago, *Tonduz 11353* (G, US); Aguacaliente, prov. Cartago, *Stevens 324* (US); Rio Hondo, plains of Santa Clara, *Cook & Doyle 530* (S); San Jose, *Tonduz 11353* (US); Villa Quesada, prov. Alajuela, *Austin Smith 2542* (G); Las Vueltas, Tucurrique, *Tonduz 12759* (US).

PANAMA: Almirante, Bocas del Toro, *Cooper 83* (G); Changuinola Valley, Bocas del Toro, *Dunlap 90* (G); western Panama, 1923, *Stork 16* and *19* (US).

This is one of the previously unrecognized species that has been contained in the complex, passing under the names *C. ulmifolia, C. corymbosa,* and *C. polycephala.* It is the common representative of the complex in Colombia and southward along the Andes into northern Argentina, and is readily delimited except where it approaches the area of its Brazilian relatives in Paraguay and northeastern Argentina. Though formerly not distinguished from the other Central American member of the complex, *C. lineata,* it is decisively separable and utterly different in appearance. In *C. bifurcata* the cymes are all terminal or internodal, and usually very evidently so. Though at times the flower clusters may be rather dense, they always show some evidence of being two-lobed and in the very mature fruiting condition always reveal a forked rhachis to some extent. Usually, however, the cyme is evidently forked even in bud and is generally very conspicuously so when in fruiting state. This is all very different from the condition in *C. lineata,* where the small, distinctly capitate inflorescences spring from axils along the leafy twigs. The foliage of the two species also differs. In our present plant the leaves usually have a thinner texture than in *C. lineata* and are conspicuously very much less hairy, especially on the upper surface.

8. **Cordia lineata** (L.) R. & S. Syst. 4: 464 (1819).
   Varronia lineata L. Syst. ed. 10, 916 (1759); Amoen. Acad. 5: 394 (1759); Sp. Pl. ed. 2, 275 (1762); Syst. ed. 12, 176 (1767). — Jamaica.
   Cordia ulmifolia var. *lineata* (L.) DC. Prodr. 9: 495 (1845).
   Lantana corymbosa L. Sp. Pl. 628 (1753); not *Varronia corymbosa* Desv. (1809), nor *Cordia corymbosa* Willd. (1819), nor Don (1838). — Jamaica.
   Ulmarronia corymbosa (L.) Friesen, Bull. Soc. Bot. Genève, sér. 2, 24: 143 (1933), as to name-bringing synonym only.
   ? ? *Cordia adnata* DC. Prodr. 9: 493 (1845). — Cuba.

Ranging from southern Mexico to Panama, in the northern West Indies (Jamaica, Cuba, and Haiti), and possibly also in northern South America.

MEXICO: Zacuapan, Vera Cruz, *Purpus 6272* (G, US) and *10825* (US); Jicaltepec, Vera Cruz, March 1841, *Liebmann 12704* (US); Rio Cascabel, Oaxaca, *Mell 2303* (US).

BRITISH HONDURAS: San Agustin, El Cayo Dist., *Lundell 6756* (G, US).

GUATEMALA: Quirigua, dept. Izabel, *Standley 23698* (G, US).

COSTA RICA: El General, *Skutch 3831* (G, US), *4314* (G, US), and *4769* (US).

PANAMA: San Blas Dist., *Cooper 276* (G, US); Balboa, *Standley 25474* (G, US), *26068* (US), and *29245* (G, US); Punta Paitilla, *Heriberto 212* (G, US); between Pacora and Chepo, *Woodson, Allen & Seibert 1671* (G); Rio Tapia, *Standley 28153* (US).

JAMAICA: St. Margarets Bay, *Fredholm 3271* (US); Oxford, near Troy, *Harris 9434* (US); indefinite, *Macfadyen* (G).

CUBA: Herradura, Pinar del Rio, *Van Hermann 858* (G, US); between Herradura and Paso Real, *Shafer 11769* (US); Viñales, Pinar del Rio, *Killip 13543* (US); Los Palacios, Pinar del Rio, *Shafer 11652* (US); Pitajones, Santa Clara, *Shafer 12276* (US); Sancti Spiritus, Santa Clara, *Shafer 12111* (US); Cieneguita, Santa Clara, *Combs 420* (G); vicinity of Soledad, Santa Clara, *Jack 5483* and *6629* (G, US); Soledad, *Howard 6619* (G); La Gloria, Camaguey, *Shafer 119* (G, US); Saltadero, Oriente, *Wright 423* (G); between Lebisa Bay and El Purio, Oriente, *Shafer 3429* (US).

HAITI: St. Michel de l'Ayalaye, *Leonard 7519* (G, US); St. Louis du Nord, *Leonard 14289* (US); Terre Neuve, *Buch 542* (US); Pilate, *Leonard 9651* (US); Plaisance, *Leonard 9173* (US); Gros Morne, l'Artibonite, *Leonard 9852* (US); Massif du Nord, Port Margot, Bayeux, *Ekman 2560* (US); north of Morne Jeffrard, southern peninsula, *Bartlett 17559* (US).

DOMINICAN REPUBLIC: San Jose de las Matas, prov. Santiago, *Jimenez 959* (US); banks of Rio Mao to La Ceiba, prov. Monte Cristy, *Valeur 474* (US).

VENEZUELA: Perija, Zulia, *Tejera 8* (US); between Guamitas and Rancho Grande, P. N. Aragua, *Williams 10368* (US); La Paragua, Bolivar, *Killip 37614* (G); Avila, savana del monte, *Vogl 710* (G).

COLOMBIA: Boyaca, Rio Meta, Orocue, Los Llanos, *Cuatrecasas 4401* (US).

A very well marked but previously unrecognized species here associated with a neglected specific name long ago proposed by Linnaeus. The plant is known only from Mexico, Central America, and the northern West Indies and is to be found in herbaria mistakenly identified as *C. ulmifolia, C. corymbosa,* or *C. polycephala*. These latter names have, at one time or another, been used to cover a complex of species distributed from Mexico and Cuba south to Argentina. A study has shown that the aggregate can be broken up into a number of well-defined species. In the West Indies, Mexico, Central America, and coastal northern South America three species should be segregated from the complex, our present species being one of them. *Cordia polycephala* (Lam.) Johnston, *sensu str.*, is another. It ranges in the West Indies from Santo Domingo through Porto Rico, the Virgin Islands, the Lesser Antilles, and Trinidad into northern South America, where it occurs in the Guianas, Venezuela, and coastal northern Colombia. The third segregate is *C. bifurcata* R. & S., which ranges north along the cordillera into Colombia and has outlying stations on the Atlantic slopes of Panama and Costa Rica. These three species, *C. lineata, C. polycephala,* and *C. bifurcata* have distinct patterns of geographic distribution and are easily distinguished by differences in inflorescence.

Most of the species of the section Varronia have peduncles that are either terminal or internodal and never axillary. This normal condition prevails in *C. bifurcata*. In *C. lineata* and *C. polycephala s. str.*, however, while the first few inflorescences on a long shoot may be terminal or internodal, the very abundantly produced later ones are all axillary. Their peduncles arise directly from the leaf-axils along the leafy shoot and have their foot confluent with the indurated basal portion of the petiole of the subtending leaf. In *C. lineata* the peduncles are very slender, 2–3 cm. long, and terminated by a small dense capitate flower-cluster. Only exceptionally do they branch or bear a reduced leaf. They are never clustered. In *C. polycephala s. str.* the cymes are commonly glomerate and are only rarely markedly spherical in form. The peduncles are coarser than in *C. lineata* and frequently branched. They tend to be especially numerous and even paniculately arranged towards the ends of the shoot. The corolla of *C. polycephala s. str.* averages larger than that in *C. lineata* and is more abundantly glandular-hairy inside. The upper surface of its leaves is minutely tuberculate and only sparingly strigose. In *C. lineata* the distinctly lanceolate leaves are less variable in form, dry a darker color, and average more elongate than in *C. polycephala s. str.* Their upper surface is evidently more hairy, since in addition to a coarse strigosity it bears minute tuberculations, comparable to those already noted in *C. polycephala,* which are here prolonged upwards into minute appressed hairs.

In geographic distribution *C. lineata* and *C. polycephala* approach each other only in the Dominican Republic and in western northern South America. The latter species I have seen from only three general localities in the Dominican Republic (Paradis, Barahona, *Fuertes 998;* vicinity of Ciudad Trujillo, *Ekman 12336, Allard 13226* & *15742;* and San Pedro de Macoris, *Rose, Fitch & Russell 4162*), all near the southern coast of the country and apart from the known localities in northern and western parts of the republic where *C. lineata* has been collected. Judging from material examined, the two species remain distinct and readily separable in the West Indies. Only in Venezuela is there any difficulty in distinguishing them. In northern South America *C. polycephala* ranges as far west as Santa Marta, Colombia (*Smith 2737*) and is particularly common and well distributed in Venezuela. In the latter country, unlike its behavior in other parts of its range, however, it tends to lose its stability and is accompanied by a goodly number of variants, some of which are separable from *C. lineata* only with difficulty. The proper interpretation of these forms must await a detailed study of the Venezuelan *Varronias*. The specimens from Colombia and Venezuela cited above can, accordingly, be now only tentatively identified with typical *C. lineata*.

The oldest name applied to the present plant is *Lantana corymbosa* L. Sp. Pl. 627 (1753). Linnaeus applied the name to Jamaican plants treated by Sloane, Hist. 2: 83, t. 194, f. 3, and Plukenet, Alm. t. 328, f. 5. Sloane's plant most suggests true *Cordia polycephala,* a plant not known from Jamaica, but in any case it is probably not the same as the plant illustrated by Plukenet. Plukenet's plant is clearly representative of *C. lineata* as here accepted. The name *Lantana corymbosa* L. cannot be transferred to *Cordia,* since the resulting combination is already preoccupied by *Cordia corymbosa* Don, 1838 (based upon *Varronia corymbosa* Desv., 1809, a renaming of *V. monosperma* Jacq.), as well as by *Cordia corymbosa* Willd. ex R. & S., 1819. The name *"Varronia corymbosa* L.," Desf. Tableau 71 (1804), possibly may have been based on *Lantana corymbosa* L., but it is published merely as a bare name in a list for a botanic garden and cannot be accepted as a nomenclatorial transfer since its association with *L. corymbosa* L. is merely conjecture.

The name *Varronia lineata* L. Syst. ed. 10, 916 (early 1759) is the second one applied to our present plant. It was published thus: *"lineata.* A. V. fol. lanceolatis linearis, spicis oblongis. Lantana corymbosa. *Spec. pl. 628. Brown, jam. t. 13. f. 2."* The concept is a confused one. The phrase "spicis oblongis" in the diagnosis best describes *Cordia curassavica.* Browne's plate represents *Cordia globosa.* The reference to *Lantana corymbosa* involves two other species, one of which is the species we now have under consideration.

In Nov. 1859, Linnaeus's student, Elmgren, Amoen. Acad. 5: 394, gave under the name *Varronia lineata* a very good detailed description of our present species. It was based on a specimen collected in Jamaica by Browne., The specimen is now catalogued in the Linnaean Herbarium as no. 255.1 and has been discussed by Smith, Rees Cyclop. 36: sub *V. lineata* (1817).

In Dec. 1859, another student of Linnaeus, Sandmark, Amoen. Acad. 5: 376, applied the name *V. lineata* to a plant figured in Browne's History of Jamaica. Sandmark, by his reference to the second species treated by Browne on page 172, associated the name with what is probably *Cordia curassavica.*

The application of the name *Varronia lineata,* previously confused, was finally clarified by Linnaeus in the second edition of his Species Plantarum, 275 (1762), where he treated it as follows: "lineata. 1. VARRONIA foliis lanceolatis lineatis, pedunculis lateralibus petiolo adnatis, spicis globosis. *Amoen. acad. 5. p. 394.** Lantana *corymbosa,* foliis alternis, floribus corymbosis. *Sp. pl. 628.* Ulmi angustifoliae facie baccifera jamaicensis, foliis superne scabris, subtus villosis, floribus flavis perpusillis, fructu botryoide monospermo. *Pluk. alm. 393, t. 328, f. 5.* Habitat in America." The diagnosis is a new one and applies perfectly to our present plant. The asterisk calls attention to the full description given by Elmgren. Sloane's plant, cited when *Lantana corymbosa* was published, is excluded by both the diagnosis and description. The Plukenet plant is the Jamaican plant here treated and the one with which Linnaeus is almost exclusively concerned in the second edition of the Species Plantarum. In the twelfth edition of the System, p. 176 (1767), the species appears as follows: "*lineata.* 1. V. fol. lanceolatis lineatis, pedunc. lateralibus petiolo adnatis, spicis globosis." This is the same diagnosis as that which first appeared in the second edition of the Species Plantarum, five years earlier.

In disposing of the two Linnaean names, *Lantana corymbosa* and *Varronia lineata,* there are only two choices that can be justified logically. They can be discarded as *nomina confusa,* or they can be typified by the Jamaican plant illustrated by Plukenet. The names were applied by Linnaeus to an aggregate, but to no more confused an aggregate than many other names of that author which have been subsequently restricted and are now generally accepted. In five out of the six times which Linnaeus or his students used the names between 1753 and 1767, the Jamaican plant illustrated by Plukenet was included in the species treated. It was not only a recurring element in the Linnaean concept, but also the one which Linnaeus eventually emphasized and allowed to dominate in his concept. I have accepted Plukenet's plate as typifying both *Lantana corymbosa* and *Varronia lineata.* This seems logical and furthermore is of some practical moment, since it provides a name for a species otherwise without one.

9. **Cordia coyucana** Johnston, Jour. Arnold Arb. 29: 227 (1948). — Coyuca, Guerrero, *Hinton 8156.*

MEXICO: Coyuca, Guerrero, 3 m. tall, *Hinton 8156* (G, TYPE).
GUATEMALA: Jalapa, shrub 2 m. tall, *Standley 76595* (G).
HONDURAS: (dept. Morazán): Zamorano, *Valerio 139* (G); El Pedregal, *Valerio 896* (G); road to Tatumbla, *Valerio 532* (G).
COSTA RICA: Hacienda Santa Maria, Guanacaste, *Dodge & Thomas 6294* (G); La Cruz de Guanacaste, 1890, *Pittier 2751* (G).

The species is known only from the collections cited above. Although the plant has a large, plump, ellipsoidal or capitate inflorescence which is rounded at the base and hence very different from the elongating, more slender and narrower, basally attenuate spikes of *C. curassavica,* I believe it is most closely related to the latter species. In foliage, in bristly twigs, and in form and indument of the inflated fruiting calyx it is especially suggestive of those forms of *C. curassavica* found in Guerrero which have been described as *C. imparilis* Macbr. It can be noted here, as an interesting coincidence, that among the Mexican *Varronias* three very different species have developed very bristly forms in the state of Guerrero, i.e., *C. oaxacana* (*C. urticacea*), *C. curassavica* (*C. imparilis*) and *C. coyucana.*

10. **Cordia ambigua** Schl. & Cham. Linnaea 5: 115 (1830). — Jalapa, *Schiede 216.*

MEXICO: Jalapa, Vera Cruz, *Schiede 216* (G, photo of TYPE); Jalapa, *Rose & Hay 6139* (US); Jalapa, shrub 3–6 m., *Pringle 8193* (G, US) and *9407* (G, US); Izuatlanchillo, near Orizaba, Vera Cruz, *Boureau 2625 bis* (G); near Orizaba, *Boureau*

2625 (G, US); Orizaba, *Botteri 169* (G) and *181* (G); Tenango, near Orizaba, *Botteri 482* (US); Dos Puentos, Oaxaca, Aug. 1842, *Liebmann 12733* (US); Mt. Orando, Chiapas, *Matuda 771* (G).

A very well marked species known only from southeastern Mexico.

11. **Cordia inermis** (Mill.), comb. nov.

Lantana inerma Miller, Dict. (1768).

Cordia cana Mart. & Gal. Bull. Acad. Brux. 11[2]: 331 (1844). — Pacific slope of Oaxaca, *Galeotti 7140.*

Cordia insularis Greenm. Proc. Am. Acad. 33: 482 (1898). — Maria Madre Island, *Nelson 4296.*

Ranging from northwestern Mexico south through Central America to Panama and the dry north coast of Colombia. In Mexico it is confined to the seasonally dry Pacific slope and is found as far north as Sinaloa.

MEXICO: Ymala, Sinaloa, 1891, *Palmer 1419* (G, US); San Juan, Sinaloa, *Ortega 4030* (US); Rosario, Sinaloa, *Rose 1825* (G, US); San Ignacio, Sinaloa, *Montes & Salazar 550* (US); Culican, Sinaloa, 1904, *Brandegee* (G); Yervacito, Sinaloa, 1904, *Brandegee* (US); Maria Madre Island, *Nelson 4296* (G, TYPE; US), *Solis 68, Ferris 5629* (US), *Howell 10518* (G) and *Mason 1779* (G, US); Zapotlan, Jalisco, 3 m. tall, *Pringle 4389* (G); Sacoalco, Jalisco, *Jones 363* (US); barranca near Guadalajara, Jalisco, 1886, *Palmer 84* (G, US); La Palma, Jalisco, *Jones 364* (US); Barranca de Tequila, Jalisco, 1.5–4.5 m. tall, *Pringle 4436* (G, US); Zitacuaro to El Souse, Michoacan, tree 2 m. tall, *Hinton 13248* (G, US); Acapulco, Guerrero, 1895, *Palmer 2* (G, US); Acatitlan, Mexico, 1 m. tall, *Hinton 4337* (G, US); Tenatac, Mexico, 3.5 m. tall, *Hinton 4213* (G); Salitre, Mexico, 1.5 m. tall, *Hinton 6510* (G, US); Tehuantepec, Oaxaca, *Matuda 584* (G, US); Jalisco, Chiapas, *Purpus 9211* (G, US); Mt. Orando, Chiapas, *Matuda 683* (US).

GUATEMALA: divide between Zacapa and Chiquimula, shrub 2–3 m. tall, *Standley 73704* (G); Gualan, Zacapa, shrub 3 m., *Deam 6319* (G, US) and *6377* (G, US); Cobán, *Johnson 39* and *567* (US); Guatemala City, *Tejada 24* and *147* (US).

SALVADOR: Santa Ana, shrub 1.5–2.5 m., *Standley 19689* (G, US); La Union, shrub 9–12 dm. tall, *Standley 20668* (G, US); La Union, *Standley 20843* (US); Izalco, dept. Sonsonate, *Standley 22182* (G, US); San Salvador, *Velasco 8926* (US) and *Calderon 1068* (US); dept. Ahuachapán, *Sisto Alberto Padillo 84* and *377* (US).

HONDURAS: Isla de Disposicion, 1.5 m. tall, *Stork & Worth 8864* (G); Bella Vista, dept. Choluteca, shrub 2–3 m., *Williams & Molina 10873* (G); Yeguare, Morazán, *Valerio 314* (G); Zamorano, Morazán, *Valerio 174* (G).

NICARAGUA: Granada, *Oersted 12799* (US); near Granada, *Maxon, Harvey & Valentine 7624* (G, US); Managua, *Garnier 1093* (US) and *Chaves 9* (US); Momotombo, 1.8–2.1 m. tall, *C. L. Smith 123* (G, US); Pueblo Nuevo, dept. Esteli, *Williams & Molina 10808* (G).

COSTA RICA: road to Nicoya, *Tonduz 13789* (G, US); Puntarenas, *Rowlee 19, 65* and *141* (US); Nicoya, *Cook & Doyle 645* (US).

PANAMA: Isla Taboga, 2 m. tall, *Woodson, Allen & Seibert 1478* (G); Isla Taboga, 2–3 m. tall, *Standley 27039* (US).

COLOMBIA: Santa Marta, *Smith 582* (G, US).

For a widely ranging member of the section Varronia this species shows very little variation. The species usually has an indument of fine, closely appressed hairs. At the northern end of its area of dispersal the hairs, and especially those on the calyx, tend to become spreading. *Cordia insularis* was distinguished on this character.

The plant has for a century been identified, and correctly so, with *C. cana* Mart. & Gal., a species based on material from southern Oaxaca. It was, however, named very much earlier by Miller in his Gardeners Dictionary as *Lantana inerma.* The type of Miller's species, preserved at the British Museum, is an unmistakable, very characteristic specimen of the present plant, labeled, subsequent to Miller's time, as having been collected by Houston. According to Miller, "The seeds of this sort were first sent me by the late Dr. Houstoun, from La Vera Cruz, but I have since received them from Jamaica." The plant, however, is known neither from Jamaica nor from Vera Cruz, Mexico, or their general vicinity. Except for mistakes as to the color of flowers and fruit, Miller's description agrees reasonably well with his type. Even the ambiguous polynomial quoted from Sloane, really applying to a very different plant of Jamaica, might fit our species also.

12. **Cordia bullata** (L.) R. & S. Syst. 4: 462 (1819).
Varronia bullata L. Syst. ed. 10, 916 (1759); Amoen. Acad. 5: 394 (1759); Sp. Pl. ed. 2, 276 (1762). — Jamaica.
Cordia asperrima DC. Prodr. 9: 498 (1845); Urban, Symb. Ant. 3: 360 (1903). — Jamaica, *Bertero.* Not *Cordia asperrima* Spreng. Syst. 1: 649 (1825), which is a *Hyptis.*
Varronia asperrima (DC.) Friesen, Bull. Soc. Bot. Genève, sér. 2, 24: 155, t. 1, f. 5 (1933).
? *Varronia clarendonensis* Britton, Bull. Torr. Bot. Cl. 41: 16 (1914). — Jamaica, *Harris 10995.*

The species is known only from scattered localities in Jamaica, Mexico, and Central America.

MEXICO: Xnocac, Yucatan, *Gaumer 23479* (G, US); Dzitás, Yucatan, *Stewart 372* (G).
GUATEMALA: La Libertad, dept. Peten, *Aguilar 171* (G); near Chinana, shrub 1–1.5 m., July 1860, *Hayes* (G); Fiscal, dept. Guatemala, shrub 18 dm., *Standley 59552* (G); near Guatemala City, *Tonduz 630* (G, US); barranca near Guatemala City, 2.5–3 m., 1860, *Hayes* (G); indefinite, *Heyde 171* (US).
SALVADOR: near Chalchuapa, *Calderon 1002* (G, US).
NICARAGUA: near Granada, *Maxon, Harvey & Valentine 7612* (G, US).
HONDURAS: Zamorano, dept. Morazán, *Valerio 140, 175,* and *1157* (G); Medina near Coyoles, dept. Yoro, *Yuncker, Koepper & Wagner 8637* (G).
JAMAICA: Farm Pen, Spanish Town, *Campbell 5857* (NY); Yardly Chase, *Harris 9671* (NY); upper Clarendon, *Harris 10995* (TYPE of *V. clarendonensis,* NY); Indefinite, *Wolle* (G); Union Hill, north slope of Mt. Diable, *Maxon 10417* (US).

The species has a close relative in the widely distributed *C. globosa* (Jacq.) HBK. and in *C. Bonplandii* (Desv.) R. & S. of northern Venezuela. It differs from the Venezuelan plant by having much smaller leaves and much smaller heads with less thickened calyx-tips and more elongate peduncles. Although *C. bullata* practically always can be separated at a glance from the closely related *C. globosa,* no single character has been found that decisively separates them. There are numerous differences, but these do not vary together and are not always positive. Although an honest statement of differences in the key may not be very impressive, I am of the opinion that *C. bullata* and *C. globosa* are two species worthy of recognition. Of the two, *C. bullata* is more loosely branched and has more slender and more woody twigs. Its leaves are usually ovate, sharply and frequently doubly serrate, and are sharp-pointed at the apex. They are usually a darker green than the lanceolate or elliptic, usually bluntly toothed thinner leaves of *C. globosa.* The leaf-veins are usually much branched and anastomosing to form an evident reticulum that is usually prominent on the lower face and frequently evident as impressed lines on the upper face. The lower surface of the leaf, and generally the upper also, is therefore broken up into small areoles a few millimeters in breadth. This is generally most evident on old, very mature foliage. The upper surface has short stiff ascending bristles, usually arising from bulbose mineralized bases. On hardened old leaves, on which the veins are well impressed on the upper surface, usually only one to several bristles arise from within each areole. On the lower leaf-surface the vein-reticulum may be moderately prominent on lush new foliage or, in some plants, partially hidden by an abundance of appressed hairs. Usually, however, and especially on hardened old leaves, the reticulum on the lower leaf-face is prominent and conspicuous. The areoles on the lower face in herbarium material, when examined under a lens, usually reveal a rather distinctive development of this species. In drying there is shrinkage of tissue beneath many of the thick bases of the major bristles on the upper surface. Accordingly, within the areoles on the lower surface there are usually present tiny concave depressions. A suggestion of this development may be detected very rarely in some specimens of *C. globosa.* In *C. bullata,* however, it is practically always present, at least in some degree, and in most specimens is very evident when looked for. The flowers of *C. bullata* are borne in heads averaging perceptibly smaller than those in *C. globosa.* The peduncles of *C. bullata,* furthermore, usually become distinctly more elongate than those of its relative. The tips of its calyx-lobes tend also to be thicker and somewhat shorter than in *C. globosa.* The corolla of *C. bullata* seems to be always small. Its short tube is very hairy within and swells only moderately to form a subcampanulate throat. The usually larger corolla of *C. globosa* is funnelform with the tube flaring into a widely dilating throat. It has a well-defined hairy band inside the tube. In *C. bullata* the band is less well defined and hairs frequently occur proportionately much lower down on the tube surface.

The name *Cordia bullata* (L.) R. & S. is clearly the oldest name for the plant of Jamaica later described as *C. asperrima* DC. It was originally published as *Varronia bullata* L. Syst. ed. 10, 916 (early 1759) and treated as follows: "bullata. B. V. fol. ovatis venoso-rugosis, spicis globosis. *Sloan. jam. t. 195, f. 1.*" The descriptive details and the cited plate both apply to the Jamaican plant later called *C. asperrima.* The name *V. bullata* next appears in the literature associated with the short original description of a Jamaican specimen collected by Browne. This was published by Elmgren, one of Linnaeus's students, Amoen. Acad. 5: 394 (Nov. 1759). The plant described is that now catalogued in the Linnaean Herbarium as no. 255.2 and is also the one discussed at length by Smith in Rees Cyclopedia, 36: sub *Varronia bullata.* Jamaican *Cordia asperrima* is clearly represented. A month after Elmgren published his dissertation, another was published by Sandmark, Amoen. Acad. 5: 376 (Dec. 1759), in which the name *V. bullata* was again mentioned. In this case it was associated with the first of the *Varronias* treated on page 172 of Browne's History of Jamaica. Browne's descriptive matter is ambiguous, but the plate cited, t. 13, f. 2, evidently represents the northern form of *C. globosa.* The fourth appearance of the name *V. bullata* is in the second edition of the Species Plantarum, 276 (1762). Linnaeus gave only two references as basis for the name, the first being Elmgren's description of *C. asperrima* and the second Jacquin's account of the utterly different *V. mirabiloides.*

It is to be noted that *Lantana bullata* L. Sp. Pl. 627 (1753), although a species of *Cordia,* is not synonymous with *Varronia bullata* L. Syst. ed. 10, 916 (1759). In the Species Plantarum, ed. 2, 276 (1762), Linnaeus correctly cites *Lantana bullata* as a synonym of *Varronia curassavica.*

13. **Cordia globosa** (Jacq.) HBK. var. **humilis** (Jacq.), comb. nov.

Varronia humilis Jacq. Enum. 14 (1760); Sel. Stirp. 41 (1763). — Jamaica.

Cordia humilis (Jacq.) Don, Gen. Syst. 4: 383 (1838).

Lithocardium corymbosum var. *humile* (Jacq.) Kuntze, Rev. Gen. 2: 438 (1891).

Cordia jacmeliana Krause, Beih. Bot. Centralb. 32: 344 (1914); Urban, Symb. Ant. 8: 579 (1921). — Jacmel, Haiti, *Krause.*

Varronia jacmeliana (Krause) Friesen, Bull. Soc. Bot. Genève, sér. 2, 24: 177 (1933).

Varronia humilis var. *mexicana* Friesen, Bull. Soc. Bot. Genève, sér. 2, 24: 162, t. 1, f. 4 (1933). — Morelos, Mexico, *Pringle 6346.*

Varronia mexicana Friesen, Bull. Soc. Bot. Genève, sér. 2, 24: 162 (1933).

MEXICO: Mazatlan, Sinaloa, *Rose, Standley & Russell 13719, 14136* (US), *Howell 10546* (US), and *Rose 3108* (US); La Constancia, Sinaloa, shrub 4 m., *Ortega 5518* (G, US); between Rosario and Acaponeta, Sinaloa, *Rose 1871* (G); Topolobampo, Sinaloa, 1897, *Palmer 180* (US); Culican, Sinaloa, shrub 2–3 m. tall, *Gentry 7081* (G) and *7087* (G); Colima, 1897, *Palmer 52* (G, US); Zitacuaro to Laurelles, Michoacan, shrub 4 m., *Hinton 13209* (G, US); Ixtapan, Mexico, tree, *Hinton 1164* (G, US); near Cuernavaca, Morelos, 3–4.5 m. tall, *Pringle 6346* (G, US); Yautepec, Morelos, *Rose, Painter & Rose 8547* (G, US); San Luis Tultitlanapa, Puebla, *Purpus 2472A* (G, US); Mt. Male, near Porvenir, Chiapas, *Matuda 4661* (G); Cosumel Island, *Gaumer 126* (G); Izamal, Yucatan, *Gaumer 801* (G, US); Progreso, Yucatan, *Lundell 7961* (G, US).

GUATEMALA: between Rio Hondo and Santa Cruz, dept. Zacapa, shrub 2 m. *Standley 74084* (G); Zacapa, shrub 2–3 m. tall, *Standley 73627* (G) and *73964* (G); Chiquimula, shrub 2 m., *Standley 73967* (G); between San Ildefonso and Cuilco, dept. Huehuetenango, *Steyermark 50751* (G).

SALVADOR: La Libertad, shrub 1–3 m., *Standley 23218* (G, US); Acajutla, shrub 1.5 m., *Eyerdam & Beetle 8735* (G, US).

NICARAGUA: base of Coseguina Volcano, *Howell 10256* (G); Santiago Volcano near Masaya, *Maxon 7678* (US); Managua, *Chaves 386* (US).

PANAMA: Punta Paitilla, shrub 1–2.5 m. tall, *Standley 26268* (G, US).

The widely ranging *Cordia globosa* breaks up into two geographic varieties. The northern and western plants, those found from Florida and northwestern Mexico south through the Greater Antilles and Central America, are here distinguished as the var. *humilis.* Typical *Cordia globosa,* a plant of the Lesser Antilles, Trinidad, Venezuela, and eastern Brazil, has larger, more pointed (acute or acuminate) leaves sharply serrate on the margins. Its flower-heads are also larger. These two varieties of the species are to be detected in any large and representative suite of specimens. The differences are not alway positive, especially in the Lesser Antilles, but serve reasonably well for the separation of northern and southern plants.

The variety is typified by the Jamaican plant described and illustrated as the "Round spiked Varronia" by Browne, Hist. Jam. 172, t. 13, f. 2, since Jacquin specially mentioned it when he described *Varronia humilis*. The plant described as *V. globosa* by Jacquin is evidently the southern plant. He stated that it resembled his *V. martinicensis*, but differed in flowers and inflorescence. In size and form of leaves the southern plant is indeed very similar to *C. martinicensis* as illustrated by Jacquin, Sel. Stirp. 41, t. 32 (1763).

14. **Cordia curassavica** (Jacq.) R. & S. Syst. 4: 460 (1819).

Varronia curassavica Jacq. Enum. 14 (1760) and Sel. Stirp. 40 (1763). — Curaçao.

Lantana bullata L. Sp. Pl. 627 (1753). Not *V. bullata* L. (1759) nor *C. bullata* R. & S. (1819). — Jamaica.

Varronia macrostachya Jacq. Enum. 14 (1760) and Sel. Stirp. 41 (1763). — Cartegena, Colombia.

Cordia macrostachia (Jacq.) R. & S. Syst. 4: 461 (1819).

Cordia brevispicata Mart. & Gal. Bull. Acad. Brux. 11²: 331 (1844). — Tehuacan, Puebla, *Galeotti 7192.*

? *Cordia peruviana* var. *mexicana* DC. Prodr. 9: 491 (1845). — Campeche.

Cordia linearis DC. Prodr. 9: 493 (1845). — Mexico, *herb. Pavon.*

Cordia hispida Benth. Bot. Sulphur 139 (1845). — Gulf of Fonseca, *Sinclair.*

Cordia Palmeri Wats. Proc. Am. Acad. 24: 62 (1889). — Guaymas, Sonora, *Palmer 281.*

Cordia socorrensis Brandeg. Erythea 7: 5 (1899). — Socorro Island, *Anthony 384.*

Cordia brevispicata var. *hypomalaca* Greenm. Field Mus. Pub. Bot. 2: 338 (1912). — Cerro San Felipe, Oaxaca, *Conzatti 1831.*

Cordia imparilis Macbride, Contr. Gray Herb. 49: 16 (1917). — Banio nuevo, Michoacan or Guerrero, *Langlassé 265.*

Cordia chepensis Pittier, Contr. U. S. Nat. Herb. 18: 253 (1917). — Chepo, Panama, *Pittier 4511.*

Cordia littoralis Pittier, Contr. U. S. Nat. Herb. 18: 253 (1917). — Porto Limon, Costa Rica, *Pittier 3641.*

Cordia mollis Pittier, Contr. U. S. Nat. Herb. 18: 294 (1917). — between Guatemala City and Salama, *Pittier 134.*

Ranging from Mexico and Cuba south through Central America and the West Indies into northern South America. In Mexico the plant grows along the Pacific slope in the western and southern parts of the country, extending as far north as middle Baja California and middle-western Sonora. Only in Yucatan is it found on the Caribbean slopes of Mexico. In Central America it occurs on both slopes but apparently with greater frequency on the Pacific.

The species is very widely ranging and includes very diverse forms. It has accumulated a formidable list of synonyms. The names given above include only the very oldest few and those based upon plants originating in Mexico and Central America. Although readily distinguishable by its inflorescence, our plant has been frequently confused with *C. cylindrostachya* (R. & P.) R. & S. and its allies, of northwestern South America. The latter range along the Andes from Colombia to Bolivia and produce most of their spikes directly from leaf-axils along leafy twigs, only the very first produced on the shoot being terminal. The spikes of *C. curassavica,* on the other hand, are all terminal. By subsequent elongation of the twig, however, the spikes may appear to arise from stem-forks or, still on naked peduncles and without subtending leaves, from internodes along leafy stems. None of the spikes in *C. curassavica* ever arise from the leaf-axils.

The oldest name for this widely distributed plant is *Lantana bullata* L. Sp. Pl. 627 (1753). The description of the species records it as "spicis oblongis" and as originating in Jamaica. Linnaeus's knowledge of it was apparently derived entirely from the writings of Plukenet and Sloane. Of the three references given, one is to the works of the former and two to the latter. The first given is to Plukenet, Alm. 329, t. 221, f. 3, and clearly applies to a form of *C. curassavica.* The second reference, *Periclymenum . . . folio majore oblongo bullato . . .,* Sloane, Hist. 2: 81, applies to a close relative of *C. curassavica.* The third reference, however, *Periclymenum . . . folio majore subrotundo bullato,* Sloane, Hist. 2: 81, t. 195, f. 1, involves a very different species, one bearing flowers in heads, which Linnaeus, Syst. ed. 10, 916 (1759), later distinguished as *Varronia bullata.* In the second edition of the Species Plantarum 2: 276 (1762), Linnaeus cited *Lantana bullata* (without name) as a synonym of *Varronia curassavica* Jacq. Of the three references originally given for *Lantana bullata* only the first of the two Sloanean ones is repeated in his synonymy of Jacquin's species. It is to be particularly noted that the significant phrase, "spicis oblongis," first used in 1753, again appears in his diagnosis of *C. curassavica.* Although the name *Lantana bullata* L. (1753) much antedates *Verronia curassavica* Jacq. (1760), it cannot be transferred to *Cordia* or *Varronia,* since the resulting combination would be a homonym of *C. bullata* R. & S. (1819) or *V. bullata* L. (1759).

The next available names for our plant are *Varronia curassavica* Jacq. and *V. macrostachya* Jacq. These were first published in Jacquin's Enumeratio, p. 14 (1760) as follows:

"*curassavica* 1. VARRONIA spicis oblongis; foliis lanceolatis. ♄ *Brown. Jam. 2. p.* 172.

"*macrostachya* 2. ——— ——— spicis oblongis; foliis lanceolato-oblongis. ♄ ." Three years later they were again treated, with more detail, by Jacquin, Sel. Stirp. p. 40–41 (1763), as follows:

"1 VARRONIA spicis oblongis; foliis lanceolatis. Varronia assurgens sarmentosa, foliis & capitulis oblongis. *Brown. jam. 2. p.* 172. Frutex quindecimpedalis; *ramis* teretibus, scabris, senioribus ferrugineis. *Folia* lanceolata, acuta, serrata, rugosa, venosa, facie scabra, petiolata, alterna. *Spicae* densae, terminales, duos tresve pollices longae, insidentes pedunculo bipollicari. *Flores* parvi, inodori. *Calycis* inflati *laciniae* subovatae desinunt in denticulos setaceos ejusdem secum longitudinis. Corollae albae *tubus* longitudine calycem aequat; *limbus* brevis est & emarginatus. *Stamina* petalo sunt paulo breviora. *Stylus* etiam brevis *stigmate* capitato simplicique instruitus. *Drupa* rubra & parva est. Habitat in Curaçao in sepibus arboreis.

"2. VARRONIA (*macrostachia*) spicis oblongis; foliis lanceolato-oblongis. Arbuscula erecta, duodecimpedalis. *Spicae* semipedalis. *Folia* angusta, semipedalis. Reliqua, ut in praecedente. Habitat Carthagenae in fruticosis & silvaticis."

It will be noted that the trivial name *curassavica* was omitted in the second publication. The lengthy discussion published in 1763, however, evidently applies to *V. curassavica.*

I have come to the conclusion that Jacquin's two binomials apply to forms of a single species. *Varronia curassavica* is the common xerophytic phase, and *V. macrostachya* is the more luxuriant mesophytic phase of the most common of the spicate *Varronias* in northern South America. This is a departure from some recent usage in which *V. curassavica* has been applied to the plant distinguishable as *C. divaricata* HBK.*

The identity of *V. macrostachya* is readily established since there is only one species to which it is possibly applicable that has been found at its type locality (Cartagena) and in ecologically similar stations (Barranquilla, Santa Marta) on the dry north coast of Colombia. Jacquin says that *V. macrostachya* differs from *V. curassavica* in being a shrub 3.6 m. (rather than 4.5 m.) tall, in having spikes 15 cm. (rather than 5–7.5 cm.) long, and in having lance-oblong (rather than lanceolate) leaves reaching 15 cm. in length. The elongate spikes and large leaves indicate that he had one of the luxuriant mesophytic phases of the species repeatedly collected near the ports of northern Colombia.

The specific name selected by Jacquin when he named *V. curassavica* makes it desirable that the binomial should apply to some plant of Curaçao. Only two spicate *Varronias* occur on the island. Judging from the relative number of collections made there, *C. divaricata* must be rare or local on the island, and the xerophytic phase of the plant named *V. macrostachya* must be common and widely distributed there. The latter seems to be the plant to which the name *V. curassavica* belongs. Jacquin's description of the leaves of the island plant, "lanceolate" and "acute," certainly apply best to it. Had Jacquin possessed material of *C. divaricata,* he would certainly have mentioned the hairy upper leaf-faces in distinguishing it from the plant of Cartagena. He does speak of the scabrous leaves of *V. curassavica,* but this almost certainly refers to the harshness resulting from the great numbers of minute siliceous tubercules usually present on the glabrous upper surface of the xerophytic form of *V. macrostachya.* If *V. curassavica* is taken as one of two possible species of Curaçao and is judged by comparisons with *V. macrostachya,* its identity

* A species widely distributed in northern Venezuela and best known from the region about Caracas. It extends into northeastern Colombia and is present on Curaçao and also on Dominica and Martinique. It differs from *C. curassavica* in having leaves broadest at or above the middle, round at the apex, usually strongly crenate or toothed on the margin, and commonly soft-hairy on the upper surface. The calyx-lobes tend to be shorter and proportionately broader, and the corolla-lobes are usually more erose-denticulate and crisped than in *C. curassavica. C. cuneiformis* DC. is a synonym.

seems clear. *Varronia curassavica* and *V. macrostachya* are forms of one species.

Some of the details in Jacquin's later discussion of *V. curassavica*, however, are puzzling. They agree neither with *C. divaricata* nor with forms of *V. macrostachya*. They suggest that Jacquin's notes may have been faulty, that he may have been misled by extraneous material associated with his specimens, or that there was some confusion in his manuscript. In the first place he states that *V. curassavica* grew 4.5 m. tall, a height which is certainly unusual if not greatly excessive for the species. Most important, however, he gives the calyx as inflated and having subovate lobes prolonged into setaceous tips. This agrees with the calyx of *Varronia globosa* Jacq., a species with capitate inflorescences common on Curaçao, but certainly not with any of the spicate *Varronias* known from the island or from Venezuela. Indeed almost all of the details given for the flowers of *V. curassavica* could apply better to *V. globosa*. It is surprising that Jacquin, in his description of *V. globosa*, made no mention of the setaceous tips of the calyx-lobes, one of the most conspicuous and distinctive traits of that species. Finding reference to such structures in Jacquin's description of *V. curassavica*, where they certainly do not belong, I am willing to believe that the notes on flowers and fruit appearing there may have been intended for his account of *V. globosa* and were somehow misplaced. Fortunately, the confusion described can be overlooked, since it does not appear in the Enumeratio (1760), where the species were established. It appears only in the Stirpium (1763), his second amplified treatment of the species, where by oversight even the specific name "*curassavica*" was omitted. Since we are able to associate it with one of the two spicate *Varronias* of Curaçao, the name *V. curassavica* can be used. Moreover, it is preferred to *macrostachya* in combining Jacquin's two species, since it belongs to the species originally given priority of position and a fuller discussion. Also it has been more frequently used by subsequent authors and is hence the more familiar name.

In the present paper I have defined *C. curassavica* very broadly, for the simple reason that I have not had time to give the Mexican and Central American plants of this complex group the study they need. I have included under it some very diverse forms which will almost certainly be treated eventually as separate species. The diverse forms of Mexico and certain hairy plants of Central America are in many ways more similar to plants of the Greater Antilles than to typical *C. curassavica*, and must be studied with the former.

Typical *C. curassavica* is known only from northern South America from the Guianas to Colombia, and extends north only to Martinique and Yucatan. In our region it has synonyms in *C. chepensis* Pittier and *C. littoralis* Pittier. It is the only form of the present aggregate found in Panama. Specimens in the Gray Herbarium representing typical *C. curassavica* from Central America are as follows:

PANAMA: Chepo, *Pittier 4511* (*C. chepensis* Pittier); Balboa, *Standley 25552* and *27152*; Ancon Hill, *Killip 12059*; Race Track near Panama, *Standley 27795*; Bella

Vista, *Maxon & Valentine 6945;* Miraflores Lake, *White 244;* Isla Taboga, *Woodson, Allen & Seibert 1485;* Aguadulce, Coclé, *Pittier 4860;* between Aguadulce and Anton, *Woodson, Allen & Seibert 1207;* El Valle, Coclé, *Allen 100* and *753, Seibert 439;* between Las Margaritas and El Valle, *Woodson, Allen & Seibert 1293;* Manzanillo Island, *Hayes 5;* Chagres, *Fendler 130;* near Chiriqui Lagoon, Bocas del Toro, *Wedel 562, 2478, 2608,* and *2923.*

COSTA RICA: Port Limon, *Pittier 3641* (*C. littoralis* Pittier).

SALVADOR: Acajutla, *Beetle 8730.*

NICARAGUA: San Juan del Norte, *C. L. Smith 91.*

GUATEMALA: Jutiapa, *Standley 75263.*

BRITISH HONDURAS: Manatee Lagoon, *Peck 65;* Lower Belize River, *Record;* New Town, *Schipp 821;* Bakers Pine Ridge, *Lundell 7002;* Honey Camp, *Lundell 508;* San Antonio, Corozal, *Lundell 4986.*

MEXICO: Yucatan, Chankon, *Bequaert 84;* indefinite, *Gaumer 24027* and *24234;* Quintana Roo, Lake Coba, *Lundell 7686;* Campeche, Hecelchakan, *Stewart 11.*

15. **Cordia costaricensis**, sp. nov.

Frutex scandens, ramulis minute brunneo-pubescentibus, internodis 1–7 cm. longis; foliis alternis late lanceolatis penninervis reticulato-venosis, majoribus 10–15 cm. longis et infra medium 5–6 cm. latis, apice acutis acuminatisve, basi obtusis vel rotundis, margine minute sed distincte serratis, facie superiori minute papillatis pilis rigidis ad 0.5 mm. longis plus minusve donatis rare subglabris, facie inferiori pilis minutis mollibus 0.2–0.5 mm. longis plus minusve donatis; petiolo 1–3 cm. longo cum pedunculo vel ramo axillari basi connato; spicis densis vel laxis 2–8 cm. longis ad 8 mm. crassis 1–3 cm. longe pedunculatis in paniculis laxis 15–25 cm. longis terminalis vel axillaribus paucissime foliatis gestis; calyce sessile fere ad medium lobato, in alabastro late obovato 2–3 mm. crasso summum ad apicem rotundatum apices liberes loborum 0.2–0.5 mm. longas prorerenti, extus subglabro vel supra medium pilis minutis rigidulis sparse obsito, intus glaberrimo, sub anthesi 4–5 mm. longo basi et paulo supra basem 1–1.5 mm. crasso deinde sursum gradatim ampliato apice 4–5 mm. diametro; lobis calycis ascendentibus deltoideis vel ovato-deltoideis, apice apiculatis et subincrassatis, sinibus acutis; corolla campanulata 5–6 mm. longa, basi 1.5–2 mm. crassa ceinde sursum ampliata, apice 5–6 mm. diametro, margine erosa haud lobata, extus glabra, intus sub insertione staminum villosa alibi glabra; staminibus inclusis, antheris 1 mm. longis, filamentis 2.5 mm. longis; ovario cum stylo glabro; fructu ignoto.

COSTA RICA: Vicinity of El General, prov. San Jose, 1190 m. alt., scandent shrub, edge of forest, fl. white, Aug. 1936, *A. F. Skutch 2828* (TYPE, Gray Herb.); Vara Blanca de Sarapiqui, north slope of Central Cordillera, 1500–1750 m. alt., in thicket, fl. white, July-Sept. 1937, *Skutch 3175* (G).

A very well marked species with its closest relations in *C. multispicata* Cham. of eastern Brazil. From that species it differs in its somewhat larger and more elongate leaves, axillary panicles of spikes, and tubular erose-margined corollas.

16. **Cordia spinescens** L. Mant. 2: 206 (1771). — "India orientali."

Varronia ferruginea Lam. Tab. Encyc. 1: 418 (1791); Poir., Encyc. 4: 263 (1797); Desv. Jour. de Bot. 1: 266, t. 9 (1809). — Based on plants cultivated at Paris.

Cordia ferruginea (Lam.) R. & S. Syst. 4: 458 (1819).

Cordia riparia HBK. Nov. Gen. et Sp. 3: 71, t. 207 (1818). — Type from Mompox, Magdalena Valley, Colombia.

Cordia laxiflora HBK. Nov. Gen. et Sp. 3: 72 (1818). — Between Mompox and Morales, Magdalena Valley, Colombia.

Cordia pyrifolia Willd. ex R. & S. 4: 802 (1819). — South America.
Cordia Thibaudiana DC. Prodr. 9: 489 (1845). — America.
Cordia crenulata A.DC. Prodr. 9: 492 (1845). — Mexico, *herb. Pavon.*
Varronia crenulata Sessé & Moc. Fl. Mex. 48 (1893), ed. 2, 44 (1894). — From Orizaba, Mexico.
Cordia pauciflora Rusby, Mem. Torr. Bot. Cl. 6: 83 (1896). — Near Cochabamba, Bolivia, *Bang 1291.*

Ranging from Mexico southward through Central America into Colombia and from there south along the Andes to Bolivia. In Mexico it is practically confined to lower altitudes towards the coasts and is found as far north as Nayarit and middle Vera Cruz. Most of the many specimens examined come from Mexico, Guatemala, and Panama.

This species has been called *C. ferruginea* (Lam.) R. & S. It has, however, an older name in *Cordia spinescens* L. This latter was based upon a specimen still preserved in the Linnaean Herbarium. It was launched with a detailed description, but, unfortunately, was mistakenly said to be an East Indian plant. Unrecognized by botanists in the Old World and unstudied by botanists in America the species has remained neglected and unplaced. No *Cordia* remotely suggesting it is known from the Old World. It is, however, indistinguishable from the well-known American species usually called *C. ferruginea.* The type of *C. spinescens* has a few spikes and numerous developing axillary shoots and the general appearance of growing in a botanic garden away from its natural environment. I suspect that it may have been grown from seeds sent from Colombia by Mutis or have been derived from plants of other sources grown at Madrid or Paris. The species is known to have been in cultivation in Europe in the late eighteenth century. The synonymous *C. ferruginea,* indeed, was based on plants growing at Paris sometime previous to 1791. The specific name "*spinescens*" adopted by Linnaeus refers to the decurved spurs, persisting indurated basal portions of petioles, that are very well developed along the clambering shoots of this shrub.

B. THE IDENTITY OF SPECIES PROPOSED BY SESSÉ AND MOCIÑO

A very large number of puzzling species were published about fifty years ago, when the manuscripts of Sessé & Mociño were dug out of the archives at Madrid and printed in Mexico as the "Flora Mexicana" and "Plantae Novae Hispanicae." The Boraginaceae described in these works mostly defied identification. On various trips to Europe, accordingly, I methodically recorded the data on all specimens believed to be collections of Sessé & Mociño. Notes were also made on the set of Mociño drawings at Geneva. In 1936, when the Sessé & Mociño herbarium at Madrid was loaned to the Chicago Natural History Museum for study, I was allowed to examine all the Boraginaceae it contained. With data assembled from the sources mentioned it is now possible to identify with reasonable accuracy the species first published in the posthumous writings of Sessé & Mociño. Only those species which the authors themselves obviously intended as new proposals are here discussed, since only these have any nomenclatorial importance. The many misidentifications contained in the work are properly ignored.

The specimens from Madrid commonly bear the identification of Sessé & Mociño and frequently also their collection number, but never any geographical data. To facilitate reference, a new set of herbarium numbers was applied to the sheets in the collection after it arrived at Chicago. In referring to the Sessé & Mociño material belonging to Madrid, this new set of numbers has been used. For each collection mentioned I have given its recently assigned number, and, when it is not an unpublished binomial, have given the Sessé & Mociño identification also.

The study of the Sessé & Mociño borages has made it clear that the authors either collected in northern Mexico or had collaborators there. In the past it has been generally stated that their material came only from central and southern Mexico, Guatemala, Cuba, and Porto Rico. Rickett has recently found proof that northwestern Mexico was another source. Northeastern parts of the country, very likely the vicinity of Monterrey, are also to be included. This is evidenced by the presence in the Sessé & Mociño herbarium of material of *Cordia podocephala* Torr., *Cordia Boissieri* DC., *Ehretia Anacuna* (Berl.) Johnston, and especially *Omphalodes aliena* Gray.

Cordia alliodora (R. & P.) Cham.

Varronia tuberosa S. & M. Pl. N. Hisp. 30 (1888), ed. 2, 28 (1893). — From Metepec, Vera Cruz.

The material of this species assembled by Sessé & Mociño and now at Madrid is numbered and bears original identifications as follows: 752 (*Cerdana*), 1352 (*Varronia tuberosa*), 1366 (*Cordia nodosa*), 1452 (without name), 1568 (*Cordia Gerascanthus*), 1569 (*Cerdana*), 5275 (*Cordia globosa*). A specimen at Oxford is labeled "*Varronia tuberosa*, Mexico ex herb Ruiz."

When *Varronia tuberosa* was described reference was given to "Fl. Mex. Ic. 193." This plate number appears on no. 882 of DeCandolle's copies of the Mociño plates at Geneva. The plate is labeled "*Cordia nodosa*," a name apparently originating with Sessé & Mociño. It is incorrectly cited under *Cordia nodosa* Lam. in the Prodromus 9: 475 (1845).

Cordia diversifolia Pavon ex DC.

Cordia paniculata S. & M. Fl. Mex. 49 (1894), ed. 2, 45 (1894). — Habitat in Oppido de la Punta, ? Vera Cruz.

An unidentified specimen at Madrid bears the number 760. It is conspecific and probably a duplicate of at least the Mexican specimen from Pavon's herbarium cited by DeCandolle, Prodr. 9: 474 (1845), when he described *C. diversifolia*.

Cordia dodecandra DC.

Cordia dodecandria S. & M. Fl. Mex. 50 (1894), ed. 2, 46 (1894). — From coast at Alvarado, Vera Cruz.

This species is represented by an unidentified specimen, no. 758 bis, at Madrid, and also by a fine colored plate, tab. 874, among the copies of the Mociño drawings at Geneva. The plant, bearing the name *"Cordia dodecandra,"* is the basis upon which DeCandolle, Prodr. 9: 478 (1845), described the species.

Cordia elaeagnoides DC.

? *Cordia exsucca* S. & M. Fl. Mex. 49 (1894), ed. 2, 45 (1894). — Habitat in Apataingani [Michoacan] aliisque calidissimis Novae Hispaniae locis.

I have seen no material collected by Sessé & Mociño and am able to judge their *C. exsucca* only from the description. This fits *C. elaeagnoides* DC. reasonably well.

Cordia pauciflora DC. ex Ramirez, Estud. Hist. Nat. 295 (1904), not Rusby (1896).

Ramirez identifies plate 877 of the set of Sessé & Mociño plates at Geneva with plate 25 of the set at Madrid and associates them with *"Cordia Sebestena,* Jacq. — Plantae Novae Hispaniae pag. 28. Ic. 36." The plate at Geneva is very sketchy, being only a poor pencil outline. It bears the name *"Cordia pauciflora,"* which probably originated with Sessé & Mociño. In general habit the sketch most suggests a species of *Bourreria.* I do not believe it is the same as *Cordia Sebestena* sensu Sessé & Mociño, Pl. N. Hisp. 30 (1888), ed. 2, 28 (1893), which is given as originating in dry fields near Cuernavaca. Ramirez's publication of the name *"Cordia pauciflora"* consists of mere casual mention. No description is given.

Cordia podocephala Torr.

Varronia longifolia S. & M. Fl. Mex. 48 (1893), ed. 2, 44 (1894). — Habitat in Praedio de la Punta, ? Vera Cruz.

A specimen at Madrid, no. 5269, bears the name *"Varronia longifolia* N." The plant is unquestionably conspecific with *C. podocephala,* known only from northeastern Mexico and adjacent Texas. The published description of *V. longifolia* agrees with Torrey's species, also.

Cordia spinescens L.

Varronia crenulata S. & M. Fl. Mex. 48 (1893) ed. 2, 44 (1894). — From the vicinity of Orizaba, Vera Cruz.

Material at Madrid representative of the species is as follows: 739 (*Varronia crenulata*), 740 (without name), 741 (without name), 742 (without name), 5262 (new sp. aff. spinescens), 5264 (*Varronia spinescens*), 5273 (*Varronia crenulata*). Judging from similarities in material I would say that parts of only three different collections are represented in the suite cited. The type of *Cordia crenulata* DC., Prodr. 9: 492 (1845), is almost certainly a duplicate of one of these collections.

Ehretia Anacuna (Berl.) Johnston

Ehretia lancifolia S. & M. Fl. Mex. 51 (1894), ed. 2, 44 (1894). — Habitat in Texcuco.

Representative specimens of the species at Madrid are as follows: 773 (*E. lancifolia*), 774 (*Ehretia* sp. nov.), 775 (without name), 5247 (*Ehretia* sp. nov.), 5250 (*E. lancifolia,* communicavit D. Ignatius de Leon, Horti Reg. Mex. Alumnus). Judging from general appearance, the material cited probably consists of duplicates of no more than two different collections, one bearing the name *E. lancifolia* and the other an unpublished binomial. The species is known as a wild plant only in northeastern Mexico and adjacent Texas, but I have seen cultivated specimens of it from as far south in Mexico as Guanajuato.

Bourreria rotata (DC.) comb. nov.

Cordia rotata Mociño ex DC., Prodr. 9: 483 (1849).

Ehretia calophylla Richard in Sagra, Fl. Cubana 2: 112, t. 61 (1853).

Bourreria calophylla (Rich.) Wright in Sauvalle, Fl. Cubana 110 (1870); Schulz in Urban, Symb. Ant. 7: 52 (1911).

The species described by DeCandolle is based upon a handsome colored plate, no. 880, in the set of Mociño drawings at Geneva. The plate shows a plant with the characteristic forking style of a *Cordia,* but in all other details it is a remarkably good representation of the Cuban plant now current as *Bourreria calophylla.* The forked style is evidently a mistake of the artist.

Bourreria spathulata (Miers) Hemsley

Ehretia cuneifolia S. & M. Fl. Mex. 51 (1894), ed. 2, 47 (1894). — From Chilpanzingo, Guerrero.

Two collections of the species are at Madrid: 1354 (*Ehretia exsucca*) and 5252 (*Ehretia cuneifolia,* olim *exsucca*). A fine original colored plate of the species occurs among the Mociño plates at Geneva, no. 887. It bears an unpublished binomial, under *Ehretia,* and also Mociño's number, 292. This latter was cited when *Ehretia cuneifolia* was described. Miers based his species upon a plant from Pavon's herbarium. The type is almost certainly a duplicate of one of the two Madrid specimens cited above.

Heliotropium angiospermum Murr.

Heliotropium lancifolium S. & M. Fl. Mex. 31 (1893), ed. 2, 29 (1894). — Cuernavaca, Morelos.

Cerinthe lanceolata S. & M. Pl. N. Hisp. 20 (1888), ed. 2, 19 (1893). — Cuernavaca, Morelos.

The herbarium at Madrid contains a number of specimens of this species: 858 (*Heliotropium* sp., *Cerinthe lanceolata*), 1384 (*Heliotropium indicum*), 1718 (*Heliotropium lancifolium*), 1719 (*Heliotropium* sp. nov.), 1722 (*Heliotropium parviflorum*), 5254 (*Heliotropium parviflorum*). Some of the material probably came from Havana and is that treated as *H. parviflorum* in Flora Mexicana 31 (1893), ed. 2, 28 (1894).

Heliotropium assurgens Johnston

Anchusa incana S. & M. Fl. Mex. 33 (1893), ed. 2, 30 (1894). — Cuernavaca, Morelos.

Two specimens at Madrid clearly belong to this species: 931 (*Lithospermum* olim *Anchusa incana*) and 1435 (*Anchusa incana*).

Heliotropium calcicola Fernald

Symphitum fruticosum S. & M. Pl. N. Hisp. 21 (1888), ed. 2, 20 (1893). — Chilpancingo, Guerrero.

There are three specimens at Madrid, 861 (*Heliotropium frutescens*), 1716 (*Heliotropium* sp. nov.), and 5256 (*Heliotropium* sp. nov.). They are so similar in appearance that they may well be only duplicates of a single collection. At Geneva there is a beautiful plate of the species, tab. 901, labeled *Symphitum fruticosum* and bearing the number 288 of Sessé & Mociño's series of plates. This latter number is cited in Sessé & Mociño's account of *S. fruticosum*. *Antiphytum mexicanum* DC., Prodr. 10: 121 (1846), was based entirely upon the plate at Geneva.

Heliotropium oaxacanum DC.

Lithospermum rosmarinifolium S. & M. Fl. Mex. 33 (1893), ed. 2, 30 (1894).— From Uruapam, Michoacan.

Anchusa depressa S. & M. Pl. N. Hisp. 21 (1888), ed. 2, 20 (1893). — From Uruapam, Michoacan.

Representative of the species at Madrid is one specimen, no. 5238. This is associated with an unpublished binomial of which "*rosmarinifolium*" is the specific adjective. The descriptions of Sessé & Mociño apply reasonably well to *H. oaxacanum* DC., and I am content to refer this proposed species to the synonymy of it.

Heliotropium Sessei Johnston

Myosotis mexicana S. & M. Fl. Mex. 33 (1893), ed. 2, 31 (1894). — In temperatis N. Hispan. montibus.

Two specimens are preserved at Madrid, 1725 (*Myosotis mexicana*) and 5229 (*Myosotis mexicana*). They are probably duplicates of a single collection. The description of *Myosotis mexicana* fits them reasonably well. The species is known only from Sierra de la Mesa, Hidalgo (*Purpus 1402* and *Rose, Painter & Rose 9122*) and from Sessé & Mociño's collections cited above.

Tournefortia bicolor Sw.

Tournefortia laevis S. & M. Fl. Mex. 52 (1894), ed. 2, 48 (1894). — Habitat in Novae Hispaniae regionibus.

A specimen at Madrid represents Sessé & Mociño's species, 1712 (*T. laevis*).

Tournefortia hirsutissima L.

Tournefortia odorata S. & M. Fl. Mex. 52 (1894), ed. 2, 48 (1894). — Habitat in Apatzingani [Michoacan].

Several collections of this species are at Madrid, most of them under unpublished names: 1705 (*T. suffruticosa*), 1706 (*Tournefortia* n. sp.), 1707 (*Tournefortia* sp. nov.), 1715 (*Tournefortia* sp. nov.), 5261 (*Tournefortia* sp. nov.). I suspect that no. 1707 may be the type of *T. odorata*. The other collections are perhaps those described as *T. suffruticosa* sensu S. & M. Fl. Mex. 52 (1894), ed. 2, 48 (1894), and *T. cymosa* sensu S. & M. Pl. N. Hisp. 31 (1888), ed. 2, 29 (1893). These latter two names apply to plants from San Juan de los Platanos near Apatzingan, Michoacan.

Tournefortia syringaefolia Vahl

Tournefortia lanceolata S. & M. Fl. Mex. 52 (1894), ed. 2, 48 (1894). — From mountains near Tuxtla, Vera Cruz.

Two specimens representative of *T. syringaefolia* (*T. peruviana*) are found at Madrid: 1711 (*T. lanceolata*) and 5260 (*Tournefortia* n. sp.). One is probably the type of *T. lanceolata* S. & M.

Lithospermum distichum Ortega

Lithospermum laevigatum S. & M. Fl. Mex. 32 (1893), ed. 2, 30 (1894).—Habitat in montibus Predii S. Nicolai [state of Mexico].

? *Anchusa mexicana* S. & M. Pl. N. Hisp. 21 (1888), ed. 2, 20 (1893).—Mountains of Patzquaro, Michoacan.

I have seen two specimens from Madrid representative of *L. distichum,* viz., 1732 (*Lithospermum laevigatum*) and 5226 (*Lithospermum* n. sp.). No specimen identified as *"Anchusa mexicana"* has been encountered. The original description of that species, however, agrees reasonably well with *L. distichum,* and I am content to refer it to the synonymy of the latter.

Lithospermum discolor Mart. & Gal.

Lithospermum obtusiflorum S. & M. Fl. Mex. 32 (1893), ed. 2, 29 (1894).—Habitat in montibus Oppido de El Valle.

Two specimens at Madrid belong here: 1737 (*L. obtusiflorum*) and 5232 (*L. obtusiflorum*). Specimens in the Boissier Herbarium labeled "Nueva Espana, herb. Pavon, Lithospermum obtusiflorum," are also referable to *L. discolor.*

Lithospermum strictum Lehm.

Lithospermum angustifolium S. & M. Fl. Mex. 32 (1893), ed. 2, 29 (1894).—From Ario, Michoacan.

Heliotropium mexicanum S. & M. Pl. N. Hisp. 20 (1888), ed. 2, 19 (1893).—Habitat in Sancti Angeli hortis, Valley of Mexico.

Lithospermum rosmarinifolium S. & M. Pl. N. Hisp. 20 (1888), ed. 2, 19 (1893).—Habitat in Oppido Ario, Michoacan. Not *L. rosmarinifolium* S. & M. Fl. Mex. 33 (1893), ed. 2, 30 (1894), which equals *Heliotropium oaxacanum* DC.

Three specimens from Madrid have been seen, viz., 1389 (*Heliotropium mexicanum*), 1734 (*Lithospermum angustifolium*), and 5234 (*Lithospermum angustifolium*). Among the drawings at Geneva there is a poor pencil sketch, no. 1174, labeled *"Heliotropium mexicanum."* In both of the large herbaria at Geneva there are specimens from the Pavon herbarium bearing the name *"Lithospermum angustifolium."* The description accompanying the name *L. rosmarinifolium* in the Plantae Novae Hispaniae is a repetition of that associated with *Lithospermum angustifolium* in the Flora Mexicana. The names, accordingly, must be synonymous.

Macromeria exserta Don

Echium longiflorum S. & M. Pl. N. Hisp. 20 (1888), ed. 2, 19 (1893).—Habitat in Mazatlani et Chilpanzingi montibus, Guerrero.

One specimen from Madrid has been seen, 859 (*Echium longifolium*). In the library at Geneva there is a fine original plate (no. 903 of the DeCandolle series) which bears Sessé & Mociño's original number, no. 293, and their original name, *Echium longiflorum.* This latter plant-number is cited with the published description of *Echium longiflorum.*

Macromeria longiflora Don

Lithospermum flavum S. & M. Fl. Mex. 32 (1893), ed. 2, 30 (1894).—Mountains between Zitacuaro and Malucatepec, Michoacan.

One specimen from Madrid has been seen, 1738 (*Lithospermum longiflorum*). There is a good plate at Geneva, no. 905, determined by Sessé

& Mociño as a species of *Philonomia*. DeCandolle has identified it with *Macromeria discolor* Benth. A specimen in the Boissier herbarium from Pavon was determined as *Lithospermum longiflorum* as was also Don's type of *Macromeria longiflora* at the British Museum. It should be noted that *M. longiflora* Don was formerly misunderstood and that, as has been shown, Contr. Gray Herb. **92**: 93 (1930), it properly applies to the well-marked species later described as *M. discolor* Benth.

Macromeria viridiflora DC.

? *Lithospermum longiflorum* S. & M. Fl. Mex. 32 (1893), ed. 2, 29 (1894).— Santa Rosa near Guanajuato.

Only one specimen from Madrid has been seen, 5231 (*Lithospermum longiflorum*). There are two plates of the species at Geneva. Upon them DeCandolle founded his *M. viridiflora*. One is plate no. 904 of the folio series, and the other is plate 12, f. 1 of the volume of Sessé & Mociño's generic analyses. They were treated as members of the new genus *Philonomia* and associatd with the specific name adopted by DeCandolle. The two plates and the specimen from Madrid are evidently conspecific with the plants subsequently treated as *Macromeria* (or *Onosmodium*) *Thurberi*. This latter species, however, is known only from southern Arizona and New Mexico and south along the northern Sierra Madre Occidental to southernmost Chihuahua. In the absence of modern collections from more southern localities it seems well to question old records attributing the species to central Mexico. Rickett, Chron. Bot. 11 [1]: 29 (1947), has given evidence that Mociño and his artist traversed the area in Chihuahua in which the species is well known. I am inclined to believe that they may have obtained it there.

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STUDIES IN THE BORAGINACEAE, XVIII
BORAGINACEAE OF THE SOUTHERN WEST INDIES

IVAN M. JOHNSTON

PRELIMINARY TO THE PREPARATION of an account of the Boraginaceae of Trinidad and Tobago it has been found desirable to survey the representation of the family in the West Indies. Some of the results are here presented in a synopsis of the species known from the Lesser Antilles, Tobago, and Trinidad. Special attention has been given to the details of distribution in the southern West Indies and to the taxonomic history of the species concerned. The study is primarily based on the collections of the Gray Herbarium (G), but numerous specimens from the New York Botanical Garden (NY), the United States National Herbarium (US), and the Trinidad Botanic Garden Herbarium (T), have also been examined.

KEY TO GENERA

Style twice cleft, with the four branches each bearing a stigma...1. *Cordia*.
Style cleft or simple.
    Style evidently cleft, bearing two stigmas.
        Corolla subrotate; flowers and leaves produced on dense axillary short-shoots; plant frequently spiny........2. *Rochefortia*.
        Corolla salverform; plant unarmed................3. *Bourreria*.
    Style simple or very short or none; stigma annular, usually surmounted by a sterile, conic or cylindric, occasionally lobed appendage.
        Fruit with fleshy mesocarp; large shrubs........4. *Tournefortia*.
        Fruit dry, without any fleshy mesocarp; herbaceous...5. *Heliotropium*.

1. CORDIA

KEY TO THE SPECIES

Corolla vermilion, about 4 mm. long, frequently 6-lobed; mature fruit hard, dry, ovoid, 20–25 mm. long, completely and tightly invested by the calyx that becomes white and fleshy...............1. *C. Sebestena*.

Corolla white or cream-colored, 5-lobed; calyx not fleshy at maturity.

Pubescence stellate; corolla marcescent, persistent; fruit slender, elongate, thin-walled, dry, developing ensheathed by corolla-tube and 10-ribbed cylindrical calyx, when fully mature the whole flower falling with the enclosed fruit, the still spreading corolla-lobes functioning as a parachute. .2. *C. alliodora.*

Pubescence simple or none; corolla withering, falling after anthesis; fruit drupaceous.

Corolla very large, 35–50 mm. long, the slender exserted tube abruptly and broadly expanded into a well-developed cylindrical throat; inflorescence capitate; tips of calyx-lobes conspicuously long-attenuate. . . . . .3. *C. grandiflora.*

Corolla less than 15 mm. long and usually much shorter, without a well-differentiated tube and throat.

Fruiting calyx half to almost completely investing the drupe, the latter red, 4–6 mm. long, with a thin quickly dessicated flesh; stone irregularly warted; corolla-limb usually only shallowly and very broadly lobed; plant usually with a sagy odor.

Inflorescence not distinctly spicate.

Calyx-lobes with prolonged hairy setaceous tips about 5 mm. long; inflorescence a globose head 1.5–3 cm. in diameter. . . . . .4. *C. globosa.*

Calyx-lobes acute, without prolonged tips.

Upper leaf-surface bearing short stiff hairs in great abundance; inflorescence terminal or internodal but never axillary, repeatedly forked and becoming a loose open cyme at maturity; corolla with reflexed, crisped, lacerate-dentate lobes about as long as broad. . . . . 5. *C. salvifolia.*

Upper leaf-surface glabrous or apparently so, stiff hairs few, scattered and inconspicuous; inflorescences mostly axillary, simple or sparingly branched, the cymes capitate or glomerate and loosening little if at all in most advanced maturity; corolla with obscure lobes several times as broad as long, margins entire or nearly so. .6. *C. polycephala.*

Inflorescence spicate.

Spikes mostly axillary, with the peduncle and the petiole of the subtending leaf united for 3–9 mm. at their base; upper surface of leaves more or less lustrous, with scattered tightly appressed hairs. . . . . .7. *C. Schomburgkii.*

Spikes all terminal or internodal, never axillary; upper surface of leaves glabrous or bearing ascending or erect hairs.

Corolla-limb subentire, its very short inconspicuous lobes several times broader than long; calyx-lobes usually with short but distinct tips that are free in the bud; spike dense, in fruit 10–15 mm. thick; fruit matured in a subinflated calyx....8. *C. martinicensis.*

Corolla smaller, the limb with evident reflexed lobes about as broad as long; calyx-lobes without prolonged tips that are free in the bud; spikes frequently becoming loose and interrupted, in fruiting state usually 8 mm. or less thick; fruit partially protruding from the cup-shaped calyx.

Leaves lanceolate to lance-ovate, broadest at or below middle, apex acute, margin entire or somewhat dentate or crenate, upper surface usually glabrous or rarely with short stiff hairs; corolla-lobes entire or obscurely erose-dentate, weakly if at all crisped............................9. *C. curassavica.*

Leaves broadest at or above middle, apex usually rounded, margin usually evidently crenate or dentate, upper surface at least on young foliage usually with evident soft hairs; corolla-lobes usually erose-dentate and crisped...............................10. *C. divaricata.*

Fruiting calyx usually explanate or saucer-shape, covering only the very base of the drupe, the latter 8–16 mm. long and with a very well-developed juicy mesocarp; stone ribbed or lacunose.

Calyx 10-ribbed, in the bud appendaged at apex, usually irregularly circumscissile below summit; corolla showy, broadly funnelform, its lobes emarginate and about as broad as long.............11. *C. dentata.*

Calyx not distinctly ribbed, not appendaged at apex, usually opening regularly and 5-lobed; corolla with cylindrical tube and spreading elongate lobes.

Petioles of well-developed leaves 1.5–4 cm. (usually 2–3 cm.) long.

Leaves 5–11 cm. long, lower surface (as well as petiole and branches of inflorescence) practically glabrous at maturity; fruit a very plump and juicy drupe, 1.5 cm. long, pink or salmon in color.........12. *C. obliqua.*

Leaves 10–20 cm. long, with brownish indument of abundant short soft appressed hairs on lower surface, as well as on petiole and branches of inflorescence; fruit a whitish drupe, 8–10 mm. long....13. *C. tetrandra.*

Petioles of well-developed leaves 0.2–1.5 cm. (usually 0.5–1 cm.) long.

Leaves usually broadest above middle, apex acute or with a coarse, generally obtusish short prolongation; tree deciduous, producing its inflorescence on bare twigs before or simultaneously with the appearance of the new leaves of the season; fruit red; flowers markedly heteromorphic, those on each tree functionally either male or female....... ....14. *C. Collococca.*

Leaves usually broadest below the middle, at least the larger ones with a sharp prolonged attenuate tip; plant bearing its inflorescence on leafy shoots; fruit white or yellowish.

Lower leaf-surface with an evident pallid indument of abundant minute whitish hairs, the hairs confined to the veins and veinlets and appressed and directed concentrically over the numberless areoles in the veinlet-reticulum; fruit strigose; flowers homomorphic, perfect, functionally bisexual........... ....15. *C. bicolor.*

Lower leaf-surface velvety and somewhat glabrescent, green, gray or tawny, the areoles in the veinlet-reticulum not covered by appressed, concentrically directed hairs; fruit glabrous.

Flower-buds large, 7–9 mm. long, broadly clavate; calyx coarsely and irregularly 2–3-lobed, its margins fragmenting and erose; flowers homomorphic, all perfect and functionally bisexual............ ....16. *C. elliptica.*

Flower-buds smaller, 2.5–4 mm. long; calyx with 5 small subequal teeth; flowers markedly dimorphic, those on a particular tree functionally either male or female; female flowers with a clavate-cylindric bud, at anthesis with a cylindric calyx, an inconspicuous corolla, small stamens and evidently protruding styles; male flowers with a subglobose or globose bud, at anthesis with a cup-shaped calyx, evident corolla-limb, conspicuously exserted stamens and reduced included female organs.

Larger leaves usually subcordate at base, tip acute or moderately attenuate, blade up to 19 cm. broad, usually strigose or rather smooth above though at times somewhat velvety, at most only moderately scabrous; twigs, petioles and inflorescence tomentose-floccose, velvety or strigose, the short hairs spreading or appressed.......17. *C. sulcata.*

Larger leaves acute, obtuse or rounded at base, the tip attenuate and prolonged.

Leaf decidedly scabrous above, with rigid hairs only moderately appressed; blade up to 15 cm. broad; twigs, petioles, and inflorescence bristly with stiff hairs 1–2 mm. long, if also bearing other hairs these minute appressed and (especially on the twigs) usually retrorse.......18. *C. panamensis.*

Leaf with very minute closely appressed hairs and rather smooth; blade up to 11 cm. broad; twigs, petioles and inflorescence not at all bristly, very finely strigose with the minute short hairs very closely appressed and all antrorse.19. *C. sericicalyx.*

1. **Cordia Sebestena** L. Sp. Pl. 190 (1753). — Type West Indian.

Native of the West Indies and ranging from the Bahamas to northern Venezuela; now widely cultivated in the tropics.

GUADELOUPE: *Duss 2754* (G). MARTINIQUE: *Hahn 763* (G). BARBADOS: *Eggers 7183* (G).

2. **Cordia alliodora** (R. & P.) Cham. ex DC. Prodr. 9: 472 (1845); Urban, Symb. Ant. 8: 574 (1921); Johnston, Contr. Gray Herb. 73: 77 (1924) and l.c. 92: 13 (1930).

Cerdana alliodora R. & P. Fl. Peruv. 2: 47, *t. 184* (1799). — Type Peruvian.
Cordia Gerascanthus, var. *subcanescens* DC. Prodr. 9: 472 (1845). — Type West Indian.

Cordia Gerascanthus, var. *domingensis* Cham. ex DC. Prodr. **9**: 472 (1845), in synonymy.

Cordia Gerascanthus, forma *martinicensis* Chodat, Bull. Soc. Bot. Genève, sér. 2, **12**: 210 (1920). — Type from Martinique, *Hahn 626*.

Cordia Gerascanthus, forma *micrantha* Chodat, Bull. Soc. Bot. Genève, sér. 2, **12**: 210 (1920). — Type West Indian.

Cordia Gerascanthus of many authors, not of Linnaeus.

Widely distributed in tropical America.

MONTSERRAT: *Shafer 557* (NY, US). ANTIGUA: *Box 1316* and *1342* (US); *Rose, Fitch & Russell 3320* and *3456* (US). GUADELOUPE: *Duss 2580* (G, US, NY); *Questel 694* (US); *Stehlé 85* (NY), *126* (US), *559* (US), and *2684* (G). DOMINICA: *Imray* (G); *Hodge 1627* (G). MARTINIQUE: *Duss 1425* (NY, US); *Stehlé 6031* (G). ST. VINCENT: *Smith 1249* (G, NY). TRINIDAD: *Sieber 121* (G, NY); *Broadway 5547* and *9845* (G); *Fairchild 2863* (G).

North of our area the species is known from the Virgins, Porto Rico, Haiti and Cuba. Although reported from Jamaica it is almost certainly not native there. The West Indian material of *C. alliodora* has its twigs much less deformed by ant-domatia than that of Central America and northwestern South America. The older writers identified the plant with *C. Gerascanthus*, but that is a very different species native to Cuba, Jamaica, and adjoining Central America. For an excellent very detailed account of our tree see R. C. Marshall, Silviculture of trees of Trinidad and Tobago, pp. 167–172 (1939). He reports the plant from Tobago as well as from Trinidad.

3. **Cordia grandiflora** (Desv.) HBK. Nov. Gen. et Sp. **3**: 77 (1818); Johnston, Jour. Arnold Arb. **16**: 32 (1935).

Varronia grandiflora Desv. Jour. de Bot. **1**: 273 (1809). — Type from Venezuela.

Ranging from British Guiana to central Venezuela and southward into the Amazon Basin; Trinidad.

TRINIDAD: Caparo, June 1918, *Broadway* (T); "Trinidad," Aug. 1928, *Abrahams, Herb. Trin. 12215* (T).

According to Williams & Williams, Useful and Ornamental Pl. Trinidad, ed. 3, p. 112 (1941), the plant is frequently found in peasant gardens in southern Trinidad.

4. **Cordia globosa** (Jacq.) HBK. Nov. Gen. et Sp. **3**: 76 (1818).

Varronia globosa Jacq. Enum. 14 (1760) and Sel. Stirp. 41 (1763). — In Caribaearum maritimis.

Varronia dasycephala Desv. Jour. de Bot. **1**: 274 (1808). — Habitat in Cumana, Antigua, arenosis humidis.

Cordia dasycephala (Desv.) HBK. Nov. Gen. et Sp. **3**: 76 (1818).

Cordia sphaerocephala Humb. ex R. & S. Syst. **4**: 801 (1820). — In arenosis Cumanae.

Varronia sphaerocephala Willd. ex HBK. Nov. Gen. et Sp. **3**: 453 (1820).

Cordia bullata, var. *angustata* DC. Prodr. **9**: 496 (1845). — Type from Guadeloupe.

Ranging south through the Lesser Antilles into South America.

St. Barthélemy: *Questel 578* (US). St. Kitts: *Britton & Cowell 257* (US); *Rose, Fitch & Russell 3240* (US). Antigua: *Box 1160* (US); *Rose, Fitch & Russell 3330* (G, US). Montserrat: *Shafer 232* and *510* (US). Guadeloupe: *Duss 2575* (G, US); *Stehlé 2681* (G). Dominica: *Hodge 2769* and *3861* (G). Martinique: *Duss 652* (US).

The species as here accepted includes plants from the Lesser Antilles, Trinidad, Venezuela, and eastern Brazil. Related plants of the Greater Antilles, Mexico, and Central America are separated as *C. globosa* var. *humilis* (Jacq.) Johnston, Jour. Arnold Arb. 30: 98 (1949). They are distinguished by their leaves, which not only average much smaller than in typical *C. globosa,* but also have the marginal teeth and apex obtuse rather than acute. Also related to *C. globosa* are *C. caput-medusae* Taub., a very glandular plant of Brazil, and *C. subtruncata,* a Colombian plant with pallid strigose herbage. There are some other closely related but separable plants in Colombia and Venezuela, but these are as yet unnamed.

No type of *Varronia globosa* is preserved. It is necessary to interpret the species entirely from Jacquin's short diagnosis and vague remarks. They are as follows: "VARRONIA (*globosa*) spicis globosis, aequalibus. Frutex hic perfecte congruit cum Varronia martinicensi. Discrimen solum est in constanti globositate spicarum, in corollarum laciniis emarginatis ipsis, & in stigmate obtuso quadruplici. Habitat in Caribaearum maritimis." Curiously, there is no mention of the setaceous calyx-lobes, probably the most distinctive feature of our species, cf. Johnston, Jour. Arnold Arb. 30: 102 (1949). Jacquin's statement that his *V. globosa* agrees closely with *V. martinicensis,* except as to inflorescence and floral structures, offers the most help in placing it. The foliage of typical *C. globosa,* as I have delimited it, agrees well in size, shape, and dentation with that shown in Jacquin's illustration of the type of *V. martinicensis.* Since *V. globosa* is given by Jacquin as Caribbean (i.e., West Indian and not continental), it very likely came from the Lesser Antilles, where he did much collecting and could have compared growing plants with *C. martinicensis.*

5. **Cordia salvifolia** Juss. ex Poir. Encyc. 7: 46 (1806). — Source of type not given.

Endemic to the Lesser Antilles.

Barbuda: *Box 613* (US). Antigua: *Box 1034* (US); *Rose, Fitch & Russell 3339* (G, US). Montserrat: *Shafer 495* (US). Guadeloupe: *Duss 3959* (US); *Stehlé 2025* (US), *2689* (G), *2698* (G), *6161* (G). Marie Galante: *Stehlé 165* (US), *2678* (G). Désirade: *Stehlé & Quentin 5340* (US). Martinique: *Duss 287* (US). St. Lucia: *Beard 1080* (G).

A very distinct member of the section Varronia which is endemic to our area. It is readily distinguished from all immediate relatives by its large, loose, repeatedly forked cymes. Many of the specimens have parasitized fruit, which eventually contains smooth ellipsoidal pupae suggestive of seeds. Normal fruit, however, has the irregular tuberculate single-seeded stone characteristic of all Varronias.

6. **Cordia polycephala** (Lam.) Johnston, Jour. Arnold Arb. **16**: 33 (1935).

Varronia polycephala Lam. Tab. Encyc. **1**: 418 (1791); Poir. Encyc. **4**: 263 (1798). — Type from "America."

Varronia paniculata Wikström [Öfv. Guadeloupe. Fl.], K. Vet. Akad. Handl. **1827**[1]: 59 (1828). — Type from Guadeloupe, Forsström.

Cordia Wickstroemii Steud. Nom. ed. 2, **1**: 419 (1841). — Based on *Varronia paniculata* Wikst. not *Cordia paniculata* Roth.

Cordia Wikstromii Steud. ex DC. Prodr. **9**: 495 (1845).

Cordia sulfurata Krause, Beih. Centralb. **32**[2]: 341 (1914). — Type from St. Vincent, *Krause 11821*.

Cordia ulmifolia, var. *ovata* DC. Prodr. **9**: 495 (1845). — Type West Indian.

Cordia ulmifolia, var. *ovalis* DC. Prodr. **9**: 495 (1845). — Type West Indian.

Ranging from the southern parts of the Dominican Republic south through Porto Rico, the Virgins and Lesser Antilles into northern South America.

St. Barthélemy: *Stehlé 7076* (G). St. Kitts: *Britton & Cowell 203* (NY). Guadeloupe: *Stehlé 3* (NY), *1100* (US), *2614* (US), *2680* (G), *2695* (G); *Duss 2576* (G, NY, US). Dominica: *Cooper 22* and *141* (G, NY, US); *Lloyd 420* and *688* (NY); *Hodge 792* (US), *793* (NY, US), *1451* (G), *2217* (G), *2319* (G), *2905* (G), *3900* (G). Martinique: *Hahn 873* (G, US); *Duss 1421* (G, NY, US); *Stehlé 3646* (G). St. Vincent: *Eggers 6551* (G); *Smith 781* (G); *Beard 1347* (G). Grenada: *Broadway* (G, US, NY).

The name *C. polycephala* is here restricted to the more southerly and easterly of the two West Indian species formerly included in the aggregate of tropical American shrubs assembled under the names "*C. corymbosa*" or "*C. ulmifolia.*" It ranges from the Dominican Republic south through our area into northern South America. On the southern continent it is most abundant in Venezuela, but it also occurs west to northern Colombia and in Brazil at least as far south as Ceará. The species is reported from Trinidad, but I have seen no material from the island and doubt that it is native there. It has recently been reported from St. Lucia, Stehlé, Carib. Forester **8**: 106 (1947).

The former aggregate species of which *C. polycephala, sensu stricto,* is a small part, breaks up into two well-marked groups distinguishable by differences in inflorescence. In one the cymes are chiefly axillary, only the first produced by the shoot being terminal. In the other the cymes are all terminal, but, with the elongation of the shoot, come to be borne on stem internodes without any subtending leaf. *Cordia polycephala,* as here narrowly delimited, has an axillary inflorescence as does also *C. lineata* (L.) Don and *C. patens* HBK. These three segregates of the old complex may be at times difficult to distinguish in Venezuela but elsewhere are recognizable at a glance. They have very different patterns of geographical distribution. *Cordia polycephala* extends north via the Lesser Antilles to

Hispaniola. *Cordia lineata* appears in the northern and western parts of Hispaniola and extends to Cuba, Jamaica, Central America, and, apparently, Venezuela, cf. Johnston, Jour. Arnold Arb. **30**: 92 (1949). *Cordia patens,* in contrast, is a shrub of the Amazonian headwaters and extends from the Guianas to eastern Peru.

The segregates of the old complex having extra-axillary inflorescences have their center of distribution south of the Equator. *Cordia bifurcata* R. & S. ranges from Costa Rica and Colombia south along the Andes into Argentina, cf. Johnston, Jour. Arnold Arb. **30**: 90 (1949). *Cordia boliviana* Gandog. is Bolivian. *Cordia urticifolia* Cham. is a coarsely strigose representative of the group in Brazil and Paraguay. Another member is *C. discolor* Cham. of Brazil. Of all these southern representatives only *C. discolor* shows instability as to type of inflorescence. It is the only one of the southern group which now and again makes embarrassing approaches towards *C. polycephala.*

The first name given to our plant appears to be *Varronia polycephala* Lam., which was described as follows: "1887, *Varronia polycephala.* V. foliis ovato-lanceolatis, serrati; pedunculis lateralibus; spicis globosis. Ex America. ♄ *Pluk. t. 328 f. 5? Il varie à pédoncules rameaux.*" The brief description certainly applies to some member of the former aggregate of which our plant is a part. Poiret, Encyc. **4**: 263 (1797), so accepted it and so have all subsequent authors. I am assuming that Lamarck's type came from the French West Indies. If investigations at Paris prove this to be incorrect, then the next available name for our species is *C. Wickstroemii* Steud.

A few comments should be made regarding the name *Varronia monosperma* Jacq. Pl. Rar. Hort. Schoenbr. **1**: 18, *t. 39* (1797). The material upon which that species is described is said to have come from Caracas, Venezuela, a locality at which *C. polycephala* has been repeatedly collected. Jacquin's beautiful and very detailed plant of *V. monosperma* is unlike any plant I have seen from Central America, the West Indies, or northern South America. In fact it seems to represent the Brazilian and Paraguayan plant described as *C. urticifolia* Cham. (1829). The illustration shows very clearly the extra-axillary, internodal or oppositiflorous inflorescences that characterize the relatives of true *C. polycephala* south of the Equator. Jacquin's name is, in fact, the oldest name applied to that group. It has exact synonyms in *C. monosperma* (Jacq.) R. & S., 1819, *Varronia corymbosa* Desv. Jour. de Bot. **1**: 275 (1809), and *Cordia corymbosa* (Desv.) Don, 1838.

7. **Cordia Schomburgkii** DC. Prodr. **9**: 490 (1845); Johnston, Jour. Arnold Arb. **16**: 39 (1935). — Type from British Guiana.

Cordia tobagensis Urban in Fedde, Repert. **16**: 39 (1919). — Type from Tobago, *Broadway 3072.*

Cordia tobagensis, var. *Broadwayi* Urban in Fedde, Repert. **16**: 40 (1919). — Type from Tobago, *Broadway 4235.*

Known only from the Guianas and from Tobago.

TOBAGO: Dennet Estate, *Broadway 4235* (G, pt. of TYPE); Forest Reserve beyond Caledonia, *Broadway 3072* (G, pt. of TYPE); Menna Road near Mason Hall, low shrub, fl. white, June 6, 1925, *Williams, Herb. Trin. 11140* (T); Mt. St. George-Castara road, Oct. 18, 1937, *Cheesman, Herb. Trin. 13208* (T).

8. **Cordia martinicensis** (Jacq.) R. & S. Syst. 4: 461 (1819).

Varronia martinicensis Jacq. Enum. 14 (1760) and Sel. Stirp. 41, *t. 32* (1763). — Type from Martinique.

Known only from Dominica, Martinique and St. Lucia.

DOMINICA: *Hodge 2543* and *2663* (G). MARTINIQUE: *Duss 1423* (G, US); *Hahn 286* (G, US); *Sieber 60* (G); *Bailey 252* (US); *Stehlé 1040* (G, US), *2128* (NY), *3470* (G), *3642* (G), and *6925* (G). ST. LUCIA: *Beard 1011* (G).

9. **Cordia curassavica** (Jacq.) R. & S. Syst. 4: 460 (1819); Johnston, Jour. Arnold Arb. **30**: 99 (1949).

Varronia curassavica Jacq. Enum. 14 (1760) and Sel. Stirp. 40 (1760). — Type from Curaçao.

Varronia macrostachya Jacq. Enum. 14 (1760) and Sel. Stirp. 41 (1763). — Type from Cartagena, Colombia.

Cordia macrostachya (Jacq.) R. & S. Syst. **4**: 461 (1819); Johnston, Jour. Arnold Arb. **16**: 36 (1935).

Varronia guianensis Desv. Jour. de Bot. **1**: 270 (1809). — Type from French Guiana.

Cordia canescens HBK. Nov. Gen. et Sp. **3**: 73. (1818). — Type from Ibaque, Colombia.

Cordia graveolens HBK. Nov. Gen. et Sp. **3**: 74 (1818). — Type from between Ferreras and Angostura, Venezuela.

Cordia cylindrostachya, var. *graveolens* (HBK.) Griseb. Fl. Brit. W. I. 480 (1861).

Cordia spicata Willd. ex R. & S. Syst. **4**: 799 (1819). — Type from Angostura, Venezuela.

Cordia rugosa Willd. ex R. & S. Syst. **4**: 801 (1819). — Type South American.

Cordia interrupta DC. Prodr. **9**: 491 (1845). — Type from French Guiana.

Cordia cylindrostachya, var. *interrupta* (DC) Griseb. Fl. Brit. W. I. 480 (1861).

Cordia oxyphylla DC. Prodr. **9**: 492 (1845). — Type from British Guiana.

Lithocardium cylindrostachyum, var. *platyphyllum* Kuntze, Rev. Gen. **2**: 438 (1891). — Type from Trinidad.

Cordia chepensis Pittier, Contr. U. S. Nat. Herb. **18**: 253 (1917). — Type from Panama.

Cordia littoralis Pittier, Contr. U. S. Nat. Herb. **18**: 253 (1917). — Type from Costa Rica.

Ranging in northern South America (French Guiana to Colombia) and north into Central America and the Lesser Antilles.

MARTINIQUE: *Duss 289* (NY). ST. VINCENT: *Smith 470* (G, NY). GRENADA: *Eggers 6139* (G); *Broadway 141* (G, NY). BARBADOS: *Dash 14* (NY). TOBAGO: *Eggers 5458* (G); *Elmore* (G); *Broadway 4254* (G, NY). TRINIDAD: *Johnston 78* (G); *Broadway 11* (G); *Britton & Hazen 18* (G); *Riley 68* (NY).

The plant has sharp-pointed, lanceolate or lance-ovate leaves which are green and usually glabrous above. The upper leaf-surface may be smooth but commonly is more or less roughened by minute siliceous tuberculations present there in varying abundance and development. Occasionally the tuberculations become conic or even prolonged into short stiff bristle-tips. The surface of the leaf, however, is never soft hairy nor more or less velvety. The xerophytic form of the species has thickish lanceolate leaves 1.5–4 cm. broad, roughened on the upper face by an abundance of tuberculations. It is the form represented by the type of *Varronia curassavica.* In more sheltered places and especially those with much rainfall, the plants produce larger, proportionately broader and thinner leaves, 4–9 cm. wide, on which the upper surface is nearly bare or has tuberculations much reduced in size and number. Its spikes also tend to become very elongate. This is the form described as *Varronia macrostachya* Jacq. An extreme phase of this broad-leaved form was described from Trinidad as *Lithocardium cylindrostachyum,* var. *platyphyllum* Kuntze. For our purposes it may be called **Cordia curassavica,** var. **platyphylla** (Kuntze), comb. nov. As the name for the mesophytic phases with broad leaves it is applicable in our region only to plants collected on Trinidad and Tobago.

The present species, though not distinguished from *C. cylindrostachya* by many West Indian botanists, is readily separable from that more southerly ranging South American species by its complete lack of axillary spikes. True *C. curassavica* is very different in appearance and readily separable at a glance from the various closely related but as yet imperfectly defined species that occur north of it in the Greater Antilles and in Mexico. These latter are excluded from *C. curassavica* as here accepted. Our species is a natural and practicable one that occurs in northern South America from the Guianas to Colombia and extends north into Central America and the Lesser Antilles. A complete listing of its synonyms has been given above.

10. **Cordia divaricata** HBK. Nov. Gen. et Sp. **3**: 74 (1818); R. & S. Syst. **4**: 802 (1819); Johnston, Jour. Arnold Arb. **30**: 101 (1949). — Type from Cumana, Venezuela.

Cordia cuneiformis DC. Prodr. **9**: 492 (1845). — Type from Caracas, Venezuela.

Northern Venezuela and adjacent Colombia, Curaçao, Martinique, Dominica.

DOMINICA: *Hodge 3808* (G); *Lloyd 839* (US). MARTINIQUE: *Duss 288* and *289* (NY); *Stehlé 3471* (G).

A relative of *C. curassavica* distinguishable by its usually smaller, generally more or less oblanceolate or obovate leaves, usually soft hairy on the upper surface. Its calyx tends to have lobes less sharply triangular and proportionately broader than in its relative.

11. **Cordia dentata** Poir. Encyc. 7: 48 (1806); Johnston, Jour. Arnold Arb. 21: 347 (1940). — Type from Curaçao.

"*Cordia alba*" of most authors.

West Indies, Mexico, Central America, and northern South America; frequently cultivated.

ST. BARTHÉLEMY: *Questel 682* (US). GUADELOUPE: *Duss 2757* (US); *Questel 824* (US); *Stehlé 950* (US), *2691* (G), *2843* (G). MARTINIQUE: *Duss 285* (US). ANTIGUA: *Box 1188* (G, US). BARBADOS: *Waby 68* (US); *Warming 98* (US). TOBAGO: *Broadway* (G). TRINIDAD: Chacachacare Isl., *Finlay, Herb. Trin. 1842* (T).

Readily recognized because of its toothed, slenderly petiolate leaves, broad funnelform shallowly lobed white corollas, ribbed calyx, and large watery white fruits. In West Indian botany the plant is well known under the name *Cordia alba* or *Calyptracordia alba,* names unhappily not properly applicable to it.

12. **Cordia obliqua** Willd. Phytogr. 4, *t. 4* (1794) and Sp. Pl. 1: 1072 (1797). — Type from western India.

Cordia tremula Griseb. Fl. Brit. W. I. 479 (1861). — Type from Barbados, *Lane.*

An Indian tree introduced into the West Indies, where it is now widely distributed.

ST. KITTS: *Fairchild 2635* (G, US); *Britton & Cowell 135* (NY). ANTIGUA: *Box 1428* (US); *Rose, Fitch & Russell 3370* (US). MONTSERRAT: *Shafer 124* and *209* (NY, US). GUADELOUPE: *Hahn 953* (US); *Stehlé 260* (US), *2683* (G). MARIE GALANTE: *Stehlé 195* (US). ST. VINCENT: *Smith 462* (G). GRENADA: *Beard 34* (G); *Broadway 1810* (G, US). BARBADOS: *Bovell 466* (NY); *Gooding* (G); *Eggers 7179* (G, US).

For the most of a century this tree has been known in the West Indies as *C. tremula* Griseb. and accepted as a native species, endemic to the Lesser Antilles. It is, however, a native of India and was introduced into the West Indies, probably during the eighteenth century, and most likely at Barbados. Mr. E. G. B. Gooding (in lit., June 1942) has some significant observations concerning the plant on Barbados. He notes that the species is absent from the few remnants of original forest on the island. It grows "wild" only on open waste land, seldom far from habitations, and is frequently cultivated. This ability to go wild is also demonstrated in Cuba. The trees in the Botanic Garden at Soledad, originating from Lesser Antillean seed, now have progeny in waste land outside the garden.

The name *Cordia obliqua* Willd. here applied to our plant is subject to future revision, although it certainly belongs to the particular form of the Indian plant represented in the Caribbean area. Unfortunately, it is only one of a confusing complex of many closely related forms represented in the tropics of Asia and Malaysia. Until the complex is thoroughly studied and a modern classification of it available, names applied to its forms can be only tentative. Nevertheless I am inclined to believe that the name selected may stand. The Indian tree, along with its other relatives in southeastern Asia and the South Pacific, are readily distinguishable by form of style from the African and Levantine *C. Myxa* L., with which they were formerly associated. For the eastern complex there is only one name older than *C. obliqua* Willd. (1794), namely *C. dichotoma* Forst. (1786). This latter was applied to a plant of the wetter tropics and is distinguishable from *C. obliqua* by its thinner elliptic leaves and smaller flowers. The eventual monographer of the group will, I am confident, distinguish these two extreme forms, if not as species, then certainly as varieties.

13. **Cordia tetrandra** Aublet, Hist. Pl. Guian. 1: *222, t. 87* (1775); Johnston, Jour. Arnold Arb. 16: 11 (1935). — Type from French Guiana.

Widely distributed at low altitudes in tropical South America, but not common.

BARBADOS: Dodd's, St. Philip, 1902, *Bovell 437* (NY).

The specimen cited is probably from a cultivated tree. The species, however, has such a hit-and-miss distribution over so wide an area in tropical South America that its natural occurrence a little further north, as a rare tree in the southern West Indies, would not be surprising.

14. **Cordia Collococca** [Sandmark] L. Amoen. Acad. 5: 377 (1759), as "*C. Callococca.*" — Type from Jamaica.

Cordia Collococca L. Sp. Pl. ed. 2, 274 (1762), excluding "*Cordia glabra* Sp. Pl. sp. 1 p. 191."

Cordia Calloçocca L. Syst. ed. 12, 176 (1767), excluding phrase "fol. cordato-ovatis."

Cordia micranthus Sw. Prodr. 47 (1788) and Fl. Ind. Occ. **1**: 460 (1797). — Type Jamaican.

Cordia ehretioides Lam. Tab. Encyc. **1**: 421 (1791); Urban, Symb. Ant. **8**: 576 (1921). — Type from Santo Domingo.

Cordia Collococca, var. *ehretioides* (Lam.) Poir. Encyc. **7**: 42 (1806).

Cordia glabra of authors, not Linnaeus, cf. Johnston, Jour. Arnold Arb. **21**: 345 (1940).

Cuba and Mexico south to northern South America.

GUADELOUPE: *Duss 2577* (NY); *Stehlé 91* (NY), *66* (NY), *2682* (G). DOMINICA: *Hodge 3890* (G). MARTINIQUE: *Duss 282* (NY). ST. VINCENT: *Smith 1546* (NY), *1836* (G, NY). GRENADA: *Broadway* (G, NY). BARBADOS: *Gooding 609* (NY). TOBAGO: *Montserin, Herb. Trin. 13647* (T). TRINIDAD: *Britton, Freeman & Watts 2692* (G).

The plant is deciduous and develops its inflorescences late in the dry season on leafless or nearly leafless twigs, at least before the new growth of leaves is expanded. In having precocious inflorescences and bright red fruit it is readily separable from all other congeners in our area. In addition to those islands from which specimens are cited, the species is also reported from St. Barthélemy, Antigua, Bequia, and Mustique. A good account of the tree, with interesting field observations, has been published by R. C. Marshall, Silviculture of trees of Trinidad and Tobago, pp. 172–3 (1939).

The name of this well-marked species merits a few words of discussion. The first name applied to it was *Cordia Callococca* [Sandmark] Linnaeus (1759). It is one of the many binomials applied by Sandmark to Jamaican species described and named under polynomials in Browne's History of Jamaica. In the present instance Sandmark's page-reference to the History of Jamaica is incorrect, being "166" and not 167. In such a very abbreviated synopsis as that published by Sandmark this error might be very confusing indeed. However, a perusal of his dissertation makes it obvious that he intended his binomial, *C. Callococca,* to apply to the first of the two species of trees for which Browne had erected the genus *Collococca.* Sandmark's specific epithet was derived from Browne's generic name. The latter was given in allusion to the glutinous pulp in the fruit of the plant, a meaning lost by the vowel change in the specific epithet as published by Sandmark. This vowel change, I believe, is another example of typographical or clerical error in the dissertation. This is consistent with the fact that when Linnaeus, adopting the binomial proposed by his student, first treated the species in his own publications, he used the original Brownean spelling in the specific name. This he maintained in the third edition of the Species Plantarum, 274 (1764). Only in the last of his major works, Syst. ed. 12, 176 (1769), is the specific epithet *Callococca* used. Subsequent authors have spelled the name both ways. I have adopted *"Collococca"* as the correct spelling for the species, since I believe *"Callococca"* originated in error. The epithet has usually been capitalized and treated as a generic noun in apposition. As such, it is meaningless unless it conforms to the original Brownean spelling.

Though there may be some doubt as to the correct spelling of Sandmark's binomial, its correct application seems clear. The Jamaican tree discussed by Browne, History 167 (1756), as "Collococcus. 1. Foliis rugosis venosis oblongo-ovatis, floribus laxe racemosis," is evidently the same as the plant now under discussion.

In the past Sandmark's publication (Dec. 1759) has been overlooked, and the name *Cordia Collococca* has been accepted as established in the second edition of the Species Plantarum (1762). This publication of 1762 also has its complications. As has been discussed elsewhere, Jour. Arnold Arb. **21**: 345 (1940), by some error the name *Cordia glabra* L., Sp. Pl. 191 (1753), was listed as a synonym of *Cordia Collococca* rather than under *Ehretia Bourreria* L., where it properly belongs. With this incorrect synonym excluded, *Cordia Collococca* L. (1762) is based partially on the reference to Browne's History already used by Sandmark and partially on a reference to Sloane's great book on Jamaica, **2**: 95, *t. 203, f. 2* (1725). Sloane gives a good illustration and discussion of our plant.

15. **Cordia bicolor** A. DC. Prodr. **9**: 485 (1845); Johnston, Jour. Arnold Arb. **16**: 23 (1935) and **21**: 349 (1940). — Type from Dutch Guiana.

Lithocardium Lockartii Kuntze, Rev. Gen. **2**: 438 (1891). — Type from Trinidad, *Lockart.*

Cordia Lockartii Kuntze, Rev. Gen. **2**: 438 (1891), in synonymy.

Northern South America and northward in Central America; Trinidad.

St. Vincent: *Anderson* (Kew). Trinidad: *Britton & Broadway 2797* (G); *Britton 2500* (G, NY); *Britton & Hazen 1926* (G, NY); *Britton 549* (G, NY); *Eggers 1431* (Kew); *Eggers 1178B* (Berlin); *Lockart* (Kew, type).

The specimens cited from St. Vincent probably came from a cultivated tree. Alexander Anderson was director of the botanical garden on St. Vincent from 1785 to 1811. I doubt if *C. bicolor* occurs naturally in the West Indies north of Trinidad. Some excellent field observations concerning the Trinidad tree are given (sub *"Cordia Lockhartii"*) by R. C. Marshall, Silviculture of trees of Trinidad and Tobago, pp. 173–4 (1939). Marshall states that the ripe fruit is a greenish yellow drupe, ovoid-rounded, 12 mm. long, and covered with minute hairs. Its stone is said to be 10 mm. long, pointed at the apex, and irregularly furrowed.

16. **Cordia elliptica** Sw. Prodr. 47 (1788) and Fl. Ind. Occ. 1: 461 (1797); Urban, Symb. Ant. 3: 357 (1903). — Type from "Jamaica."

Cordia reticulata Vahl, Ecol. 3: 5 (1807). — Type from Montserrat, *Ryan*.
Cordia laevigata of authors.

A species endemic to the Lesser Antilles.

Montserrat: *Shafer 345* (NY). Guadeloupe: *Fairchild* (G): *Duss 2584; Stehlé 2679, 2692, 2693,* and *2844* (G). Dominica: *Cooper 58* and *142* (G, NY); *Beard 1464* (G); *Lloyd 244* (NY); *Hodge 1126, 1809, 2093, 2247, 2349, 2612, 3012, 3359,* and *3458* (G). Martinique: *Duss 242* (NY), *1422* (G, NY). St. Lucia: *Beard 495* (G).

I am following Urban in identifying our present plant with *C. elliptica* Sw. The specimen from the Swartz herbarium at Stockholm that appears to be the type of *C. elliptica* is labeled as from "Jamaica." It has an old inflorescence with some persisting, apparently blighted calyces. There are no corollas nor fruit. The indument on the inflorescence and calyces is sparse, but if these are persisting old ones found on a tree out of flower, that is not surprising. Although our species does have a dense strigose indument on new flowering inflorescences, the hairy covering thins out considerably on old inflorescences and even on fruit-bearing calyces. The herbage and stems of the Swartz type are indistinguishable from those of the plant of the Lesser Antilles. The type agrees well with plants from our area but is very different and readily separable from all members of its genus known from Jamaica. I am willing to believe that the type of *C. reticulata* was attributed to Jamaica through some error. It was more likely collected on Dominica, probably by Ponthieu.

The name *Cordia laevigata* Lam. Encyc. 1: 422 (1791); Poir. Encyc. 7: 46 (1806), has been applied to our plant. Judging from the original descriptions, however, Lamarck's plant must be very different from *C. elliptica,* particularly as to flowers. Indeed, it appears to be the same as the more northern *C. nitida* Vahl (1793), and being older, probably should be taken up in place of the latter.

Among West Indian species our plant is notable for its firm, glabrous, lustrous, strongly acuminate leaves, its elongate flower-buds that are clothed with abundant short appressed sericeous hairs, and its large glabrous drupe containing an obliquely ascending apically pointed stone. It is a very distinct species, perhaps most closely allied to plants of Venezuela and Colombia. Its drupe must be very large and conspicuous, but little has been recorded by collectors or authors concerning the color, size, configuration, and other features in the fresh state.

17. **Cordia sulcata** DC. Prodr. **9**: 488 (1845). — Type from Guadeloupe, *Bertero*.

Ranging from the Barbados and St. Vincent north to Cuba.

SABA: *Boldingh 1477* and *1495* (NY). ST. KITTS: *Britton & Cowell 302* (NY). ANTIGUA: *Box 1491* (US). MONTSERRAT: *Shafer 475* (NY, US); *Maloney 420* (G). GUADELOUPE: *Bertero* (G, photo of TYPE); *Duss 3079* and *3773* (NY, US); *Stehlé 295* (US), *1078* (US), *1831* (US), *2220* (US), *2677* (G). DOMINICA: *Imray* (G); *Beard 661* (G); *Narodny 1* (G); *Eggers 829* (G); *Hodge 3154* and *3745* (G). MARTINIQUE: *Duss 1426* (NY, US), *4502* (NY), *4703* (G, NY, US); *Hahn 752* (NY); *Stehlé 4468* (US). ST. VINCENT: *Smith 771* (G, NY). BARBADOS: *Eggers 7294* (G, US).

This is a species endemic to the West Indies which is found in the Lesser Antilles and in all the Greater Antilles except Jamaica. Its closest relative is *C. macrophylla* L., an endemic of Jamaica, which differs only in having much larger, more elongate leaves, and a shaggy-velvety indument on twigs, petioles, and inflorescences. The only other close relative of *C. sulcata* is *C. panamensis* of Trinidad, Tobago, and Central America. This latter differs in its bristly twigs, very scabrous upper leaf-surface, and non-cordate leaf-bases. These three species, *C. sulcata, C. macrophylla,* and *C. panamensis,* are immediately related and are distinguishable by neither flowers nor fruit. They have, however, distinct geographic ranges and are separable by vegetative characters. Though not "strong" species, they are useful units worthy of continued recognition.

The type of *C. sulcata* DC. is an immature specimen with new, partially expanded foliage and flower-buds. It was collected on Guadeloupe by Bertero. In addition to the islands from which I have cited specimens, the species is reported from St. Eustatius and St. Lucia.

18. **Cordia panamensis** Riley, Kew Bull. 1927: 125 (1927); Johnston, Jour. Arnold Arb. **21**: 347 (1940). — Type from Panama.

Known only from Central America, Trinidad and Tobago.

TRINIDAD: Southern Watershed Reserve, *Marshall, Herb. Trin. 12433* (T); Southern Watershed Reserve, main ridge, tree 25 ft. tall, *Marshall, Herb. Trin. 12410* (T); S. W. Reserve, *Russell, Herb. Trin. 12262* (T); Quinam Road, Southern Range, small tree, *Williams, Herb. Trin. 12186* (T); Maracas Bay, *Dannouse, Herb. Trin. 6749* (T); Maracas, *Herb. Trin. 1843* (T); Arima, *Dannouse, Herb. Trin. 8986* (T); St. Patrick, Dardaine, *Herb. Trin. 11588* (T); Monos, *Herb. Trin. 1845* (T); Botanic Garden near

Carpenter Shop, *Broadway, Herb. Trin. 3833* (T); Botanic Garden, *Herb. Trin. 1050* and *5942* (T). TOBAGO: tree 40 ft. in woods, 800 ft. alt., *Eggers 5590* (G).

In the past this tree of Trinidad and Tobago usually has been identified as *"Cordia sulcata."* I am unable to distinguish it from *C. panamensis,* a species previously recognized only in Central America. No species native to northern South America is readily confused with it. The relations of the plant are with *Cordia sulcata* DC., which ranges in the West Indies from Barbados to Cuba. Among its distinctive features are its bristly twigs and inflorescence and its harsh, very scabrous upper leaf-surfaces. Excellent field observations concerning the tree in Trinidad are given (sub *Cordia sulcata*) by R. C. Marshall, Silviculture of trees in Trinidad and Tobago, pp. 174–5 (1939). He reports the ripe fruit as a round, whitish, translucent drupe that is smooth, about 1 cm. in diameter, and very suggestive of a rather large English white currant. It contains a hard, woody, irregularly shaped stone, about 6 mm. in diameter, embedded in mucilaginous pulp.

19. **Cordia sericicalyx** A. DC. Prodr. 9: 485 (1845); Johnston, Jour. Arnold Arb. **16**: 25 (1935). — Type from British Guiana.

Cordia ierensis Britton, Bull. Torr. Bot. Club **50**: 54 (1923). — Type from Morne Bleu, Trinidad, *Britton, Freeman & Bailey 2277.*

Ranging from Dutch Guiana to western Colombia and north into Trinidad.

TRINIDAD: Morne Bleu, tree 10 m. tall, *Britton, Freeman & Bailey 2277* (NY, TYPE; G, T); Mount Tocuche, tree 15 m., corolla white, *Britton, Hazen & Mendelson 1344* (G, NY); Blanchisseuse Road near 9-mile post, small tree, *Broadway 6000* (G); St. Anne, *Herb. Trin. 1848* (T); Maracas, *Herb. Trin. 588* (T); Maraval, *Herb. Trin. 4533* (T); Arima-Blanchisseuse road, 14th-15th mile, *Marshall, Herb. Trin. 12882* (T); Tucuche, *Britton & Freeman, Herb. Trin. 9094* (T); Tucuche, *Williams, Herb. Trin. 11016* (T).

This species commonly has relatively thin, rather smooth, parchment-like leaves that are usually markedly heteromorphic. The leaf-surfaces, twigs, and inflorescences are very finely and minutely short-strigose. The indument, though readily detected with a hand lens, is inconspicuous. At a casual glance the mature twigs and leaves might pass as glabrous. Some field observations concerning this species (sub *Cordia ierensis*) are given by R. C. Marshall, Silviculture of trees of Trinidad and Tobago, p. 175 (1939). Marshall states that the drupe is green, about 1 cm. long, and contains an irregular stone embedded in a mucilaginous pulp.

2. ROCHEFORTIA

KEY TO THE SPECIES

Twigs very thorny; flowers nearly sessile, borne one or two together directly on axillary short-shoots........................1. *R. acanthophora.*

Twigs with few or no thorns; flowers borne several to many in a distinctly pedunculate cyme................................2. *R. cuneata.*

1. **Rochefortia acanthophora** (DC.) Griseb. Fl. Br. W. I. 482 (1861).
Ehretia acanthophora DC. Prodr. **9:** 510 (1845). — Type from Santo Domingo.

ANTIGUA: *Box 858* (G).

The species is reported from St. Martin and St. Eustatius.

2. **Rochefortia cuneata** Sw. Prodr. 54 (1788) and Fl. Ind. Occ. **1:** 552 (1897). — Type from Jamaica.

GUADELOUPE: *Duss 2753* (G).

The species is also reported from Dominica and Martinique.

3. BOURRERIA

Bourreria succulenta Jacq. Enum. 14 (1760) and Sel. Stirp. 44 (1763). — Type from Curaçao.

Bourreria recurva Miers, Contr. **2:** 234 (1869). — Type from Dominica.

Ranging from Florida to Venezuela and Panama, generally distributed in the West Indies.

ANGUILLA: *Boldingh 3518* (NY). ST. MARTIN: *Boldingh 2805* (NY). ST. BARTHÉLEMY: *Forsström* (NY); *Questel 90* (NY). ST. KITTS: *Britton & Cowell 366* (NY). MONTSERRAT: *Shafer 310* and *497* (NY). GUADELOUPE: *Duss 2752* (G, NY). MARIE GALANTE: *Stehlé 2837* (G). DOMINICA: *Fishlock 53* (NY); *Lloyd 616, 661,* and *664* (NY). MARTINIQUE: *Stehlé 6051* (G); *Hahn 920* and *1095* (G); *Bailey 203* (G). ST. VINCENT: *Smith 551* (G, NY) and *569* (G). GRENADA: *Broadway* (G). TOBAGO: *Broadway 9166* (G); *Eggers 5517* (G); *Williams, Herb. Trin. 11444* (T). TRINIDAD: Maraval, *Baptiste, Herb. Trin. 5860* (T).

Schulz in his monograph of the genus, Urban Symb. Ant. 7: 58 (1911), reports collections from St. Eustatius, Antigua, St. Lucia, Bequia, and Mustique.

The name of the present genus has variant spellings in *"Bourreria," "Beurreria,"* and *"Beureria."* The first, however, is correct. The name was proposed and first applied to our genus by Patrick Browne, Nat. Hist. Jamaica 168 (1756), who spelled it *"Bourreria."* This spelling was adopted by Jacquin, Enum. 2 and 14 (1760), who was the first author to use the concept and name in a publication employing binomial nomenclature. This act established the correct orthography. To be sure Jacquin, Sel. Stirp. 44 (1763), later adopted the spelling "Beurreria," and subsequent authors, notably O. E. Schulz, the spelling "Beureria," but these are not corrections of error but expressions of personal taste, and are not sanctioned by rules of nomenclature. Cf. Kew Bull. **1935:** 385 (1935).

BOURRERIA CUMANENSIS (Loefl.) O. E. Schulz.

A form of this species was described as *Crematomia Guildingiana* Miers, Contr. **2:** 246, *t. 87* (1869), and given as having been collected on St. Vincent by Guilding. If the plant is not mislabeled it almost certainly represents, not a wild, but a cultivated plant, probably one from the botanic garden that flourished on St. Vincent early in the nineteenth century. The species is known with certainty only from the dry north coast of Colombia and Venezuela, and though it might be expected on some of the small dry islands near Trinidad, it is certainly not to be expected on St. Vincent.

4. TOURNEFORTIA

Key to the Species

Leaves linear-spathulate, broadest below the apex and gradually contracted towards the attachment, 3–10 cm. long, silvery silky from an abundance of appressed hairs; fruit with a very thin flesh, having a basal central cavity, very tardily breaking up into a pair of two-seeded nutlets; strand plant. . . . . .1. *T. gnaphalodes.*

Leaves with a distinct blade and petiole; fruit with a very fleshy mesocarp, with a lobed or unlobed stone not hollow at the base.

- Fruit with a conspicuously 2–4-lobed stone; embryo curved; corolla-lobes subulate or cuneate, greenish or yellowish; style elongate, falling with the corolla.
  - Corolla-tube 3–8 mm. long, with a moderately expanded throat, lobes not more than half the length of the tube, cuneate; ripe fruit orange or yellow; leaves nearly glabrous. . . .2. *T. maculata.*
  - Corolla-tube 1.5–3 mm. long, constricted at summit, lobes subulate, nearly as long as tube; ripe fruit usually white.
    - Leaves 4–10 cm. broad, 8–18 cm. long, leathery; inflorescence narrow, stiff, the branches short, densely flowered and divaricate, borne on an elongate axis. . .3. *T. subsessilis.*
    - Leaves 0.5–4(–6) cm. broad, 3–10(–12) cm. long, firm but not leathery; inflorescence loosely branched. .4. *T. volubilis.*
- Fruit with ovoid stone, at most merely sulcate on the sides; embryo straight; corolla-lobes elliptic to triangular-ovate, white; ripe fruit white.
  - Style elongate, 1–3 mm. long, usually falling with corolla; leaves very large, usually 15–40 cm. long, and having 11–15 pairs of major veins; tree, up to 9 m. tall. . . . . .5. *T. filiflora.*
  - Style very short, sessile and persistent on the mature fruit; leaves 5–20 cm. long, with 4–9 pairs of veins; plant usually scandent or climbing.
    - Foliage and twigs glabrous or practically so; calyx-lobes 1–2 mm. long. . . . . .6. *T. bicolor.*
    - Foliage and twigs evidently hairy.
      - Calyx-lobes lanceolate, 2–4 mm. long; stems bearing short curved grayish hairs about 1 mm. long; corolla-tube 4–5 mm. long. . . . . .7. *T. hirsutissima.*
      - Calyx-lobes subulate, 5–9 mm. long, slender and long-attenuate; stems shaggy, bearing abundant slender brown hairs 2–4 mm. long; corolla-tube 5–8 mm. long. . . . . .8. *T. cuspidata.*

1. **Tournefortia gnaphalodes** (L.) R. Br. ex R. & S. Syst. 4: 538 (1819).

Heliotropium gnaphalodes L. Syst. ed. 10, 913 (1759); Amoen. Acad. **5**: 376 and 394 (1759). — Type West Indian.

Mallotonia gnaphalodes (L.) Britton, Ann. Missouri Bot. Gard. **2**: 47 (1915).

Messerschmidia gnaphalodes (L.) Johnston, Jour. Arnold Arb. **16**: 165 (1935).

A strand plant widely distributed in the West Indies.

GUADELOUPE: *Stehlé 2687* and *2842* (G). MARTINIQUE: *Duss 246* (G). MUSTIQUE: *Smith G26* (G).

In addition to the islands mentioned above it has been reported in the Lesser Antilles from Anguilla, St. Martin, St. Barthélemy, Saba, St. Eustatius, Antigua, St. Vincent, Bequia, Carriacou, and Barbados. It is not reported from Trinidad nor Tobago, but is well known to the westward on the islands off the Venezuela coast. Guppy, Plants, Seeds and Currents, p. 247 (1917), has given observations regarding the behavior of the fruits of *T. gnaphalodes* and its modes of distribution in the West Indian drift.

Considering the present status of classification in the subfamily *Heliotropioideae* it has seemed best to assign this species to *Tournefortia*. Traditionally in this subfamily those species with dry fruits have been placed in *Heliotropium* and those with a fleshy mesocarp in *Tournefortia*. There are reasons for believing that this may not be a natural division. However, until the subfamily is thoroughly studied and a convincingly natural new classification has been worked out, it seems best to continue the separation of *Tournefortia* and *Heliotropium* in the traditional manner. To assign the present species to the monotypic *Mallotonia* or to group it with two Old World species in *Messerschmidia* is inconsistent when other equally distinct groups of species are still submerged in the older traditional genus.

This West Indian species has a fleshy mesocarp, although a very scanty one that soon dries. Otherwise the fruit is very similar to that found in certain groups of *Heliotropium*. Its only distinctive feature is the presence of corky tissue, a feature which I emphasized in assigning the plant to *Messerschmidia*. This, incidentally, has its weakest development in our West Indian plant.

2. **Tournefortia maculata** Jacq. Enum. 14 (1760) and Sel. Stirp. 47 (1763). — Type from Cartagena, Colombia.

Tournefortia syringaefolia Vahl, Symb. **3**: 23 (1794); Johnston, Jour. Arnold Arb. **16**: 48 (1935). — Type from French Guiana.

Tournefortia peruviana Poir. Encyc. Suppl. **4**: 425 (1816); Urban, Symb. Ant. **8**: 586 (1921). — Type from Peru.

Tournefortia Sagraeana DC. Prodr. **9**: 522 (1845). — Type from Cuba.

Tournefortia guadelupensis Urban, in Fedde Repert. **17**: 169 (1921). — Type from Guadeloupe, *Duss 3992*.

Ranging from Cuba and southern Mexico south through the West Indies and Central America into northern and western South America.

GUADELOUPE: *Duss 3992* (G). DOMINICA: *Hodge 2385* (G). TOBAGO: *Broadway 4606* (G). TRINIDAD: *Broadway 6389* (G).

The long-neglected name *T. maculata* Jacq. is evidently the oldest and proper name for this widely distributed plant. Jacquin (1763) described fruiting specimens from Cartagena, Colombia, as follows: "TOURNEFORTIA (*maculata*) *foliis* ovatis, utrinque glabris; spicis ramosissimis, pendulis. Frutex *ramis* debilibus; *foliis* integerrimis, acuminatis, petiolatis, inodoris; *fructibus* luteis basi quatuor maculis subrotundis atrisque notatis. Habitat Carthagenae in arbustis & sepibus." The glabrous leaves and the yellow drupes splotched with black are distinctive features of the present plant.

In the West Indies and Central America *T. maculata* presents problems in delimitation only in Jamaica, Haiti, and Porto Rico. Plants from these islands, described as *T. laurifolia* Vent. and *T. jamaicensis* Urban, differ from ordinary *T. maculata* in their larger, long-attenuate calyx- and corolla-lobes. In Jamaica and Haiti plants with short or elongate lobes both occur, but in Porto Rico only the latter. The plants with elongate attenuate lobes seem to deserve some nomenclatural recognition, but only field work will determine whether this should be as species, variety, or form.

3. **Tournefortia subsessilis** Cham. Linnaea **8:** 119 (1833); Johnston, Contr. Gray Herb. **92:** 85 (1920).—Type from Brazil.

Known only from eastern Brazil and Trinidad.

TRINIDAD: Balandra Bay, June 21, 1921, *Freeman, Herb. Trin. 10431* (T); Balandra Bay, Dec. 8, 1933, shrub near sea, corolla reddish, *Broadway 9331* (G); road near sea between Balandra and Toco, fl. yellow, fruit drupaceous, lobed, apparently ripening white, Aug. 20, 1940, *Cheesman & Baker 370, Herb. Trin. 13735* (T).

I am unable to distinguish the above cited collections from the plant of eastern Brazil (Bahia) known as *T. subsessilis*. The plant, though related to *T. volubilis*, has a more compact, more elongate, and less branched inflorescence that is made up of short, much more densely flowered scorpioid cymes. Furthermore, its leaves are also very much larger. Indeed, in general appearance the leaves are most suggestive of those of *T. bicolor*. The blade is ovate to elliptic, 4–10 cm. broad, 8–18 cm. long, somewhat leathery in texture, lustrous and practically glabrous above, and dull and glabrescent beneath. Balandra Bay is on the Atlantic coast of Trinidad about 10 miles from the northeast corner of the island. It lies about 2000 miles from the Brazilian localities at which the species has been previously known. No plant readily confused with it is known north of the Amazon.

4. **Tournefortia volubilis** L. Sp. Pl. 140 (1753).—Type West Indian.

Tournefortia sericea Vahl, Ecol. **1:** 17 (1796).—Type from Montserrat, *Ryan*.

Messerschmidia punctata Spreng. Neue Entdeck. **3:** 28 (1822).—Type from Martinique, *Sieber*.

Tournefortia punctata Spreng. Syst. **1:** 643 (1825).

Tournefortia psilostachya, var. *caribaea* DC. Prodr. **9:** 525 (1845).—Based on material from Guadeloupe, Martinique, and Trinidad.

Tournefortia caribaea (DC.) Griseb. Fl. Brit. W. I. 484 (1861).

Tournefortia barbadensis N. E. Brown ex Britton, Bull. Torr. Bot. Club 48: 343 (1922). — Type from Barbados, *Bovell & Freeman 404*.

Tournefortia trinitatis Riley, Kew Bull. **1925**: 139 (1925). — Type from Trinidad, *Riley 210*.

An extremely variable species ranging from Florida and Mexico south through the West Indies and Central America into South America.

MONTSERRAT: *Ryan* (G, photo of TYPE). GUADELOUPE: *Stehlé 2685, 2686, 2832,* and *2841* (G). MARIE GALANTE: *Stehlé 2836* (G). DOMINICA: *Hodge 2533, 2542, 3083, 3084,* and *3152* (G); *Eggers 689* (G); *Imray* (G). MARTINIQUE: *Duss 4504* (G); *Hahn 415* (G); *Sieber 63* (G). GRENADA: *Broadway* (G). ST. VINCENT: *Eggers 6600* (G); *Smith 127, 1277,* and *1540* (G). BARBADOS: *Eggers 7097* (G). TOBAGO: *Broadway 3665* (G); *Eggers 5914* (G). TRINIDAD: Chacachacare, *Herb. Trin. 1858* (T); Patos Island, *Broadway 8908* (G); Gasparee Island, *Britton 451* and *2781* (G); St. Anne, *Broadway, Herb. Trin. 9203* (T).

In one form or another this extremely variable species is to be expected on all the islands in our area. In addition to islands from which specimens are cited above, it has been reported from St. Martin, St. Barthélemy, Saba, St. Eustatius, Desirade, St. Lucia, Bequia, and Mustique. The species is the most variable member of its genus. Its leaves vary greatly in size and shape as well as in quality, quantity, distribution and color of pubescence. Forms of the plant may differ conspicuously in gross appearance. With so many diverse phases it is not surprising that the species has accumulated the most extensive synonymy in the genus. Above I have given only those names that are based on plants originating in our area. These apply to phases of the plant that are neither unusual in appearance nor endemic to our region. As with most of the phases named in other regions, the named ones from the West Indies can be expected to appear here and there erratically at widely separated places within the total geographical range of the species.

5. **Tournefortia filiflora** Griseb. Fl. Brit. W. I. 483 (1861); Urban, Symb. Ant. 4: 522 (1910). — Type from Dominica, *Imray*.

Ranging from Porto Rico south to St. Vincent.

GUADELOUPE: *Stehlé 2697* and *2839* (G). MARIE GALANTE: *Stehlé 2838* (G). DOMINICA: *Hodge 1592* (G); *Imray 322* (G). ST. VINCENT: *Smith 1542* (G).

As originally published *T. filiflora* included not only our present plant but also material of another species from Jamaica. I am following Urban, l. c., who limited the species to the plant distributed from Porto Rico to St. Vincent. With the type to be selected from among the non-Jamaican specimens cited by Grisebach, the best choice is Imray's collection from Dominica. The plant grows in Porto Rico and the Virgins and is reported from St. Martin, Saba, St. Eustatius, St. Kitts, and St. Lucia. It replaces *T. foetidissima* L. in the West Indies south of Hispaniola. The various reports of the latter species in the Lesser Antilles probably all apply to *T. filiflora*.

6. **Tournefortia bicolor** Sw. Prodr. 40 (1788) and Fl. Ind. Occ. **1**: 344 (1797). — Type from Jamaica.

Tournefortia laevigata Lam. Tab. Encyc. **1**: 416 (1791); Poir Encyc. **5**: 356 (1804). — Type from Guadeloupe, *Badier*.

Widely distributed in the American tropics.

GUADELOUPE: *Stehlé 710, 2831,* and *2835* (G), *Duss 2579* (G). MARIE GALANTE: *Stehlé 2694* and *2834* (G). DOMINICA: *Cooper 195* (G); *Eggers 688* (G); *Hodge 132, 2126, 2347, 3165, 3176, 3262, 3721,* and *3756* (G). MARTINIQUE: *Hahn 719* (G); *Duss 4503* (G). ST. VINCENT: *Smith 434* (G). GRENADA: *Alexander, Herb. Trin. 434* (T). TRINIDAD: *Broadway 9104* and *9844* (G); *Britton 2206* (G); *Britton & Hazen 409* (G).

The plant occurs on most of the islands in our area. Besides those from which specimens are cited, it has been reported from Saba, St. Kitts, Antigua, Montserrat, Barbados, and Tobago.

7. **Tournefortia hirsutissima** L. Sp. Pl. 140 (1753). — Type from Haiti.

Widely distributed in tropical America.

GUADELOUPE: *Stehlé 2840* (G). MARTINIQUE: *Duss 1207* (G). TOBAGO: *Eggers 5609* (G); *Williams 11113* (G). TRINIDAD: *Broadway* (G); *Johnston 79* (G).

This species appears to have a limited distribution in our area. I have seen specimens from only a very few islands and have found reports from only two additional ones, St. Martin and St. Vincent.

The original description of *T. hirsutissima* L. was based upon a drawing made by Plumier, which Linnaeus studied in Holland previous to the publication of the Species Plantarum. The drawing was no doubt that subsequently published by Burman, Pl. Am. Plumier *226, t. 229* (1760). Notes associated with Plumier's original drawings at Paris indicate that the plant concerned was collected near Léogane, Haiti.

8. **Tournefortia cuspidata** HBK. Nov. Gen. et Sp. **3**: 83 (1818); Johnston, Jour. Arnold Arb. **16**: 54 (1936). — Type from Ecuador?

Tournefortia obscura DC. Prodr. **9**: 517 (1845). — Type from British Guiana.

Tournefortia setifera Urban & Ekman, Arkiv Bot. **22**A: no. 17: 94 (1930). — Type from Haiti, *Ekman H10204*.

Tropical South America, southern Central America, Trinidad, and Haiti.

TRINIDAD: Cedros at St. Anna, low cliff, seashore, *Broadway, Herb. Trin. 9407* (T); Irois forest, *Williams, Herb. Trin. 12046* (T); Cap de Cille, shrub in roadside bush, *Baker, Herb. Trin. 14205* (T).

5. HELIOTROPIUM

KEY TO THE SPECIES

Flowers scattered along the elongate leafy stems; fruiting pedicels elongate. 2–10 mm. long; fruit conic above the middle........1. *H. lagoense*.

Flowers aggregated into crowded unilateral spikes; fruiting pedicels stout, 0–1 mm. long; fruit rounded or depressed at summit.

Plant completely glabrous, very succulent, usually somewhat glaucous. . ...2. *H. curassavicum.*

Plant hairy; herbage not decidedly succulent, never with a pallid waxy bloom.

Petiole short, 1–4 mm. long; spike bearing scattered small bracts; fruit dividing into 4 similar single-seeded nutlets, strigose.

Leaf-blade 2–5 mm. long; plant a low much-branched perennial, usually densely strigose and silvery-silky; style very short and obscure................3. *H. microphyllum.*

Leaf-blade 10–30 mm. long; plant laxly branched, erect.

Plant perennial, shrubby, 3–15 dm. tall; leaf-blade abruptly contracted into a petiole 1–2 mm. long, style elongate, evident....................4. *H. ternatum.*

Plant annual, 1–3 dm. tall; leaf-blade very gradually contracted into a petiole 2–4 mm. long; style very short and obscure.....................5. *H. filiforme.*

Petiole well developed, evident, 5 mm. long or longer; spikes without bracts among the flowers; plants usually annual.

Corolla usually blue or violet, the tube 2–4.5 mm. long and much exserted from the calyx; fruit glabrous, ribbed, angulate, cleft vertically, the two lobes divergent and each breaking up into a pair of single-seeded nutlets.... ....6. *H. indicum.*

Corolla white, tube short, scarcely if at all surpassing the small calyx; fruit not cleft.

Fruit breaking up into 4 single-seeded nutlets, strigose; spikes commonly paired and usually 2–5 cm. long; plant usually densely strigose and cinereous...... ....7. *H. procumbens.*

Fruit breaking in half, the halves each 2-seeded, epidermis roughened by minute bladder-like swellings that collapse and appear scale-like in age; spikes commonly single and usually becoming 10 cm. long; plant sparingly appressed hairy, green..8. *H. angiospermum.*

1. Heliotropium lagoense (Warm.) Gürke in Engler & Prantl, Nat. Pflanzenf. iv. Abt. 3a: 97 (1893).

Schleidenia lagoensis Warming, Kjoeb. Vidensk. Meddel, **1867**: 15 (1868). — Type from Brazil.

Heliotropium trinitense Urban, Symb. Ant. **7**: 350 (1912). — Type from Piarco Savanna, Trinidad, *Lunt 6030.*

Known from Brazil, eastern Bolivia, Surinam, Venezuela, Panama, Costa Rica, Guatemala, and Trinidad.

TRINIDAD: Piarco Savanna, *Lunt 6030* (Berlin, TYPE; fragment, G); Piarco Savanna, 1895, *Lunt, Herb. Trin. 6030* (T); Piarco, airfield, plant decumbent, fl. white with yellow tube and eye, March 1939, *Cheesman, Herb. Trin. 13375* (T).

A broadly distributed species known only from a relatively few widely scattered localities. Its wiry, slender, ascendingly branched stems are laxly decumbent or prostrate, usually spring from a clearly annual root, and usually become 1–2 dm. long. It is a plant of damp soil and has been collected most frequently where savanna conditions prevail.

2. **Heliotropium curassavicum** L. Sp. Pl. 130 (1753). — Type from Curaçao.

Widely distributed in the warmer parts of America, growing along coasts and in saline soils inland.

ST. MARTIN: *Walsh* (NY). ST. BARTHÉLEMY: *Forsström* (NY). GUADELOUPE: *Duchassaing* (G); *Stehlé 707* and *2833* (G); *Duss 2755* (G, NY). MARTINIQUE: *Duss 1416* (NY); *Egler 394* (NY). ST. VINCENT: *Smith 1213* (G). UNION: *Smith D34* (NY). GRENADA: *Broadway* (NY). BARBADOS: *Dash 353* (NY).

This halophyte is to be expected on all the Lesser Antilles. In addition to the stations given above, the plant is reported from St. Eustatius, Antigua, Marie Galante, Bequia, and Mustique. Surprisingly, there are no reports of its occurrence on either Trinidad or Tobago.

3. **Heliotropium microphyllum** Sw. ex Wikström [Ofv. Guadeloupe. Fl.] K. Vet. Akad. Handl. 1827[1]: 58 (1828). — Type from Guadeloupe, *Forsström*.

A variable species ranging north through the Virgins, Porto Rico, Hispaniola, and Cuba into the Bahamas.

ANGUILLA: *Boldingh 3517* (NY). ST. MARTIN: *Boldingh 3034* (NY). GUADELOUPE: coralline rocks along coast, alt. 30 m., Point des Château, *Stehlé 2696* (G).

The species is here interpreted in the broadest sense and includes the habitally similar plants found in the Greater Antilles and the Bahamas. The plants are moderately variable but hardly to the degree that would justify the many segregate species that have been proposed. From Haiti the plant has been described as *H. plumerii* Urban, *H. elegans* Urban, and *H. glomerifolium* Urban, and from Porto Rico as *H. crispiflorum* Urban. Even more names have been applied to plants of Cuba and the Bahamas.

4. **Heliotropium ternatum** Vahl, Symb. Bot. 3: 21 (1794). — Type from the West Indies.

Pioctonon ternatum (Vahl) Raf. Sylva Tellur. 88 (1838).

Tournefortia humilis L. Sp. Pl. 141 (1753); Syst. ed. 10, 917 (1759); Sp. Pl. ed. 2, 202 (1762). — Based on a plant of Martinique illustrated by Plumier.

Heliotropium humile (L.) R. Br. ex R. & S. Syst. **4**: 37 (1819), not Lam. (1791).

Heliotropium hirtum Lehm. Neue Schr. Naturf. Ges. Halle 3[2]: 10 (1817), Nov. Acta Acad. Caes. Leop. Nat. Cur. **9**: 135 (1818), and Asperif. **1**: 62 (1818); R. & S. Syst. **4**: 38 (1819). — Type from Venezuela.

Heliotropium hispidum HBK. Nov. Gen. et Sp. **3**: 87 (1817) and 451 (1820). — Type from Venezuela.

Heliotropium fruticosum, var. *hispidum* (HBK.) DC. Prodr. **9**: 543 (1845).

Schleidenia hispida (HBK.) Fresen. in Mart. Fl. Bras. 8[1]: 37 (1857).

Heliotropium demissum R. & S. Syst. 4: 37 and 733 (1819), in pt. — Type West Indian; a mixture of *H. ternatum* and *H. fruticosum.*

Pioctonon antillanum Raf. Sylva Tellur. 88 (1838), in pt. — Type West Indian; a mixture of *H. ternatum* and *H. fruticosum.*

Heliotropium fruticosum, var. *confertum* DC. Prodr. 9: 542 (1845). — Type from Guadeloupe, *Bertero.*

Heliotropium fruticosum, var. *angustilobum* DC. Prodr. 9: 543 (1845). — Type from Cuba.

Native to the West Indies, Yucatan, and northern Venezuela and Colombia.

ANTIGUA: *Box 1291* (G); *Rose, Fitch & Russell 3360* (NY). MONTSERRAT: *Shafer 412* (NY). DESIRADE: *Stehlé 288* (NY), *2829* (G); *Duss 2756* (NY). DOMINICA: *Imray* (G); *Bailey 750* (NY); *Lloyd 827* (NY); *Hodge 3790* (G). MARTINIQUE: *Sieber, Fl. Mixta 430* (G, NY); *Duss 1417* (G, NY), *Egler 39–6* and *39–53* (NY); *Hahn 416* (G); *Stehlé 2215* (NY), *3469* (G), *6168* (G). ST. VINCENT: *Smith 977* (G, NY).

A loosely branched shrubby plant frequently forming a bush 3–20 dm. tall. I have seen one collection from Cuba (*Wright 3135*) and numerous collections from the Bahamas, Jamaica, Porto Rico, and the Virgins. The species has been reported from Haiti, Guadeloupe, St. Lucia, and Bequia. It is apparently absent from Trinidad and Tobago, but is common along northern Venezuela and on the adjacent Margaritas and Dutch islands.

Distinctive of the species is its bushy growth and strong root and its development of opposite or ternate leaves at one or more nodes on vigorous shoots. It varies considerably in size and shape of leaves, in pubescence, and in quantity of opposite or ternate leaves developed. In the West Indies it has been confused with the very different *H. fruticosum* L., cf. Johnston, Contr. Gray Herb. 81: 66 (1928). That species occurs in Porto Rico, Haiti, and Jamaica, and on the continent, and is readily distinguished from our plant by having a lower habit, annual root, and well-developed leaf-like bracts in the inflorescence. In an earlier paper I failed to distinguish *H. ternatum* from the related South American *H. Ottoni* Lehm. That latter species has synonyms in *H. strictum* HBK., *Tournefortia monostachya* Willd., *H. Ottonianum* R. & S., *H. Ottonis* DC., *H. strictissima* Moric., and *Schleidenia subracemosa* Warm. It differs from our species in its short-lived chiefly annual root, few usually sparingly branched and frequently strict stems, uniformly alternate leaves, and more southerly range. The plant has been found from northern Venezuela to eastern Brazil. Though formerly confused with *H. salicoides* Cham., both *H. Ottoni* and *H. ternatum* are readily distinguished by their white rather than decidedly yellow corollas, cf. Johnston, Jour. Arnold Arb. 16: 62 (1935). In Central America *H. ternatum* is confined to the Yucatan peninsula, being replaced in Mexico and other parts of northern Central America by the closely related but lower-growing and less strongly perennial *H. oaxacana* DC. and *H. mexicanum* Greenm. These two latter species have only alternate leaves. The more northerly ranging *H. mexicana* occurs from Oaxaca to Sonora and Nuevo Leon and has retrorse hairs on its leafy twigs, as well as leaves that are usually broadest at or above the middle.

For the present species Urban, Symb. Ant. 8: 590 (1921), has used the name "*H. humile* (L.) R. Br. Prodr. I (1810) p. 497 (non Lam.)." The name is based upon *Tournefortia humilis* L., which has its ultimate basis in a plant illustrated by Plumier. It is known that Linnaeus, while in Holland, studied copies of Plumier's plates during the preparation of the Species Plantarum. Among these was the representation of the present species later published by Burnam, Pl. Amer. Plumier. 224, *t. 227, f. 2* (1760). Notes accompanying the original drawing at Paris state that the plant concerned was collected on Martinique (south end) in the area known as "La pointe des Salines au Cul de Sac Marin." It is a very coarse atypical form of *H. ternatum*. Urban indicates that Robert Brown made the combination "H. humile." This is incorrect. The actual transfer was first published by Roemer & Schultes, Syst. 4: 37 (1819), and even then only as a synonym. This binomial, in any case, is not a valid name for our plant, since it is a late homonym of *H. humile* Lam. Tab. Encyc. 1: 393 (1791). The application of Lamarck's binomial has been uncertain. I have referred it to the synonymy of *H. angiospermum* Murr.

5. **Heliotropium filiforme** Lehm. Götting. Gel. Anzeigen 1817: 1515 (1817), and Asperif. 1: 37 (1818); Johnston, Contr. Gray Herb. 81: 61 (1928) and Jour. Arnold Arb. 16: 62 (1935). — Type from Venezuela.

Paraguay and eastern Bolivia northward through Brazil to the Guianas and Venezuela; northern Central America and adjacent Mexico; Trinidad.

TRINIDAD: Icacos, *Broadway 7401* (T).

This is a plant of wet ground. It has been collected most commonly near streams.

6. **Heliotropium indicum** L. Sp. Pl. 130 (1753).

A weedy plant widely distributed in the warmer parts of the world.

ANTIGUA: *Box 929* (G). MONTSERRAT: *Shafer 366* (NY). DOMINICA: *Lloyd 247* (NY); *Hodge 3872* (G). MARTINIQUE: *Duss 1419* (G, NY). ST. LUCIA: *Walsh* (NY). ST. VINCENT: *Smith 1213* (G). BEQUIA: *Joseph 231* (NY). GRENADA: *Broadway* (G, NY). BARBADOS: *Freeman 12H* (NY). TRINIDAD: *Herb. Trin.*

Reported from most of the islands in our area and very probably present on all of them.

7. **Heliotropium procumbens** Miller, Dict. ed. 8, no. 10 (1768); Johnston, Contr. Gray Herb. 81: 52 (1928). — Type from Cartagena, Colombia.

Heliotropium inundatum Sw. Prodr. 40 (1788) and Fl. Ind. Occ. 1: 343 (1797). — Type from Jamaica.

A species widely distributed in the warmer parts of America but of restricted occurrence in the West Indies.

ANTIGUA: *Box 852* and *1357* (G). TRINIDAD: *Broadway* (G, NY); *Britton 2506* (G, NY), *Britton & Hazen 720* (NY).

The plant has been found in Jamaica, Cuba, Hispaniola, and Porto Rico, but is very rare or absent in the Lesser Antilles. It has been reported from Guadeloupe, but recent collectors have not found it there, and Duss, Fl. 452–3 (1897), does not list it for the French islands. The plant is usually annual and usually favors places subject to periodic inundations of fresh water.

8. **Heliotropium angiospermum** Murray, Prodr. Stirp. Göttingen 217 (1770); Johnston, Contr. Gray Herb. **81**: 10 (1928). — Type from a European botanic garden.

Schobera angiospermum Murray ex Scopoli, Intr. 158 (1777); Britton & Wils., Bot. Porto Rico **6**: 134 (1925).

Heliotropium parviflorum L. Mant. **2**: 210 (1771).

Heliotropium humile Lam. Tab. Encyc. **1**: 393 (1791); Johnston, Jour. Arnold Arb. **16**: 186 (1935).

Widely distributed in the warmer parts of America.

ST. MARTIN: *Boldingh 2344* (NY). ST. BARTHÉLEMY: *Forsström* (NY). ST. EUSTATIUS: *Walsh* (NY). ST. KITTS: *Kidder* (G); *Britton & Cowell 279* (NY). ANTIGUA: *Duss 41* (NY); *Box 1050* (G). GUADELOUPE: *Stehlé 762* (NY), *2688* (G), *2830* (G); *Duchassaing* (G, NY). MARTINIQUE: *Stehlé 3641* (G); *Duss 1418* (G, NY); *Hahn* (G); *Egler 39–45* (NY). ST. VINCENT: *Smith 1582* (NY). GRENADA: *Broadway* (NY). TOBAGO: *Williams* (T). TRINIDAD: *Broadway 2717* and *5140* (G).

A plant of sunny open places with well-drained soil. Frequently a weed in waste ground. The species has been reported from Anguilla, Saba, Dominica, and Barbados.

The name *H. humile* Lam. has long been of uncertain application and a source of confusion, cf. R. & S. Syst. 4: 38, 733 and 734 (1819) and Johnston, Contr. Gray Herb. 81: 67 (1928). It has been applied to such diverse species as *H. ternatum* Vahl, *H. fruticosum* L. and *H. angiospermum*. After a study of specimens available to Lamarck at Paris I am now of the opinion that *H. humile* Lam. belongs in the synonymy of *H. angiospermum*.

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PLANTAE PAPUANAE ARCHBOLDIANAE, XIX *

LILY M. PERRY

THIS PAPER covers the Cunoniaceae of Papuasia in the Arnold Arboretum herbarium. The following genera are represented: *Spiraeanthemum, Gillbeea, Opocunonia, Spiraeopsis, Ceratopetalum, Schizomeria, Aistopetalum, Weinmannia,* and *Pullea.* I have found nothing to match either *Kaernbachia* or *Stollaea.* The latter, from the description, appears exceedingly close to the genus *Opocunonia,* which Schlechter accepted as having fleshy fruit. In the abundant material of this genus at hand, it can now be shown that the fruit is capsular and very similar to that described for *Stollaea.* The fruit of *Aistopetalum,* however, is a drupe; there are, accordingly, two genera with drupaceous fruits represented in New Guinea. Some reductions have been made, others may need to be made. Wherever species have been added to a genus (except in *Weinmannia*), a brief key is given to help future workers evaluate the species. In *Weinmannia,* because of the interrelationships of the species, it would be necessary to prepare a key including the Malaysian and Polynesian species as well; we do not have sufficient material for such a key. The genus *Gillbeea* is represented by two collections (*Clemens 3430, 3769*) which practically match the figure of Schlechter's *G. papuana.* The other genera are elaborated below.

SPIRAEANTHEMUM A. Gray

KEY TO THE SPECIES

Leaves denticulate, chartaceous............................*S. Kajewskii.*
Leaves entire or inconspicuously crenulate-serrulate, coriaceous (except in *S. parvifolium*).
- Pubescence of the branchlets, the under surface of the leaves, and the inflorescence dense and shaggy; calyx shortly villous or pilose...*S. Pulleanum.*
- Pubescence of the branchlets and inflorescence shorter, usually ± appressed; calyx glabrous.
  - Leaves four in a verticil, cuspidate-acuminate; scales of the disk ovate....................................*S. integrifolium.*
  - Leaves opposite or ternate, not cuspidate-acuminate; scales of the disk oblong or quadrate, not ovate.
    - Leaves small, 2–2.7 × 1–1.7 cm., chartaceous; carpels villous; styles subclavate......................*S. parvifolium.*
    - Leaves larger, 5.5–13 × 2.5–6 cm., coriaceous; carpels puberulous or almost glabrous; styles subulate.
      - Axis of the inflorescence hirtellous or subtomentose.................................*S. reticulatum.*

*Botanical Results of the Richard Archbold Expeditions. See Jour. Arnold Arb. **30**: 39–63. 1949.

Axis of the inflorescence puberulous.
Leaves elliptic or lance-elliptic (broadest at the middle).
Mature leaves densely reticulate on both surfaces, margins remotely crenulate-serrulate; follicles practically glabrous (here and there are very scattered minute hairs) .... *S. novoguineense.*
Mature leaves obscurely reticulate on the upper surface only, margins entire; follicles sparsely but evenly puberulous .... *S. idenburgense.*
Leaves lanceolate (broadest below the middle) .... *S. lanceolatum.*

Spiraeanthemum Kajewskii Perry, spec. nov.

Arbor usque 20 m. alta; ramulis atro-fuscis, novellis minute pubescentibus, compressis, nodis paulo incrassatis, cito glabratis; stipulis oblongis, 9 mm. longis, 3 mm. latis, obtusis, extus appresse pubescentibus; foliis chartaceis, ellipticis, 5–12 cm. longis, 2.5–5 cm. latis, utrinque angustatis, apice acutiusculis vel breviter et obtuse acuminatis, basi cuneatis, margine denticulatis, supra olivaceis subtus pallidioribus, utrinque glabris (subtus costa venisque hinc inde pilis obsitis), venis primariis utrinsecus ±13 oblique patentibus prope marginem furcatis utrinque perspicuis, venulis ± dense reticulatis utrinque manifestis; petiolo 0.8–2 cm. longo; inflorescentiis ±7.5 cm. longis, axi et ramulis puberulis, multifloris; pedicellis 1 mm. longis; calyce 1.5 mm. longo, lobis 4 vel 5, oblongis, 1 mm. longis, acutiusculis; staminibus longioribus 1 mm. alternis 0.7 mm. longis, antheris minutis; disci squamis 4 vel 5, bilobatis apice truncatis vel paulo retusis, 0.4 mm. longis, 0.5 mm. latis; carpellis 4 vel 5, ovariis 0.7 mm. longis, pubescentibus, 2-ovulatis, stylis 0.4–0.5 mm. longis, vix 0.2 mm. crassis, stigmate capitata; folliculis 3.5 mm. longis, 0.7 mm. diam., appresse pubescentibus.

SOLOMON ISLANDS: Bougainville: Kupei Gold Field, *Kajewski 1700* (TYPE), April 1930, alt. 1000 m., rain-forest (tall tree up to 20 m. high); Koniguru, Buin, *Kajewski 2082*, Aug. 1930, alt. 950 m., rain-forest (tree up to 20 m. high; flowers white. Wood used by natives for building houses). Guadalcanal: Uulolo, Tutuve Mt., *Kajewski 2533*, April 1931, alt. 1200 m., rain forest (tree 8 or 9 m. high; flowers minute, green; fruits small, mostly in fours).

Kajewski 2082 is taken from new growth. It is much more pubescent than the type, the terminal bud is villous as well as two very young leaves subtending it. Also, the leaves are somewhat larger (10–15 × 5.5–8.5 cm.) and the midrib and veins of both surfaces are pubescent with fine hairs, the lower surface more densely so. Between the veins the lamina is glabrate. Further, the axis and branches of the inflorescence are much more hairy than those of the type. These collections appear nevertheless to be conspecific.

Spiraeanthemum Kajewskii is more like some Polynesian species than those of New Guinea. It should be compared with *S. Macgillivrayi* Seem. from Aneityum, which is only very briefly characterized and of which we have no specimen. It suggests *S. samoense* A. Gray, but this last species has leaves rounded at the base, stamens as long as the calyx or longer, and the parts of the disk as many as the stamens.

Spiraeanthemum Pulleanum Schlechter in Bot. Jahrb. **52**: 140. 1914, in Nova Guin. **12**: 491, *t. 191.* 1917; Kaneh. & Hatus. in Bot. Mag. (Tokyo) **56**: 111. 1942.

NETHERLANDS NEW GUINEA: 15 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 11923, Brass 12017, 12136,* Jan. 1939, alt. 1780 and 1800 m., common in mossy forest (subsidiary tree 15–18 m. high; flowers light yellow; leaves stiff, convex).

I am unable to distinguish these collections either from this species (as defined in the original description) or from Kanehira's collection taken in the type locality, except that the leaves are not, or are only very slightly, bullate. This characteristic appears to be variable within the species.

Spiraeanthemum reticulatum Schlechter in Bot. Jahrb. **52**: 140. 1914.

NETHERLANDS NEW GUINEA: 18 km. southwest of Bernhard Camp, Idenburg River, *Brass 12693,* Feb. 1939, alt. 2150 m., mossy forest (tree attaining a height of 25 m. and stem diameter of 30 cm.).

This collection agrees fairly well with the original description except that it is difficult to decide what Schlechter considered a short petiole. In this specimen the largest leaf is 6.5 cm. long (including a petiole 1 cm.) and 3.2 cm. wide. The smaller leaves have petioles about 5 mm. long not including the shortly decurrent (1–3 mm.) base of the lamina. The lamina tends to be slightly convex between the impressed primary nerves, and the margins are somewhat revolute. The axis and branchlets of the inflorescence are more hirtellous or subtomentose than villous, the hairs are fairly short and crinkly but not matted. The carpels are mostly puberulous in this profusely fruiting specimen. The seeds are about 2.5 mm. long.

Spiraeanthemum idenburgense Perry, spec. nov.

Arbor 16 m. alta, 35 cm. diam.; ramulis atro-fuscis, novellis puberulis, nodis incrassatis; foliis coriaceis, oppositis et ternatis, ellipticis, (2.3–) 5.5–11 cm. longis, (1.5–) 2.5–6 cm. latis, utrinque angustatis, apice obtusis, basi cuneatis, margine integris, utrinque glabris, supra olivaceis, subtus pallidioribus, venis primariis utrinsecus 6–8 supra impressis subtus prominulis, oblique patentibus prope marginem arcuatis, venulis dense reticulatis supra vix distinctis, subtus perspicuis; petiolo (0.3–) 1–1.5 cm. longo; inflorescentiis 5.5–13 cm. longis, pedunculo 0.5–6 cm. longo, axi et ramulis puberulis; calyce 2 mm. longo, glabro, lobis 4 vel 5, ovatis subacutis, 1.3 mm. longis, 1 mm. latis; filamentis 1.2 mm. longis, antheris ellipsoideis, 0.4 mm. longis, leviter retusis; disci squamis oblongis vel quadratis 0.6 mm. longis; carpellis saepissime 3, ovariis pubescentibus, 0.7 mm. longis, 2-ovulatis; stylis 1.1 mm. longis; folliculis 5 mm. longis ± puberulis; seminibus 2.3 mm. longis.

NETHERLANDS NEW GUINEA: 15 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 11938* (TYPE), Jan. 1939, alt. 1680 m., frequent on forested slopes (tree 16 m. high, 35 cm. diameter; flowers light yellow; fruit yellow-green).

This species shows much variability in the size of the leaves and the length of the infructescences. The mature leaves are more firmly coriaceous than in any other species at hand. When the leaves are ternate, often one leaflet is much smaller than the others.

Spiraeanthemum novoguineense Perry, spec. nov.

Arbor ± 15 m. alta, 20 cm. diam.; ramulis atro-cinereis, novellis puberulis, nodis incrassatis; foliis coriaceis oppositis, interdum ternatis, ellipticis utrinque angustatis, basi cuneatis, apice anguste obtusis vel subrotundatis, interdum breviter et obtuse acuminatis, margine remote crenulato-serrulatis vel integris, utrinque glabris dense reticulatis, venis primariis utrinsecus 5–7, patenti-ascendentibus prope marginem arcuatis, supra inconspicuis, subtus prominulis, lamina 2.5–8.5 cm. longa, 1.3–4.2 cm. lata, in petiolo 2–5 mm. decurrente; petiolo 3–10 mm. longo, supra ± applanato, interdum puberulo; infructescentiis usque 9 cm. longis, axi et ramulis ± puberulis; pedicellis vix 1.5 mm. longis; calyce vix 2 mm. longo, glabro, lobis 4, 1.3 mm. longis, 0.9–1 mm. latis, acutiusculis vel obtusiusculis; filamentis 1.7–2 mm. longis, glabris; disci squamis 0.5–0.6 mm. longis, 0.2 mm. latis, oblongis vel paulo cuneatis vel interdum subquadratis; carpellis 3 vel 4, immaturis 1.8 mm. longis, sparsim pilosulis 2- or 3-ovulatis, maturis 4 mm. longis, hinc inde pilis minutis obsitis; stylis subulatis 1.2 mm. longis; seminibus 2 mm. longis.

NETHERLANDS NEW GUINEA: 15 km. southwest of Bernhard Camp, Idenburg River, *Brass 11860* (TYPE), Jan. 1939, alt. 1800 m., mossy forest (abundant subsidiary tree ± 15 m. high, 20 cm. diameter; fruits green).

NORTHEAST NEW GUINEA: vicinity of Samanzing, *Clemens 9476, 9584*, Jan., Feb. 1939, alt. ± 2400 m.

In these collections the leaves are occasionally ternate. At a glance the reticulate upper surface of the leaf may be seen. The species differs from *S. parvifolium* Schltr. in having somewhat larger and flat coriaceous leaves. It may be distinguished from *S. reticulatum* Schltr. by the larger leaves, the shorter infructescence (not more than half as long again as the leaves), and the puberulous axis and branchlets. In *S. reticulatum* Schltr. the inflorescence is two or three times as long as the leaves, and the peduncle is villous.

Spiraeanthemum lanceolatum Perry, spec. nov.

Arbor glabra; ramulis fuscis, nodis incrassatis, alabastris parvis, breviter tomentosis; foliis coriaceis, oppositis vel interdum ternatis, lanceolatis, 6.5–13 cm. longis, 2.4–4.8 cm. latis, basi cuneatis, apice late et obtuse acuminatis, acumine 6–12 mm. longo, margine integris, utrinque glabris, venis primariis utrinsecus ± 7, patenti-ascendentibus prope marginem arcuatis, supra impressis subtus prominulis, venulis dense reticulatis supra inconspicuis subtus perspicuis; petiolo (incl. lamina 3–7 mm. decurrente) 0.5–1.3 cm. longo, canaliculato; inflorescentiis 3–5 cm. longis, axi et ramulis puberulis; pedicellis 1–1.8 mm. longis; calyce 1.7 mm. longo, lobis 4–6, 1.2 mm. longis, 0.6–0.7 mm. latis, oblongis vel oblongo-ellipticis, acutiusculis; filamentis 1.5–2 mm. longis, antheris minutis, late ellipsoideis minute apiculatis; disci squamis 4–6, bilobis (interdum bipartitis), 0.2–0.3 mm. longis truncatis vel paulo retusis; carpellis 2–4, ovariis 0.5 mm. longis, sparsim pubescentibus, 4-ovulatis; stylis 1.5–2 mm. longis.

NETHERLANDS NEW GUINEA: 2 km. southwest of Bernhard Camp, Idenburg River, *Brass 13615* (TYPE), Mar. 1939, alt. 700 m., rain-forest (substage tree; flowers white).

This species is readily distinguished from *S. novoguineense* by the lanceolate entire leaves with a smooth upper surface. The latter character is also found in *S. idenburgense*, but the leaves of the latter are elliptic and somewhat more firmly coriaceous. *Spiraeanthemum idenburgense* also has a little larger flowers with shorter filaments and styles but larger disk scales than *S. lanceolatum*.

OPOCUNONIA Schlechter

In our material there are at least four species of this genus, and five different collections in fruit. The fruits are bivalvate capsules instead of drupes having a fleshy exocarp as indicated in the original description. The seeds are winged at both ends ± 3 mm. long (including the wings) and about 0.5 mm. broad. With only the original description of the genus *Stollaea* Schltr. and the figure of the type-species *S. papuana* Schltr. for comparison, I am unable to find any generic characters to separate that genus from *Opocunonia* Schltr. However, since we have no material which matches *S. papuana* Schltr., I merely mention this in passing, and leave the actual reduction to the monographer, who should have access to isotype material, if possible.

Opocunonia kaniensis Schlechter in Bot. Jahrb. 52: 160, *fig. 8, A-G.* 1914.

NETHERLANDS NEW GUINEA: Bele River, 18 km. northeast of Lake Habbema, *Brass & Versteegh 11120, Brass 11478,* Nov. 1938, alt. ± 2200 and 2300 m., frequent in the forests (large canopy tree; bark reddish brown, warted; wood soft, flowers white); 6 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 12563,* Feb. 1939, alt. 1230 m., common in primary forest (tree 32 m. high, 59 cm. diam.; bark gray; sapwood orange, heartwood dark red; flowers white; fruits green).

NORTHEAST NEW GUINEA: Ogeramnang, *Clemens 5022,* Jan. 1937, alt. 1770 m.; Samanzing, *Clemens 8967, 9297,* Oct., Nov. 1938, alt. 1600–1800 m., mountain bush (tree 15 in. to 3 ft. diam.; flower buds pale green; flowers white); Matap, *Clemens 11102,* Feb. 1940, alt. 1500–1800 m.

In these specimens the base of the leaflets is often rounded, then very shortly cuneate; the ovary is puberulous rather than glabrous; the capsule is 6–8 mm. long and about 3 mm. diameter. The stipules vary in size (0.7–2.5 cm. long, 1–3 cm. broad) and are somewhat rectangular in outline, with truncate or broadly and shallowly retuse apex. The rounded sides contract into a broad short base at the attachment to the stem. From this base the two main veins extend to the outer points of the apex like a very broad V.

Opocunonia Nymanii (K. Sch.) Schlechter in Bot. Jahrb. 52: 159. 1914.

Ackama Nymanii K. Sch. in K. Schum. & Lauterb. Nachtr. Fl. Deutsch. Schutzgeb. Südsee, 272. 1905.

NORTHEAST NEW GUINEA: Morobe District, Sattelberg, *Clemens 6654*, June 1937.

This collection, although fragmentary and with only young flower-buds, matches very closely the original description. At hand is another specimen collected below Boana in Aug. 1938, at approximately 750 m. alt., *Clemens 8704* (tall tree 2 ft. diam.); a few leaflets of this specimen are about the same size as those of *Clemens 6654*, but most of the leaflets are larger, the largest being 12.5 cm. long, 4 cm. broad and chartaceous; those of *Clemens 6654* are slightly firmer. The branches of the inflorescence are villous, even in the infructescence, those of the other specimen (of which we have only a fragment of the inflorescence) are only minutely puberulous. *Clemens 8704* has an inflorescence (young buds only) about 10 cm. long and an infructescence about the same length. The capsule (without the persistent style) is 5 mm. long and minutely appressed-pubescent.

Opocunonia papuana Kanehira & Hatusima in Bot. Mag. (Tokyo) 56: 108, *fig. 4.* 1942.

NETHERLANDS NEW GUINEA: Chaban, 30 km. inward from Nabire, *Kanehira & Hatusima 11756*, Feb. 1940, alt. 100 m., in dense rain-forest (tree 30 m. high); 15 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 11950*, Jan. 1939, alt. 1900 m., occasional in primary forest (tree 31 m. high, 43 cm. diam.; bark black; sapwood red-yellow, heartwood dark red; flowers white); 18 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 12501*, Feb. 1939, alt. about 2000 m., rare in primary forest (tree 43 m. high, 67 cm. diam.; bark black, rough; wood red-yellow; flowers white; ripe fruit brown); 6 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 12540, 13105*, Feb. 1939, alt. 1200 m., frequent or occasional in primary forest (tree 20–28 m. high, 43–53 cm. diam.; bark brown, scaly in one, in the other gray, rough; flowers white); 4 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 13117, Brass 13309, 13630*, March 1939, alt. 850 and 900 m., plentiful in rain forest canopy and common subsidiary tree in *Agathis* forest (tree 35 or 25 m. high; flowers white).

NORTHEAST NEW GUINEA: Sambanga, *Clemens 6957*, Sept. 1937, alt. 1500–1800 m. (tall tree 18 in. diam.).

There is some variation in the size of the flowers of the collections cited above. The length of the calyx-lobes varies from 1.4–2 mm. long, and the pedicels from 1–2 mm. long. The leaves also vary considerably in size, but all seem to be of similar texture and venation; in some specimens the lower surface of the leaf is sparsely and minutely pubescent and small domatia occur in the axils between the primary veins and the midrib. The capsule of this species is 4–5 mm. long (not including the style), with scattered minute hairs on the outside. The seeds are ± 3 mm. long.

Possibly the following collection belongs here: 2 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 13505*, Apr. 1939, alt. 750 m. The leaves of this specimen are a little coarser than in most of the collections cited above, and the inflorescence (flower buds very young) in one specimen measures 20 × 25 cm.

Opocunonia trifoliolata Schlechter in Bot. Jahrb. **52**: 161. 1914.

BRITISH NEW GUINEA: Central Division, Mafulu, *Brass 5247*, Sept.-Nov. 1933, alt. 1250 m., old secondary forest (tree 8 m. high, with shining smooth leaves and white flowers).

The above cited specimen is probably only a pubescent form of this species. On the lower surface of the leaves there are minute scattered hairs, the base of the lateral leaflets is rounded, while that of the terminal ones is usually cuneate. The leaves are both 3- and 5-foliolate. The axis of the inflorescence is densely pubescent, as are the pedicels, the lower part of the calyx, and the ovary. The filaments are 6 and 8 mm. long.

SPIRAEOPSIS Miquel

In our herbarium the genus *Spiraeopsis* Miq. is represented by thirteen specimens, one from the Celebes, two from Manado, and ten from the Philippines. The genus was originally described as dioecious by Miquel, later emended to monoecious by Koorders in his Suppl. Fl. Celebes **1**: 22. 1918. Since then B. L. Burtt, in Kew Bull. **1936**: 462. 1936, in a discussion of *S. celebica* Miq., has indicated that all herbarium specimens seen have been entirely male or entirely female. I have dissected several flowers, all perfect, i.e., possessing both pollen and ovules, and in appearance they are like *figs. 11, 12, 13,* of Koorders' plates *7a, 7b,* which in the legend are designated as "masc." Could it be that the fugacious character of the petals and stamens gives rise to the impression of a pistillate inflorescence?

The genus *Betchea* Schlechter, hitherto regarded as endemic in New Guinea, seems to differ only in having two to five carpels instead of two, rarely three. In this study it is treated as a synonym of *Spiraeopsis*.

KEY TO THE SPECIES

Flowers with mostly 2 (occasionally 3)-loculed ovary.
- Lower surface of the leaves glabrous (but conspersely glandular) except midrib and veins.............................*S. glabrescens*.
- Lower surface of the leaves not glabrous, or if so, leaves 5–9-foliolate.

Lower surface of the leaves tomentulose, or if glabrous, leaves 5–9-foliolate........................*S. celebica* sensu lato.
Lower surface of the leaves densely tomentose or pilose-tomentose.
Leaves 3-foliolate; capsule 5–6 mm. long, tomentose; seeds papillose..................................*S. Brassii.*
Leaves 5-foliolate; capsule 3–4 mm. long, shortly villous-tomentose..............................*S. pubescens.*
Flowers with 3–5-loculed ovary.
Flowers with mostly 3 (occasionally 4)-loculed ovary.
Leaves 3-foliolate....................................*S. fulva.*
Leaves 5–11-foliolate.
Leaflets sessile..............................*S. canariifolia.*
Leaflets petiolulate.
Lower surface of leaflets rufous-tomentose........*S. rufa.*
Lower surface of leaflets stellate-puberulous to almost glabrous and glandular.
Leaflets small, 2.5–7 × 1.3–3 cm.......*S. Clemensiae.*
Leaflets larger, 8–12 × 3.5–5 cm.
Leaflets 7–11, gradually acuminate...*S. papuana.*
Leaflets 5, acutish................*S. myriantha.*
Flowers with 4- or 5-loculed ovary.
Flowers with 4-loculed ovary; under surface of leaves glabrous and glandulose.............................*S. pometiiformis.*
Flowers with 5 (occasionally 4)-loculed ovary; under surface of leaves densely tomentulose................*S. aglaiaeformis.*

Spiraeopsis celebica (Bl.) Miq. Fl. Ind. Bot. **1**(1): 719. 1856; B. L. Burtt in Kew Bull. **1936**: 462. 1936; sensu lat.

Cunonia celebica Bl. Bijdr. 868. 1826.

SOLOMON ISLANDS: Bougainville: Kupei Gold Field, *Kajewski 1715,* Apr. 1930, alt. 1200 m., rain forest (tree up to 30 m. high; fruit brown when ripe splitting into two parts, length without style 5 mm., diam. 2.5 mm.); Buin, Koniguru, *Kajewski 2113,* Aug. 1930, alt. 900 m., rain forest (tree up to 25 m. high; flowers with green sepals, very long stamens, and a faint sweet odor). Ysabel: Tiratona, *Brass 3214,* Nov. 1932, alt. 600 m., common in mountain rain forests (tall tree with thin gray bark; fruit brown).

There is considerable variation in the pubescence of these three collections as is also true of the other material of this species at hand. But until such time as a critical examination of the species can be made, it seems preferable to place the material here.

Spiraeopsis aglaiaeformis (Kaneh. & Hatus.) Perry, comb. nov.

Betchea aglaiaeformis Kanehira & Hatusima in Bot. Mag. (Tokyo) **56**: 106, *fig. 2.* 1942.

NETHERLANDS NEW GUINEA: Angi, Arfak Mts., *Kanehira & Hatusima 13907* (ISOTYPE), Apr. 1940, alt. 1900 m., in forest along Iray River to Lake Gita (tree 15 m. high, 20 cm. diam.); 9 km. northeast of Lake Habbema, *Brass & Versteegh 10476,* Oct. 1938, alt. ± 2700 m., rare in primary forest (tree 34 m. high, 30 cm. diam.; wood rose; bark gray, fairly smooth; flowers and fruits yellow); Bele River, 18 km. northeast of Lake Habbema, *Brass & Versteegh 11138,* Nov. 1938, alt. 2350 m., frequent in primary forest (tree 31 m. high, 42 cm. diam.; bark gray, rough; wood rose; flowers brown); 15 km. southwest of Bernhard Camp, Idenburg River, *Brass 12231,* Jan. 1939, alt. 1700 m., in rain forest ravine (tree 5 m. high, 10 cm. diam.; flowers white).

Northeast New Guinea: Sambanga, *Clemens 6835,* Aug. 1937, alt. 1500–1800 m., margin of mountain forest (frequent big tree).

Among the fruits I have found three, four and five locules but mostly the last mentioned. The leaves are 3-, 5- or 7-foliolate, with the 3-foliolate opposite the 5-foliolate ones.

Spiraeopsis rufa (Schlechter) Perry, comb. nov.

Betchea rufa Schlechter in Bot. Jahrb. **52:** 148, *f. 4, A-G.* 1914.

Northeast New Guinea: Yunzaing, *Clemens 3872,* Aug. 1936, alt. 1350 m.; Quembung, *Clemens 3195,* June 1936, alt. 750 m., forest hills (tall tree 10–12 in. diam.; flower purplish, stamens purple-red, anthers pale yellow; fruits brown, 3-fid, purple inside); Sattelberg, *Clemens 2216,* Apr. 1936, alt. ± 1000 m., in forest.

In flowers and pubescence these three specimens match *Schlechter 17086,* one of the numbers cited in the original description. The capsules are 3 mm. long, valves ± 1 mm. broad; seeds including the wings 1 mm. long.

Spiraeopsis fulva (Schlechter) Perry, comb. nov.

Betchea fulva Schlechter in Bot. Jahrb. **52:** 148. 1914.

We have no specimen which matches this species, but it should be compared with *S. glabrescens* Perry.

Spiraeopsis Brassii Perry, spec. nov.

Arbor; ramulis dense subferrugineo-tomentosis deinde glabratis, crassiusculis, 5 mm. diam.; stipulis parvis, 5–7 mm. longis, 7–8 mm. latis, subreniformibus vel subrotundis, utrinque tomentosis; foliis trifoliolatis, margine plerumque crenato-dentato interdum fere subintegris, supra rugosis, novellis tomentosis cito glabratis, subtus dense tomentosis vel breviter sublanatis, foliolis ellipticis terminali interdum obovato-elliptico, 7–11 cm. longo, 4–8.5 cm. lato, apice subacuto vel obtuso vel interdum breviter et obtuse acuminato, basi cuneato vel rotundato, petiolulo 0.5–1.8 cm. longo, lateralibus ellipticis, saepe minoribus, 3–7 cm. longis, 2.3–5.4 cm. latis, apice obtusiusculis, basi plerumque inaequaliter rotundatis interdum cuneatis, subsessilibus vel sessilibus, venis primariis utrinsecus 8–12 patenti-ascendentibus prope marginem furcatis ± anastomosantibus, supra impressis subtus prominulis, venulis supra perspicuis; petiolo 1.5–3 cm. longo, dense tomentoso; inflorescentiis tomentosis, 15 cm. vel. ultra, multifloris; pedicello 1–1.5 mm. longo; floribus 4–5-meris; calycis tubo 1 mm. longo, lobis 1–1.5 mm. longis; petalis circiter 1.5 mm. longis, obovato-oblongis; filamentis petalis aequalibus, antheris 0.5 mm. longis latisque apiculatis; disco 10-lobulato; stylis 2, circiter 1 mm. longis; ovario dense tomentoso 2-loculari, pluri-ovulatis; capsula 5–6 mm. longa, seminibus 2–2.5 mm. longis (alis inclusis) minute papillosis.

NORTHEAST NEW GUINEA: Sarawaket, *Clemens 6050* (in fruit), *7535a* (leaves and very young flower buds), Apr., Nov. 1937, alt. 2400–2700 and 2100 m.; vicinity of Samanzing, *Clemens 9511*, Jan. 1939, alt. 2100–2400 m. (tree with brown fruit).

BRITISH NEW GUINEA: Central Division, Mt. Tafa, *Brass 4852* (TYPE), May-Sept. 1933, alt. 2700 m., on cleared summit (bushy small tree 4 m.; underside of leaves densely brown pubescent); same locality, *Brass 5024*, alt. 2400 m., very common in valley forests (tree up to about 30 m. high; irregular scant-foliaged crown; branchlets stiff; profusion of small green flowers; fruit not seen).

In the last specimen cited there is only one old leaf (not as rugose on the upper surface as those of the other specimens), the rest are immature, but the lateral leaflets are sessile and the margin is inconspicuously serrate-dentate; the inflorescence is broken, but the main axis is 26.5 cm. long, the branches on one side (the others are broken off) are 10–12 cm. long, the pubescence of the whole plant is definitely tomentose. In the other specimens the lower surface of the leaves is almost lanate or villous-tomentose, the upper noticeably rugose. Until more material is at hand it seems best to accept all as one species. No other species of the genus which I have seen has papillose seeds or as thick pubescence.

Spiraeopsis pubescens Perry, spec. nov.

Probabiliter arbor; ramulis tomentosis crassiusculis, ± 5 mm. diam.; stipulis non visis; foliis 5-foliolatis, coriaceis, inconspicue serratis, supra rugulosis stellato-pilosulis, subtus brunnescentibus dense stellato-pilosis vel piloso-tomentosis, foliolis 7–17 cm. longis, 4–9 cm. latis, ellipticis vel ovato-ellipticis, terminali basi cuneato, petiolulo 0.7–2.5 cm. longo, lateralibus basi rotundatis vel rotundato-cuneatis, apice brevissime et obtuse acuminatis vel acutiusculis, venis primariis utrinsecus 12–16 oblique patentibus prope marginem ± anastomosantibus, supra impressis subtus prominulis, venulis supra distincte manifestis, petiolulis 3–6 mm. longis; petiolo 3–4 cm. longo et rhachide tomentosis; inflorescentiis multifloris, juvenilibus ± 20 cm. longis, dense tomentosis, in fructu 28 cm. longis, ramis inferioribus 15 cm. longis; pedicellis 1 mm. longis; floribus 5-meris; calyce 1.5 mm. longo (incl. lobis vix 1 mm.); petalis (siccis) 1 mm. longis, spathulatis; filamentis 2 mm. longis, antheris ovatis apiculatis; disco 5-lobato; ovario dense subvilloso-tomentoso, stylis 2 vix 1.5 mm. longis; capsula 3–4 mm. longa, ± 2 mm. lata, seminibus vix 1.5 mm. longis, minute rugulosis vel ± reticulatis.

NORTHEAST NEW GUINEA: Yoangen, *Clemens 3429* (TYPE), June 1936, alt. 1500–1800 m. (specimen with infructescence and one separate leaf); Ogeramnang, *Clemens 4802*, Dec. 1936, alt. about 1800 m. (specimen with very young inflorescence, branches not yet elongated).

The pubescence of this species is of longer hairs and more dense than that of *S. rufa* (Schltr.) Perry, and practically as long as that of *S. Brassii* described above. In fact, the latter differs only in the trifoliolate leaves (but some species have 3–7-foliate leaves), the slightly larger capsules usually with shorter stellate tomentum, and minutely papillose seeds.

Spiraeopsis glabrescens Perry, spec. nov.

Arbor; ramulis minute stellato-puberulis fuscis; stipulis circiter 1 cm. longis, 1.5 cm. latis, late rotundatis, basi subtruncatis deinde 3–5 mm. stipitatis, margine ± dentatis utrinque stellato-puberulis; foliis 3–5-foliolatis, novellis supra consperse stellatis subtus dense glandulosis, maturis subcoriaceis margine serrulatis, supra fere glabris, costa nervisque ± puberulis, subtus consperse glandulosis, costa nervisque ± dense stellato-puberulis, foliolis ellipticis vel obovato-ellipticis, 8–16 cm. longis, 4.5–8 cm. latis, terminali basi cuneato, petiolulo 0.5–1.5 cm. longo, lateralibus basi inaequaliter rotundato-cuneatis, apice subabrupte et breviter acuminatis, venis primariis utrinsecus 11–15 oblique ascendentibus prope marginem ± furcatis arcuatim anastomosantibus, supra impressis subtus prominulis, venulis subtus manifestis, petiolulis ± 4 mm. longis; petiolo 2–5 cm. longo et rhachide consperse glandulosis et minute stellato-puberulis, infructescentiis 17 cm. vel ultra, axi et ramulis dense tomentellis; pedicellis vix 1 mm. longis; floribus 5-meris; calycis lobis vix 1 mm. longis, acutis; petalis et staminibus non visis; disco 5-lobato, lobis bilobulatis; capsula dense glandulosa et tomentella, 4 mm. longa (incl. stylis 1 mm.), 2(–3)-valvata; seminibus (incl. alis) 1 mm. longis.

NORTHEAST NEW GUINEA: Sambanga, *Clemens 7052A* (TYPE), Sept. 1937, alt. 1500–1800 m. (an infructescence, a new shoot and a separate 5-foliolate leaf); Sarawaket trail above Kaile forest, *Clemens 4966,* Jan. 1937, alt. 1650–1800 m. (a medium-sized felled tree in a heap of debris).

The nearest approach to this species seems to be *S. fulva* (Schltr.) Perry according to the description of the latter. Both have 3-foliolate leaves, very short pubescence, and very small flowers on very short pedicels. However, in *S. fulva* (Schltr.) Perry the lower surface of the leaves is densely pubescent, the ovary stellate-villous and 3-loculed.

Spiraeopsis Clemensiae Perry, spec. nov.

Arbuscula ± 12 cm. diam.; ramulis gracilibus, 3–4 mm. diam., brunnescentibus, glandulosis et minute stellato-puberulis; stipulis rotundatis, 5 mm. longis latisque tomentellis; foliis 5–7-foliolatis, 10–14 cm. longis, novellis dense glandulosis et stellato-tomentosis cito glabratis, maturis coriaceis serratis, supra pallide olivaceis fere glabris, costa ± puberula, subtus brunnescentibus, costa et venis minute stellato-puberulis ceterum glabris et consperse glandulosis, foliolis oblongis, 2.5–7 cm. longis, 1.3–3 cm. latis, apice breviter acuminatis vel acutiusculis vel obtusis, basi obtusis vel cuneatis, venis primariis utrinsecus ± 11 patenti-ascendentibus, arcuatis, supra impressis subtus conspicuis, terminalis petiolulo ± 1.5 cm. longo, lateralibus basi leviter inaequalibus, petiolulis 3–7 mm. longis; petiolo vix 1.5–2.5 cm. longo et rhachide stellato-puberulis; inflorescentiis multifloris, 14 (in fructu 24) cm. longis, axi et ramulis dense stellato-tomentellis; pedicellis 1 mm. longis; calyce minute stellato-puberulo, tubo

0.5 mm. et lobis 1 mm. longis, 0.8 mm. latis, acutis; petalis et staminibus non visis; disco 10-lobato; ovario circiter 1 mm. longo tomentello, stylis 3, vix 1 mm. longis; capsula circiter 4 mm. longa (stylis inclusis), 3-valvata, seminibus ± 1.5 mm. longis (alis inclusis).

NORTHEAST NEW GUINEA: Morobe District, *Clemens 6049*, Mar. 1937, alt. 2400–2700 m. (a fruiting specimen without further data); Sattelberg, Masak R.R., *Clemens 7568* (TYPE), Nov. 1937, alt. 1800–2400 m., in mountain forest (treelet 5 in. diam.).

Spiraeopsis myriantha (Schltr.) Perry, comb. nov.

Betchea myriantha Schlechter in Bot. Jahrb. **52**: 150. 1914.

NETHERLANDS NEW GUINEA: Bele River, 18 km. northeast of Lake Habbema, *Brass & Versteegh 11137*, Nov. 1938, alt. ± 2350 m., common in old secondary forest (tree 22 m. high, 33 cm. diam.; bark brown-green, smooth; wood white; flower-buds red).

This specimen for the most part has very immature flower buds. The leaves fall within the measure of those given for this species and are 5-foliolate, but they are almost glabrous on the lower surface. The inflorescence is about 20 cm. long. The three flowers dissected had 4-loculed ovaries, whereas the original description points to 3-loculed ones. When there is opportunity to examine the isotype, this collection may be found to belong elsewhere.

Spiraeopsis papuana (Pulle) Perry, comb. nov.; vel aff.

Ackama papuana Pulle in Nova Guin. **8**: 645. 1912.

Betchea papuana (Pulle) Schlechter in Bot. Jahrb. **52**: 150. 1914, in Nova Guin. **12**: 491. 1917.

BRITISH NEW GUINEA: Central Division, Ononge Road, Dieni, *Brass 3957*, May 1933, alt. 500 m., rain forest (slender sparsely foliaged tree 10 m. high; indumentum brown; upper surface of leaves shiny; inflorescence reddish brown).

This collection differs in several respects from the original description, but the description of the leaflets is within the limits of the specimen at hand; however, this leaf is 5-(rather than 3-) jugate. The leaflets vary in size, one measures 16 × 5 cm., and the apex is long-acuminate (2 cm.). The inflorescence is 50 cm. long (including a peduncle of 14 cm. below the lowest branches), but in other collections the size of the inflorescence varies considerably; the number of styles is usually 3, although sometimes only 2. Another difference which should be pointed out is that Professor Pulle does not mention the stellate pubescence of the inflorescence, which is a key character of the genus. In conjunction with this species *S. pometiiformis* Ridl. ought to be examined.

CERATOPETALUM Smith

Ceratopetalum tetrapterum Mattfeld in Jour. Arnold Arb. **20**: 432. 1939; Kanehira & Hatusima in Bot. Mag. (Tokyo) **56**: 108. 1942.

NETHERLANDS NEW GUINEA: 6 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 12516*, Feb. 1939, alt. 1200 m. (occasional tree 30 m. high, 58 cm. diam.; flowers white; fruits dark red); 4 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 13162*, Mar. 1939, alt. 800 m., occasional, slopes of primary rain forest (tree 32 m. high, 43 cm. diam.; sap red; flowers white); 2 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 13183*, alt. 750 m., frequent on slopes in primary rain forest (tree 20 m.; fruits dark red); Boemi, Nabire, *Kanehira & Hatusima 12801*, Mar. 1940, alt. 300 m., in *Agathis* forest.

NORTHEAST NEW GUINEA: Wareo, *Clemens 1618*, Jan. 1936, alt. ± 600 m.
BRITISH NEW GUINEA: Oroville Camp, Fly River (30 miles above D'Albertis Junction), *Brass 7405* (ISOTYPE).

Although the leaves show considerable variation in size and may be oblong or obovate-oblong, acute, obtuse, or obtusely acuminate, all appear to belong to one species. The flowers are rather small and the calyx-tube densely hirtellous; calyx-lobes four, outside sparsely hirtellous, within densely pubescent except at the very base, ovate, 2.3 mm. long, 1.5 mm. broad, acutish; petals lacking; filaments 1.3 mm. long, the anthers broadly ovate-elliptic, 0.5 mm. long and broad, the apicula short, not recurved; disk slightly lobed, glabrous; ovary densely pubescent; styles glabrous. *Ceratopetalum succirubrum* C. T. White of North Queensland is probably the nearest related species, but the leaves are smaller and lanceolate, and the anthers have a fairly prominent apiculus.

SCHIZOMERIA D. Don

The specific characters of this genus appear to be highly variable and difficult to define. Some fruits may be ellipsoid or broadly so in the younger forms and apparently become practically globose at maturity. The pubescence of the inflorescence is variable. The petals are fugacious and often irregular. With only the descriptions of *S. floribunda* Schltr. and *S. Pulleana* O. C. Schm., and very poor material of *S. serrata* Hochr., I have been unable to separate some of the named species at hand satisfactorily from them. For this reason, although these three species have priority, they are not included in the key.

KEY TO THE SPECIES

Leaves ovate, subtruncate at base, small (less than 5 cm. long), on very short petioles.......................................*S. parvifolia.*
Leaves, if ovate, not subtruncate at base, mostly larger, with longer petioles.
  Ovary densely tomentulose or tomentose.
    Inflorescences not quickly becoming glabrate; outside of flower tomentulose.
      Petioles 2–3.5 cm. long; leaves crenulate-serrulate; flowers short-pedicellate......................*S. Clemensiae.*
      Petioles 0.5–1.5 cm. long; leaves crenate-serrate; flowers sessile................................*S. Versteeghii.*
    Inflorescences quickly becoming glabrate; outside of flowers usually pubescent on the pedicel and the calyx-tube, the calyx-lobes glabrous or with scattered hairs.

Leaves oblong-elliptic or ovate-elliptic to lance-elliptic, the primary veins close (5–9 mm. apart) but widely spreading, the lower ones subhorizontal.

Fruit oblong-ovoid; leaves not glandular on the lower surface. . . . . *S. orthophlebia.*

Fruit globose; leaves minutely glandular on the lower surface. . . . . *S. novoguineensis.*

Leaves elliptic; the primary veins rather remote (1–2 cm. apart), spreading-ascending. . . . . *S. Whitei.*

Ovary pilose to glabrous (if somewhat tomentulose, flowers very small, not more than 4 mm. across).

Leaves glandular on the lower surface, glands visible without a lens; flowers 4-merous. . . . . *S. adenophylla.*

Leaves not glandular on the lower surface, or if glandular, glands very minute and not visible without a lens; flowers mostly 5–6-merous.

Leaves lanceolate or oblong-lanceolate, gradually acuminate. . . . . *S. gorumensis.*

Leaves elliptic, or if lanceolate only acute or abruptly acuminate.

Fruit ellipsoid; flowers practically glabrous (ovary with few scattered hairs). . . . . *S. katastega.*

Fruit globose or subglobose.

Leaves coriaceous or thinly coriaceous; ovary ± densely pilose; flowers small (calyx lobes 1.5–2 mm. long). . . . . *S. Brassii.*

Leaves firmly coriaceous; ovary entirely glabrous; flowers larger (calyx lobes 2.5–3 mm. long). . . . . *S. ilicina.*

Schizomeria parvifolia Perry, spec. nov.

Arbor 13–14 m. alta; ramulis brunneo-ferrugineis, glabris; stipulis oblongis, subtruncatis, 7 mm. longis, 2 mm. latis; foliis valde coriaceis 3–4.5 cm. longis, 1.8–3 cm. latis, ovatis, obtusis, basi subtruncatis, margine crenulato-serrulatis, supra nitidis, pallide olivaceis, subtus olivaceis, dense reticulatis, venis primariis utrinsecus 10–12 supra interdum paululo impressis, subtus non elevatis, oblique patentibus prope marginem arcuatis et ± furcatis; petiolo 2–5 mm. longo, 2 mm. lato, brunnescente; infructescentiae axi 2.5 cm. longo, glabro; fructibus ovoideis, 2.4 cm. longis, 1.8 cm. crassis.

BRITISH NEW GUINEA: Central Division, Wharton Range, Murray Pass, *Brass 4576* (TYPE), June-Sept. 1933, alt. 2840 m., common through forests (straight boled tree up to 13–14 m. with compact, densely foliaged crown of stiff erect branches; reddish brown fruit).

In foliar characters this species is very distinct from the rest at hand. The small ovate leaves on very short petioles are pale greenish yellow with shining upper surface, under a lens very smooth except for a few slightly impressed lines marking some of the primary veins, yet if examined without a lens the primary veins may be easily counted. On the lower surface the venation is the same color, but the small and shallow depressions between the veinlets (fairly coarse in this species) are slightly darker.

Schizomeria adenophylla Perry, spec. nov.

Arbor parva, 2–3 m. alta; ramulis cinereis, glabris; alabastris terminalibus vernicosis; stipulis oblongis, ± 4 mm. longis 1.5–2 mm. latis, obtusis, glabris; foliis tenuiter coriaceis, lanceolate-ellipticis vel ellipticis, 3.5–6 cm. longis, 2–3 cm. latis, apice acutiusculis vel obtusis, basi cuneatis deinde decurrentibus, margine crenulato-serrulatis, glabris, supra olivaceis, inter venas dense reticulatis, subtus brunneo-olivaceis, reticulatis, glandulosis, glandulis minutis sine lente manifestis, costa utrinque prominula, venis utrinsecus 6–8, oblique ascendentibus prope marginem furcatis et arcuatim conjunctis utrinque paululo elevatis; petiolo 2–5 mm. longo; inflorescentiis 1.5 cm. longis, glabris; floribus 4-meris; pedicello 1 mm. longo; calycis lobis vix 2 mm. longis latisque, acutiusculis; petalis ± 1 mm. longis, trifidis; filamentis 1.5 mm. longis, antheris apiculatis, 0.7 × 0.5 mm.; disco 4-partito, gibberibus bilobis; stylis 1 mm. longis; ovario glabro, 2-loculare; loculis 2-ovulatis.

British New Guinea: Central Division, Wharton Range, Murray Pass, *Brass 4661* (type), June-Sept. 1933, alt. 2840 m.; common in forest borders (small tree or large bush 2–3 m. tall; leaves pale, stiff; flowers greenish, ovary brown).

In the size of the leaves this species approaches *S. ilicina* (Ridl.) Schltr.; but in the description of the latter there is no indication of glands on the leaves, whereas in this species they can be seen without a hand lens. Then too, the nerves are obvious and the stipules oblong.

Schizomeria gorumensis Schlechter in Bot. Jahrb. **52**: 157, *f. 7, H-O.* 1914.

Netherlands New Guinea: 6 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 12566, 12599,* Feb., Mar. 1939, alt. 1300 and 1250 m., frequent on slopes in primary rain forest (tree ± 25 m. high, bark brown or black, with some colorless resin; sapwood rose, heartwood dark brown, flowers white; fruits brown); 2 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 13192,* Apr. 1939, alt. 800 m., frequent in primary rain forest; Bernhard Camp, Idenburg River, *Brass & Versteegh 13566,* Apr. 1939, alt. 570 m., occasional in primary rain forest (tree 21 m. high, 53 cm. diam.; bark brown, with a little light red resin; sapwood rose, heartwood dark brown; flowers light yellow).

The leaves are acuminate but mostly not obtusely so, and there is a slight variation in both the size (4.5–7.5 cm. long, 1.2–2.5 cm. broad) of those of the first two collections cited above, and also in the length of the petiole (5–7 mm. long); nevertheless, the lack of apparent floral differences or those of foliar texture suggests that these collections belong to *S. gorumensis* Schltr. The last two collections cited are almost a perfect match for the figure of *S. Ledermannii* Schlechter. However, the ovary is pilose with fairly short hairs rather than densely villous as given in the original description, the flowers are hardly more than 1 mm. pedicellate, although the fruits (ovoid to subglobose ± 1 cm. in diameter) are on pedicels 3–5 mm. long. If *S. Ledermannii* Schltr. is separable from *S. gorumensis* Schltr., these collections are more like *S. gorumensis* Schltr. in floral characters. On the under surface of the leaves, with the aid of a lens, one may find very minute and scattered glands.

Schizomeria novoguineensis Perry, spec. nov.

? Arbor ± 6 cm. diam.; ramulis ± atro-cinereis, glabris; stipulis oblongis acutiusculis, resinosis, 4 mm. longis, vix 2 mm. latis; foliis coriaceis, ovato-ellipticis vel lanceolato-ellipticis vel ovatis, 5.5–9.5 cm. longis, 2.8–5 cm. latis, apice anguste obtusis vel acutiusculis, basi subrotundatis vel cuneatis, margine crenatis, utrinque glabris, novellis puberulis, subtus consperse et minutissime glandulosis, venis primariis utrinsecus 13–17 supra manifestis, subtus prominulis, late patentibus fere horizontalibus, bifurcatis prope marginem anastomosantibus, venulis utrinque dense reticulatis; petiolo 0.7–1.8 cm. longo; inflorescentiis immaturis 5 cm. longis, ferrugineo-tomentellis; floribus 5–6-meris fere sessilibus, extus puberulis, calycis lobis ovatis, ± 1.5 mm. longis, acutis; petalis ± 1 mm. longis, trifidis, staminibus calycem aequantibus, antheris 0.5 mm. longis, ellipsoideis apiculatis; stylis 0.7 mm. longis, ovario dense tomentello, 2 (or 3)-loculare; loculis 4-ovulatis; infructescentiis 9 cm. longis; fructibus globosis 1.5 mm. diametro.

NORTHEAST NEW GUINEA: Ogeramnang, *Clemens 4763* (TYPE), Dec. 1936, alt. ± 1170 m.; Matap, *Clemens 41075,* Feb.-Apr. 1940, alt. 1500–1800 m. (2.5 inches diameter; flowers dull cream color).

In the rather close and widely spreading primary veins this species approaches *S. orthophlebia,* but the leaves of the latter are oblong-elliptic and the fruit elongate-ovoid as well as much larger than that of *S. novoguineensis.*

Schizomeria orthophlebia Perry, spec. nov.

Arbor usque 32 m. alta, 55 cm. diam.; ramulis glabris ± compressis, nodis incrassatis; stipulis triangularibus 5–7 mm. longis, 5 mm. latis, obtusis, caducis; foliis ± valde coriaceis, oblongo-ellipticis, 6–14 cm. longis, 2.5–6.3 cm. latis utrinque angustatis, basi rotundatis, apice obtusis vel acutiusculis (vel breviter et obtuse acuminatis), margine crenulato-serratulis, utrinque glabris, novellis crispe pilosulis, cito glabratis, venis primariis utrinque distinctis utrinsecus costam 17–22 inferioribus sub-horizontalibus superioribus oblique patentibus prope marginem arcuatim conjunctis utrinque dense reticulatis vel in vetustioribus supra obscure reticulatis; petiolo 0.8–1.7 cm. longo; (inflorescentiis immaturis, 3–10 cm. longis, tomentulosis, bracteis oblongis obtusis; alabastris non expansis, extus tomentulosis, calycis lobis intus versus apicem puberulis; antheris ellipsoideis apiculatis; ovario tomentello 2-loculari, loculis 4-ovulatis) infructescentiae axi 7–14 cm. longo, tomentello; fructibus 2–4 cm. longis, 1.2–2 cm. latis, oblongo-ovoideis, basi 2 mm. pedicellatis.

Netherlands New Guinea: 9 km. northeast of Lake Habbema, *Brass & Versteegh 10463* (type), Oct. 1938, alt. ± 2750 m., along a stream in forest, common (tree 32 m. high, 55 cm. diam.; bark brown, fairly smooth; fruit green); Bele River, 18 km. northeast of Lake Habbema, *Brass & Versteegh 11161,* Nov. 1938, alt. 2230 m., on slope of a ridge in secondary forest, common (tree 16 m. high, 34 cm. diam.; bark black, rough, flower-buds soft green).

In the material at hand this species is easily recognized by the crenulate-serrulate oblong-elliptic leaves with fairly numerous (straight for ¾ of the distance to the margin) and almost horizontal primary veins. No other species seen has elongate-ovoid obtusely pointed fruit. Apparently it develops only one seed. Even though the inflorescences are given as 3–10 cm. long, all are very immature, and it is quite possible that in those measuring 5–10 cm. long the subtending new leaves have dropped off in process of drying.

Schizomeria ilicina (Ridl.) Schlechter in Bot. Jahrb. **55**: 194. 1918.

Cremnobates ilicina Ridley in Trans. Linn. Soc. II. Bot. **9**: 41, *pl. 3, figs. 56–63, pl. 4, fig. 55.* 1916.

Netherlands New Guinea: Bele River, 18 km. northeast of Lake Habbema, *Brass & Versteegh 11106,* Nov. 1938, alt. 2200 m., occasional in primary forest (tree 18 m. high, 30 cm. diam.; flower buds red; fruit green-brown); Balim River, *Brass & Versteegh 11188,* Dec. 1938, alt. 2160 m., in forested slopes (tree 15 m. high, 40 cm. diameter; flowers white; fruit green); 15 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 11932, Brass 12150,* Jan. 1939, alt. 1780 and 1800 m., one of the larger trees in the mossy forest, not common; 6 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 12571, 12583, 12763;* Feb. 1939, alt. 1300 and 1200 m., occasional in primary forest (tree 18–22 m. high, bark black, rough; fruit brown; flowers white); 4 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 13114A, 13114,* Mar. 1939, alt. 900 and 850 m.; frequent in primary rain forest (tree 25 m. high, 56 cm. diam.; bark gray, fairly smooth; flowers white; fruits brown).

Northeast New Guinea: Ogeramnang, *Clemens 4650, 4794, 4997, 5114a, 6358,* Dec. 1936, Jan. 1937, and May 1937, alt. 1500, 1800, 1650, 1740, and 1750 m. respectively; in mossy forest (tree 75–85 ft. high); Sambanga, *Clemens 6845, 7744a,* Nov. 1937, alt. 1500–1800 m., margin of clearing in mountain forest (tree 10–12 inches in diameter; fruit pale khaki color); Matap, *Clemens 41027,* Feb.-Apr. 1940, alt. 1500–1800 m. (tree 2 ft. diam.; flower buds immature, pale).

In designating all these collections as *Schizomeria ilicina* (Ridl.) Schltr. possibly more than one entity is included; certainly great variability is shown. Unfortunately, we have flowers and fruit of only a few numbers; however, the obvious differences between the specimens and Ridley's description and figures will be noted.

In the first place Ridley's description indicates 5-merous flowers and the figure a 4-merous one. Of the several flowers examined in this study, all are either 5- or 6-merous; apart from that, their pistils do not match that in the figure. Ridley's description "ovarium . . . uniloculare, uniovulatum" does not fit any *Schizomeria* which I have examined. Perhaps, Ridley assumed such a structure from an examination of the fruit; the styles sometimes are very short, but most of them are as long or almost as long as the calyx-lobes. In *Brass & Versteegh 12583* the inflorescence is 1.8 cm. long and glabrous, with flowers slightly smaller than those in the other collections. The leaves are 5–7 × 2.5–4 cm., and the reticulations of the leaf are very dense (the shallow hollows between the veinlets are about half as large as those in most of the other specimens). This specimen may represent *S. ilicina* (Ridl.) Schlechter in the strict sense of the specific definition. On the other hand, *Brass & Versteegh 13114A* has inflorescences up to 9 cm. long with slightly larger flowers, the axis and branchlets of the inflorescence ± densely puberulous, and the leaves with a similarly dense but less easily distinguished reticulation. *Brass & Versteegh 11188, 13114,* and *Brass 12763* have puberulous or tomentulose inflorescences ± 3 cm. and 7 cm. long respectively, leaves 4.5–14.6 cm. long, 2–6 cm. broad, the apex varying from rounded to subacute, the base mostly cuneate but sometimes rounded-cuneate or rounded, the margin ± crenulate-serrulate, and both surfaces obviously somewhat more loosely reticulate than in the two specimens discussed above. The calyx-lobes are 2–2.5 mm. long, the petals about as long, the stamens as long or slightly longer, and the ovary 2–3-loculed, each locule 4-ovulate. Sometimes when the ovary is 3-loculed, one locule has only 2 ovules.

Brass & Versteegh 11106, 11188, 11932, and *Brass 12150* are specimens with fruit. The second has very immature fruits, some as small and narrow as in Ridley's description while others are almost as broad as long. In the other collections the fruit is subglobose and up to 2 cm. in diameter. The material from Northeast New Guinea in some specimens has leaves that are more coriaceous and larger (7.5–17 × 3.5–10 cm.), but the flowers and fruit are very like those from Netherlands New Guinea.

Brass & Versteegh 12571 may not belong to this species but is surely very closely allied. The fruits are large, one measuring 4 × 3.7 × 3.5 cm. The leaves are firmly coriaceous and rounded at the base. One very young reddish tomentose inflorescence was collected. The bud-scales are round rather than oblong or lanceolate as in the other specimens of the species.

Schizomeria Whitei Mattfeld in Jour. Arnold Arb. **20**: 435. 1939.

NORTHEAST NEW GUINEA: Boana, *Clemens 41770*, May-Nov. 1940, alt. 750–1350 m. (flowers dull flesh-gray).

After setting up this collection as a new species from New Guinea, I found I could not separate it in my key from *S. Whitei* Mattf. collected on the Atherton Tableland, Queensland. The leaves are slightly less brittle, the veins stand out a little more on the lower surface, the leaves are cuneate at base (but this is true in some of those in *Kajewski 1135*), and the inflorescence is slightly more tomentulose. These variations do not appear sufficient to be considered specific.

Schizomeria katastega Mattfeld in Jour. Arnold Arb. **20**: 433. 1939.

Schizomeria tegens Mattf. op. cit. 434.

British New Guinea: Western Division: Oriomo River, Wuroi, *Brass 5804,* Jan.-Mar. 1934, alt. 10–30 m., common in small forest clumps on savannah (tree 10–12 m. high; flowers white; pale fleshy fruit); Oroville Camp, Fly River, *Brass 7429;* Lake Daviumbu, Middle Fly River, *Brass 7497, 7898;* Gaima, Lower Fly River (east bank), *Brass 8294.*

Perhaps the field notes of Brass indicating two collections as canopy trees and the other two as substage trees is a little misleading. Without this I am sure it would be difficult to separate them. There is a slight variation in the size of the flowers, but such is true even in a single collection. I am not sure that *S. homaliiformis* Kaneh. & Hatus. is distinct from this species. On the whole the flowers are smaller and more numerous, but the inflorescences are still young.

Schizomeria Brassii Mattfeld in Jour. Arnold Arb. **20**: 435. 1939, vel aff.

Solomon Islands: Bougainville: Koniguru, Buin, *Kajewski 2015,* Aug. 1930, alt. 800 m., rain forest (tree up to 30 m.); Hogoro, Maisua, *Waterhouse 81,* Sept. 1932, alt. ± 360 m. (tree 40 ft.). Guadalcanal: Uulolo, Tutuve Mt., *Kajewski 2580,* Apr. 1931, alt. 1200 m., rain forest (tree up to 30 m. high; bark covered with large corky pustules; fruit 1.3 cm. long, 1.5 cm. diam.). Ysabel: Tataba, *Brass 3428,* Jan. 1933, alt. 50 m., rain forest ridges, common (very large flanged tree with deeply channelled rough gray bark and hard brown wood; leaves smooth and shining; flowers white).

The type-specimen of *S. Brassii* Mattf. has only fruits and leaves. These are a fairly good match for *Kajewski 2580* from Guadalcanal. Until an isotype of *S. floribunda* Schltr. and good material of *S. serrata* Hochr. is available for study with this species, these determinations must be accepted as tentative.

Schizomeria Clemensiae Perry, spec. nov.

Arbor magna; ramulis atro-cinereis vel brunnescentibus 5–8 mm. diametro, novellis tomentellis; stipulis non visis; foliis coriaceis, ovato-ellipticis 8.5–19 cm. longis, 4.5–8.5 cm. latis, apice obtusis vel subrotundatis, basi rotundatis deinde in petiolo breviter decurrentibus, margine crenulatis, in sicco olivaceis, supra inconspicue subtus manifeste reticulatis, venis primariis utrinsecus 12–17 patenti-ascendentibus, prope marginem furcatis ± anastomosantibus, supra perspicuis, subtus prominulis, petiolo 1.7–3.5 cm. longo, subrotundato; inflorescentiis ± 12 cm. longo, ferrugineo-tomentellis; bracteis rotundatis; pedicello 1 mm. longo; flore extus ferrugineo-tomentello vel dense puberulo, expanso 7–8 mm. lato; calycis lobis 3–3.5 mm. longis, 1.8–2.5 mm. latis, ovatis, acutis; petalis 2.5 mm. longis longitudine ⅓ superiore trifidis; filamentis vix calycis lobos aequantibus, antheris 1 mm. longis 0.7 latis, cordatis, apiculatis; disco 10-gibbo, gibberibus subglobosis 0.8 mm. diametro; ovario 2–3-loculari, dense tomentoso, loculis 4(–5)-ovulatis; stylis 2 vel 3, circiter 2.5 mm. longis;

fructibus novellis ellipsoideis (2 × 1.5 cm.), maturis globosis, 3 cm. diametro.

NORTHEAST NEW GUINEA: Sattelberg, *Clemens 439* (TYPE), *1248*, Oct. 1935, alt. ± 900 m., margin of forest (tree 50 ft.; flower dull yellow, of the same odor as the fruit); Quembung, *Clemens 2180*, March 1936, alt. ± 600 m., margin of forest (tree of giant size; fruit russet).

This species is perhaps most closely related to *S. Versteeghii*, but in the latter the leaves are crenate-serrate rather than crenulate, the petioles are not more than half as long, and the flowers are sessile.

Schizomeria Versteeghii Perry, spec. nov.

Arbor 27 m. alta, 46 cm. diam.; ramulis glabris crassis sub inflorescentia ± 1 cm. diam., cortice cinereo vel brunnescente ± rimoso; stipulis non visis; alabastris axillaribus parvis vernicosis; foliis valde coriaceis ellipticis, 10.5–22 cm. longis, 5.7–14 cm. latis, apice rotundatis, basi rotundatis, margine crenato-serratis, utrinque glabris, venis primariis utrinsecus 17–19 inferioribus oblique patentibus superioribus patenti-ascendentibus, marginem versus furcatis vel bi- et tri-furcatis ± anastomosantibus supra distinctis, subtus prominulis, venis secundariis subtus manifestis, venulis utrinque dense reticulatis; petiolo 0.5–1.5 cm. longo, crassiusculo; inflorescentiis 10–16.5 cm. longis, 15–18.5 cm. latis, saepe basin prope ramosis, multifloris, tomentosis; axi et ramulis crassiusculis; bracteis rotundatis, concavis, 5 mm. longis, 5 mm. latis, caducis; alabastris 7 mm. longis, 5.5 mm. latis, sessilibus; floribus expansis (siccis 9 mm.), 1.2 cm. latis, 5–6-meris; calycis lobis ± 4 mm. longis, 2 mm. latis, ovatis vel lanceolatis, acutis, intus margine et apice puberulis, ceterum glabris; petalis 3.5–4 mm. longis, trifidis, laciniis exterioribus saepe longioribus; filamentis 3.5–4 mm. longis, antheris ellipsoideis, 1 mm. longis, 0.7 mm. latis, apiculo paulo recurvato; disco 10–12-gibbo, 1 mm. alto, 0.9 mm. crasso; stylis 2 vel 3, 2–2.5 mm. longis; ovario tomentoso, 2.5 mm. diametro; loculis 2–3, 4–6-ovulatis, ovulis biseriatis; fructibus immaturis, subglobosis vel late ellipsoideis, ± 1.5 cm. diametro.

NETHERLANDS NEW GUINEA: Bele River, 18 km. northeast of Lake Habbema, *Brass & Versteegh 11129* (TYPE), Nov. 1938, alt. 2300 m., occasional in primary forest (tree 27 m. high, 46 cm. diam.; bark 9 mm. thick, gray, rough, fissured, with a little yellow sap; flowers white; fruits brown).

Schizomeria Versteeghii is most like the collections which have been placed in *S. floribunda* Schltr. The former differs in the much shorter petioles, the crenate-serrate rather than crenulate leaves, and the considerably larger sessile flowers.

AISTOPETALUM Schlechter

At hand are four numbers of the Third Archbold Expedition plants which seem to belong to *Aistopetalum* Schltr. Two have fruits, one has both flowers and fruits, and the other only flower-buds. In addition there is an isotype of *A. tetramerum* Kaneh. & Hatus. The flower-buds of the latter are so young that it is impossible to determine without dissection whether tetramerous or pentamerous flowers predominate. The specimens *Brass & Versteegh 12513* and *Brass 13170* have both 5- and 6-merous flowers. In one instance a pentamerous flower had six carpels, and in another a hexamerous flower had five carpels. One of the characters indicated in the original description is two collateral ovules in each carpel, a character re-affirmed in the description of *A. tetramerum* Kaneh. & Hatus. Although several flowers from the above specimens have been dissected, none of them appear to have more than one pendent ovule in each carpel. The fruits are ovoid or oblong. The exocarp is fleshy and in some of the dried fruits irregularly cracked at the apex, the endocarp or putamen is bony, 5–6-celled, and at the apex 5–6-pointed bony projections cover a soft area through which probably the germinating seed pushes out. The seed is tear-shaped, the embryo is very slightly fleshy and embedded in endosperm with the radicle pointing toward the apex of the fruit.

Aistopetalum viticoides Schltr. in Bot. Jahrb. 52: 144, *f. 2, A-F.* 1914; vel aff.

Netherlands New Guinea: 6 km. SW. of Bernhard Camp, Idenburg River, *Brass & Versteegh 12513, 12565, Brass 13286,* Feb., Mar. 1939, alt. 1500, 1280, and 1200 m. respectively, primary forest, on slopes of ridge (occasional tree 15–28 m. high, 15–59 cm. diam.; flowers yellow; fruit orange or yellow); 2 km. SW. of Bernhard Camp, Idenburg River, *Brass & Versteegh 13170,* Mar. 1939, alt. 900 m., primary rain forest, on slope of ridge (frequent tree 20 m. high, 45 cm. diam.; flower-buds yellow-green).

Without more material it is difficult to decide whether the fact that *Brass 13286* and *Brass & Versteegh 12565* have ovoid fruits and *Brass 12565* oblong fruits constitutes a specific difference or only a variation within a species. The ovoid fruits are 1.5–2 cm. long and 1.1–1.9 cm. in diameter, the oblong are 2.2–2.5 cm. long and 1.5 cm. in diameter. The foliar differences are intangible; perhaps the venation in *Brass 12565* is a little less open than in the other specimens. There are no flowers for comparison. There are simple, trifoliolate, and 5-foliolate leaves in specimens of the same collection, sometimes on the same specimen. Schlechter mentions only trifoliolate leaves, but in the figure of the species simple leaves are also shown.

The seed in the fruit opened was about 1 cm. long, the embryo nearly as long, with the cotyledons about twice the length of the radicle.

WEINMANNIA L.

Weinmannia purpurea Perry, spec. nov.

Arbor usque 30 m. alta, glabra; ramulis gracilibus 2–3 mm. diametro, atro-brunnescentibus, levibus, laxe foliatis; stipulis connatis, cito caducis; foliis simplicibus, tenuiter coriaceis, lanceolatis, 8–17 cm. longis, 2.5–4.5 cm. latis, apice obtuse acuminatis, basi cuneatis, margine serrato-dentatis, verisimiliter glanduloso-dentatis, utrinque laxe reticulatis, supra ± nitidis, venis primariis utrinsecus 13–20 utrinque manifestis, non prominulis; petiolo 0.5–1.5 cm. longo; racemis plerumque ternis in pedunculo communo, usque 16 cm. longis; axi puberulo; pedicellis 2 mm. longis, sparsim puberulis; floribus 4-meris, pallide purpureis; calyce glabro, lobis 1 mm. longis, oblongo-lanceolatis obtusis; petalis ellipticis 1.5 mm. longis, 1 mm. latis; staminibus 2 mm. longis, antheris apiculatis; glandulis cylindricis, vix 1 mm. longis; ovario sparsim puberulo, stylis circiter 1.2 mm. longis; capsulis oblongis, 6 (stylis inclusis) mm. longis, seminibus (siccis) 1 mm. longis, 0.3 mm. latis, utrinque barbato-pilosis, pilis circiter 1 mm. longis.

SOLOMON ISLANDS: Bougainville: Kupei Gold Field, *Kajewski 1738* (TYPE), April 1930, alt. 100 m., rain forest (tree up to 20 m. high, found growing at very high altitudes; flowers very pale purple on purple stalks; fruit purple, length including styles 6 mm., 1.5 mm. diam.).

Most of the racemes are in threes at the apex of a common peduncle 3–6 cm. long, but in one instance there are two nodes; the lower one has two opposite racemes and the upper has three.

From the description of *W. marquesana* F. Brown, it seems as if these might be related species. The latter has broader and shorter leaves with longer petioles; nothing is said of the stipules. In *W. purpurea*, the short connate stipules, although loose, still encircle the base of the inflorescence and the younger branchlets.

Weinmannia Ledermannii Schlechter in Bot. Jahrb. 52: 162. 1914.

NORTHEAST NEW GUINEA: Wareo, *Clemens 1407,* Dec. 1935, alt. ± 600 m., margin of jungle (tree 100 ft. high; flowers cream-colored; fruits pale tinged with pink).

The leaves of this collection are 2–5-jugate, the petiole and rhachis are shortly and somewhat densely pilose, the midrib on the lower surface of the leaflets is less densely so. The axis of the inflorescence is only puberulous. Apart from these differences in pubescence the specimen agrees with the description reasonably well.

Weinmannia urdanetensis Elmer, Leafl. Philipp. Bot. 7: 2608. 1915.

NETHERLANDS NEW GUINEA: 15 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 11908,* Jan. 1939, alt. 1800 m., frequent in mossy-forest of ridges (tree 26 m. high; flowers white; fruit red); 8 km. southwest of Bernhard Camp, Idenburg River, *Brass 12733,* Feb. 1939, alt. 1600 m., one of the principal trees in the mossy forests at this altitude.

For the time being I have placed these collections in *W. urdanetensis* Elmer, originally described from the Philippines. There is at hand an isotype of this species and another collection in young fruit (seeds immature) from Mt. Palimlim, Luzon. The lower leaves of the latter specimen are a little larger than in the type and about the same size as the smaller ones in the New Guinean collections. The leaves in these are 4–9-jugate, the lateral leaflets are 0.9–1.8 cm. long and the lower surface is more pilose than in the Philippine material, in which the lower surface is often glabrous except for a few hairs along the midrib; here also the veins are a little less easily seen than in the New Guinean collections. In the latter, the mature capsules are 4–4.5 mm. long (including the 1 mm. style), the seeds 0.8–0.9 mm. long 0.4 mm. wide, not including the tufts of hairs at the ends of the seeds.

Weinmannia novoguineensis Perry, spec. nov.

Arbor parva, 10–13 cm. diam.; ramulis puberulis vel breviter pilosis; stipulis subreniformibus intus glabris, venosis, extus puberulis, 6–8 mm. longis, 1 cm. latis; foliis 4–10 cm. longis, 4–13-jugis, foliolis chartaceis vel tenuiter coriaceis, serratis, supra costa puberula excepta glabris, subtus costa praecipue parte inferiore dense et breviter pilosa excepta plerumque glabris nonnumquam hinc inde pilis conspersis, terminali lanceolato acutiusculo, 2.2–3 cm. longo, 0.7–1 cm. lato, petiolulo circiter 3 mm. longo, lateralibus 1–2.4 cm. longis, 0.5–0.8 cm. latis, oblongis utrinque angustatis, apice acutiusculis vel obtusiusculis, basi inaequaliter obtusis sessilibus; petiolo vix 1 cm. longo et rhachide ± crispe pilosulis; infructescentiis ± 8 cm. longis, axi puberulo vel ± pilosulo; pedicellis 2–3 mm. longis, puberulis; floribus 4-meris; calycis lobis 1 mm. longis, 0.7 mm. latis, glabris; petalis et staminibus non visis; glandulis 0.5 mm. longis; capsula circiter 6 mm. longa (incl. stylis 1.5 mm.), seminibus 1 mm. longis, 0.4 mm. latis, ± pilosulis.

NORTHEAST NEW GUINEA: Sarawaket, *Clemens 7517* (TYPE), Nov. 1937, alt. 1800–2400 m., in mountain forest (small tree 4–5 inches diameter; fruit pale green).

This species differs from *W. Pullei* Schltr. in the sessile leaflets with pubescent midrib on the lower surface, the more heavily pubescent leaf rhachis, the longer pedicels, and the glabrous calyx.

Weinmannia trichophora Perry, spec. nov.

Arbor 12–15 cm. diam.; ramulis parvis tomentosis dense foliatis; stipulis subreniformibus, 4 mm. longis, 5 mm. latis, intus basin versus et extus breviter appresse pilosis; foliis 2–5 cm. longis, 2–7-jugis, foliolis subcoriaceis serrulatis, supra consperse puberulis, subtus (costa dense) breviter appresse pilosis, pilis crispulis, terminali 1–1.5 cm. longo, 0.5–0.7 cm. lato, oblongo obtusiusculo vel acutiusculo, petiolulo circiter 2 mm. longo, lateralibus 0.8–1.6 cm. longis, 0.4–0.6 cm. latis, oblongis acutiusculis vel obtusis, basi vix inaequaliter obtusis sessilibus; petiolo 3–6 mm. longo et rhachide tomentosis; inflorescentiis ± 5 cm. longis, axi breviter piloso; pedicellis 1.5 mm. longis puberulis; floribus 4-meris, ante anthesin; calyce puberulo, lobis ovatis obtusis 1 mm. longis, 0.7 mm. latis; petalis 1.5 mm. longis, 1 mm. latis, ellipticis; antheris minute apiculatis; glandulis fere 0.4 mm. longis; ovario pubescente, stylis glabris.

NORTHEAST NEW GUINEA: vicinity of Samanzing, *Clemens 9498* (TYPE), Jan. 1939, alt. 2100–2400 m., in mountain bush (tree 5–6 in. diam.; flowers white-cream).

This species may be related to *W. urdanetensis* Elmer, but the leaves are smaller, the leaflets shorter and broader and much more pubescent on the lower surface.

Weinmannia ysabelensis Perry, spec. nov.

Arbor 25 m. alta; ramulis gracilibus, novellis ± 2 mm. diam., breviter et patenti-pilosulis, internodiis 1–2 cm. longis; stipulis cito caducis, non visis; foliis (petiolo incluso) 3.5–7.5 cm. longis, 1–4-jugis, foliolis tenuiter coriaceis vel chartaceis, crenulato-serratis, supra atro-olivaceis, glabris, subtus pallidioribus, costa ± pilosulis, supra laxe subtus dense reticulatis, terminali majore, 2.7–4 cm. longo, 0.8–1 cm. lato, lanceolato, acuto, petiolulo 2–3 mm. longo, lateralibus 1–2.3 cm. longis, 0.5–0.9 cm. latis, oblongo-lanceolatis, apice acutiusculis, basi inaequaliter obtusis, sessilibus vel subsessilibus; petiolo 0.5–1 cm. longo et rhachide supra subplanis obscure marginatis margine glabris, ceterum utrinque patenti-pilosulis; inflorescentiis 5–8 cm. longis, singulis vel binis, axi puberulo; pedicellis ± puberulis, 2 mm. longis; floribus 4-meris; calycis basi hinc inde minute pilis dispositis, lobis vix 1 mm. longis, ovato-oblongis rotundatis; petalis 1.4 mm. longis, obovato-ellipticis; filamentis 1.4 mm. longis, antheris 0.5 mm. longis minute apiculatis; glandulis cylindricis, 0.4 mm. longis, 0.15–0.2 mm. latis; stylis fere 1 mm. longis, ovario pubescente, circiter 1 mm. longo, 0.7 mm. diam.; capsulis (stylis fere 2 mm. inclusis) 5–6 mm. longis, 1.5 mm. diam.; seminibus circiter 1.5 mm. longis, 0.5 mm. latis, ± pilosulis.

SOLOMON ISLANDS: Ysabel: Tiratona, *Brass 3215* (TYPE), Nov. 1932, alt. 600 m., mountain forests, common (thick-boled tree 25 m. tall; reddish brown flaky bark and hard red wood; flower white; fruit pink).

We have no specimens at hand which suggest a close relationship with this species. *Weinmannia virgulata* Schltr. has 2–4-jugate leaves, but 3-merous flowers; *W. Macgillivrayi* Seem. has 5–9-jugate leaves with larger leaflets. It should be noted that the seeds have scattered hairs on the surface, not confined to the ends as in *W. Versteeghii.*

Weinmannia Versteeghii Perry, spec. nov.

Arbor 19 m. alta, 25 cm. diam., fere glabra, ramulis cinereo-brunnescentibus, novellis ± ferrugineis, minute et sparsim puberulis, ultimis gracilibus, ± 1 mm. diam.; stipulis subrotundatis 4–7 mm. longis latisque, extus sparsim et minute appresse puberulis; foliis 2.5–5 cm. longis, 1–4-jugis, foliolis glabris, terminali obovato basi anguste cuneato, subsessili, lateralibus oblanceolatis, sessilibus, 0.7–1.8 cm. longis 0.4–0.7 cm. latis, apice obtusis basi anguste et inaequaliter obtusis, margine minute crenulato-serratis, supra (in sicco) atro-olivaceis, costa pallidiora, subtus pallidioribus, venis primariis ascendentibus ± anastomosantibus utrinque manifestis; petiolo 6–10 mm. longo et rhachide anguste marginatis; racemis vulgo singulis 4–8 cm. longis, axi minute puberulo; floribus 4-meris; calycis lobis 1.3 mm. longis, obtusis, petalis obovato-ellipticis, 1.7 mm. longis, 1.4 mm. latis, rotundatis sparsim ciliolatis; filamentis vix 3 mm. longis; glandulis cylindricis vix 1 mm. longis; ovario puberulo, 2 mm. longo, stylis vix 1 mm. longis; capsulis 6 mm. longis, puberulis, seminibus 1.5 mm. longis utrinque barbato-pilosis.

NETHERLANDS NEW GUINEA: 9 km. northeast of Lake Habbema, *Brass & Versteegh 10469* (TYPE), Oct. 1938, alt. ± 2700 m., frequent in forest (substage tree 19 m. high, 25 cm. diameter; bark 4 mm. thick, gray-brown, rough: outer wood yellow, inner red).

This is the only species reported from New Guinea with the narrowly margined petiole and rhachis. In habit it suggests *W. tannaensis* Guillaumin, but in the latter the leaflets are narrower at the apex, and the margin of the petiole and rhachis is broader.

PULLEA Schlechter

In the consideration of the genus *Pullea* Schltr. I am indebted to Dr. F. P. Jonker for very generously providing for comparison two leaves and a branch of the inflorescence from the original collections of *P. glabra* Schltr.

KEY TO THE SPECIES

Flowers tapering into a very short (about 1 mm. long) stipe......*P. glabra.*
Flowers sessile.
  Leaves velvety-pubescent beneath..........................*P. mollis.*
  Leaves glabrous or only sparsely puberulous with minute hairs.
    Leaves acute or very obtusely short-acuminate.
      Flowers 10–12 on a cluster; leaves very obtusely short-acuminate, lower surface fasciculate-barbate in axils between the primary veins and the midrib........*P. Versteeghii.*
      Flowers 5–7 in a cluster; leaves acute, not fasciculate-barbate.......................................*P. decipiens.*
    Leaves obtuse, rounded, or emarginate.
      Stipules subulate; leaves small, ± 5.4 × 3 cm., reticulations prominent..............................*P. papuana.*
      Stipules oblong-lanceolate, obtuse; leaves larger, 4–9 × 3–6 cm., reticulations not prominent.........*P. Clemensiae.*

Pullea decipiens Perry, spec. nov.

Arbor 29 m. alta, 45 cm. diam.; cortice novello nigrescente, vetustiore brunneo-cinereo, glabro, lenticellato; foliis in sicco brunnescentibus subtus paullo pallidioribus, coriaceis, lanceolatis vel elliptico-lanceolatis, 3–7.5 cm. longis, 1–3 cm. latis (av. 5–6 × 2.5 cm.), apice acutis, basi cuneatis in petiolum 3–6 mm. longum angustatis, margine crenulatis, utrinque glabris, venis primariis utrinsecus 7–10, supra manifestis subtus prominulis, venulis creberrimis dense reticulatis; inflorescentiis puberulis, paniculatis, lateralibus vel apicalibus, 2.5–6 cm. longis, saepe 7 ex ramulorum apice ortis; axi 1–3 cm. longo, ramulis 2–8-natim verticillatis nonnumquam iterum verticillatis, 3–15 mm. longis; floribus (post anthesin) parvis, sessilibus, in capitulis (± 5-floris); calycis lobis 1.5–1.9 mm. longis, 0.7–1.0 mm. latis, oblongis, obtusis, membranaceis; staminibus circiter 3 mm. longis; disci squamis 0.2–0.3 mm. longis latisque, apice incrassatis, emarginatis, bifoveolatis; stylis 2, liberis, circiter 3 mm. longis, basi exceptis glabris; ovario hemi-infero, extus 1 mm. longo.

NETHERLANDS NEW GUINEA: 4 km. SW. of Bernhard Camp, Idenburg River, *Brass & Versteegh 13115* (TYPE), March 1939, alt. 850 m., primary rain forest on plain; common tree 29 m. high, 45 cm. diam.; bark gray, scaly; wood red-brown; flowers light yellow).

This species of *Pullea* seems to be most like the description of *P. papuana* Gibbs. It differs in having acute, distinctly crenulate leaves with lateral veins more raised than the reticulate areas between them, and flowers with obtuse calyx-lobes. Possibly more material would show the two are identical. One needs to examine the type to evaluate the differences. *Pullea papuana* Gibbs is described as having obtuse minutely denticulate leaves, and acute calyx-lobes.

Pullea Versteeghii Perry, spec. nov.

Arbor usque 31 m. alta, 48 cm. diam.; cortice novello brunnescente, vetustiore pallidiore, glabro, lenticellato; foliis ellipticis vel oblongo-ellipticis, 4.5–10 cm. longis, 2.5–5 cm. latis, apice breviter et obtusissime acuminatis, acumine 4–6 mm. longo latoque, basi obtusis deinde breviter cuneatis, margine crenulato-denticulatis, supra olivaceis glabris, subtus brunnescentibus, venis primariis ± pubescentibus, in axillis inter costam et venas fasciculato-barbatis, utrinsecus 7–9 patenti-adscendentibus marginem versus breviter furcatis supra perspicuis, subtus prominulis, venulis laxe reticulatis utrinque paullo elevatis sine lente manifestis, minoribus copiose reticulatis supra obscuris subtus sub lente manifestis; petiolo 0.5–1 cm. longo; inflorescentiis dense puberulis, paniculatis, axillaribus et apicalibus, usque 8 cm. longis latisque, circiter 7 ex ramulorum apice ortis; axi 1.5–4 cm. longo; ramulis 2–8-natim verticillatis, nonnumquam iterum verticillatis, 6–20 mm. longis, bracteis 1–1.5 mm. longis vix 0.5 mm. latis, oblongo-ovatis; floribus (post anthesin) parvis sessilibus, in capitulis (circiter 9–12-floris); calycis lobis 2 mm. longis, 1.5 mm. latis; staminibus 2.7 mm. longis; disci squamis 0.5 mm. longis, vix 0.4 mm. latis, apice incrassatis et fere planis; ovario extus ± 1 mm. longo, apice subconico; stylis 2.5–3 mm. longis inferiore ⅓ pubescentibus.

NETHERLANDS NEW GUINEA: Bele River, 18 km. NE. of Lake Habbema, *Brass & Versteegh 11123, 11146* (TYPE), *11147*, Nov. 1938, alt. ± 2300 m., primary and secondary forest (rare tree 13–31 m. high, 35–48 cm. diameter; bark 4–9 mm. thick, rough, white (brown in *11147*); flowers white); Balim River, *Brass & Versteegh 11185,* Dec. 1938, alt. 2160 m., forest of the slopes.

The immediately distinctive character of this species is found on the lower surface of the leaves, the tufts of hair in the axils between the midrib and the primary veins. Also there is a coarse reticulation which can be seen with the naked eye as well as a finer one visible on the under surface only with the aid of a lens. The contrast in the reticulation is much more marked than in *P. decipiens*. The flowers are in clusters of 9–12. The style is more or less pubescent the lower third of its length. *Brass & Versteegh 11147* has lanceolate rather than elliptic leaves, 3–10 cm. long, 1.5–4 cm. wide, and flowers slightly smaller than in the specimen designated as the type.

Pullea Clemensiae Perry, spec. nov.

Arbor 45–90 cm. diam.; cortice brunnescente vel cinereo-brunnescente, lenticellato, glabro, novello minute appresse pubescente; alabastris, stipulis (obtuse oblongo-lanceolatis cito caducis) et foliis novellis dense cinereo-pubescentibus; foliis coriaceis, ellipticis 4–9 cm. longis, 2.3–6 cm. latis, in sicco brunnescentibus apice rotundatis vel obtusis, basi cuneatis, margine inconspicue serrulatis, supra glabris subtus consperse puberulis vel fere glabris, venis primariis utrinsecus ± 8 oblique ascendentibus prope marginem furcatis supra distinctis, subtus prominulis, venulis laxe reticulatis utrinque manifestis non conspicuis; petiolo 1–1.5 cm. longo; inflorescentiis 4–5 cm. longis, fractis dense cinereo-pubescentibus, pilis brevibus ± appressis; capitulis 5–7-floris; floribus basi bracteatis, bracteis 1–1.5 mm. longis, 1 mm. latis, oblongis obtusis; fructibus sessilibus pubescentibus, calycis lobis 1.5 mm. longis, 1 mm. latis, obtusis vel acutiusculis; filamentis 2 mm. longis; disco squamis ± 0.3 mm. longis; ovario maturo 2 mm. diam., 1.5 mm. longo; stylis 3 mm. longis; semine levi subrotundato 1 mm. longo, 0.9 mm. lato, compresso.

NORTHEAST NEW GUINEA: above Samanzing, *Clemens 8989,* Oct. 1938, alt. ± 1800 m., in mountain bush (tree 18 in. to 2 ft. diam.); Samanzing, *Clemens 9068* (TYPE), Oct. 1938, alt. ± 1800 m., (tree 2–3 ft. diam.); Samanzing vicinity, *Clemens 9283A,* Nov. 1938, alt. 1200–1800 m., in mountain bush (tree 10–12 in. diam.; flower buds yellowish green); Wantoat (Wantot), *Clemens 10995,* Jan. 1940, alt. 1050–1800 m. (tree 40–50 ft. high; flowers pale green-white).

The specimens *Clemens 8989* and *9068* are in fruit. On some branchlets of the inflorescence where the fruits have already fallen the bracts are still on the axis. In the other two collections the flowers are in bud, but in *Clemens 9283* the bracts subtending the minute flowers have already fallen. The leaves somewhat resemble those of *P. Versteeghii,* but are not fasciculate-barbate in the axils between the primary veins and the midrib, and the apex is mostly rounded; further, the inflorescences are not nearly so large or so copiously flowered.

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STUDIES IN THE THEACEAE XVIII
THE WEST INDIAN SPECIES OF LAPLACEA

CLARENCE E. KOBUSKI

THE GENUS *Laplacea* was named by Humboldt, Bonpland and Kunth (1822) in honor of Marquis de [Pierre Simon] Laplace (1749–1827), a French mathematician and astronomer of the first order, and probably the ranking man of his time in these fields. Born the son of a small farmer in Beaumont-en-Auge in Normandy on March 28, 1749, Laplace owed his education to the interest shown in him by wealthy landowners. In 1767 he left Beaumont, where he had been teaching mathematics, and accepted the post of Professor of Mathematics at École Militaire in Paris. His *Mécanique céleste* (5 vols., 1799–1825) is considered today a monument of mathematical genius. His complete works were published by the French government in seven volumes (1843–47), and as late as 1912 a second edition containing additional matter was published.

A year earlier (1821) two other genera, *Wikstroemia* and *Lindleya,* were described by Schrader and Nees von Esenbeck respectively. These were named in honor of Dr. J. E. Wikström and the English botanist John Lindley (1799–1865).

A fourth name, *Haemocharis,* was very casually introduced by Salisbury in 1806 and taken up by Martius and Zuccarini in 1826.

Of the four names mentioned for the genus, *Laplacea* and *Haemocharis* received the greatest recognition. Considerable controversy, of a mild nature, resulted among adherents of all four generic names, but *Laplacea* and *Haemocharis* appealed most to the students of botany. Such workers as Humboldt, Bonpland and Kunth, DeCandolle, Sprengel, Cambessedes, Spach, Endlicher, G. Don, Walpers, Wawra, Melchior, Schmidt, and Lemée favored *Laplacea,* while Martius and Zuccarini, Choisy, Baillon, Kuntze, Szyszylowicz, and Urban employed the name *Haemocharis.* Later Rehder pointed out that *Laplacea* appeared to be recognized by the majority of workers and suggested its retention as a *nomen conservandum,* and as such it appeared in Kew Bull. 1940: 112. 1940.

Blake (Contrib. Gray Herb. 53: 39. 1918) made a belated plea for *Wikstroemia,* the earliest name applied to the genus. He gave an excellent and very accurate review of the history of the genus. However, the name *Wikstroemia* could not be used, since it had already been placed on the list of *nomina conservanda* in 1905 as applying to a genus in a different family, the Thymelaeaceae.

Korthals, in 1842, described the genus *Closaschima,* which has since been reduced to synonymy under *Laplacea.* The study of the Asiatic material will not be included in this review but will be taken up later under a series of Asiatic studies.

The present study of the American species of *Laplacea* has been divided into two parts, the first including the West Indian species and the second those of South and Central America. This paper deals only with the West Indian species.

Of two species only, namely, *Laplacea haematoxylon* (Sw.) D. Don and *L. portoricensis* (Klug & Urban) Dyer, could one feel that material ample for complete and satisfactory study had been accumulated in the American herbaria. Of all the others the material is very sparse, in several instances the species having been collected only once or twice. Frequently great difficulty was experienced in preparing accounts of some earlier inadequately described species. In the genus as a whole the flowers are fairly large and conspicuous. Hence, often only a single flower was included with the collected specimen, and many times this single flower was incomplete. In such cases dissections of boiled material could not be made with a clear conscience, and it was necessary to employ great caution in working with the material so as not to ruin it for study by future workers.

As far as the West Indian species are concerned, no species have been reduced to synonymy in this study. In the province of Oriente, Cuba, five species and one variety are recognized. Oddly enough, the variety (new) has the most collected specimens. In the case of all the entities included here, very little material other than the original type was available for study. It is obvious that all are very closely related, and it is possible that future collections may prove that only two or perhaps three true species are represented. The same is true for the three species from Haiti.

An attempt has been made to bring together all the species of the genus, giving as complete descriptions as possible and supplying the synonymy and literature in each case. Brief discussions showing relationships between species and the outstanding characteristics helpful in identification have also been supplied.

The following abbreviations are used to designate the herbaria cited in this paper: A=Arnold Arboretum; Ch=Chicago Natural History Museum; G=Gray Herbarium; Mo=Missouri Botanical Garden; NY=New York Botanical Garden; and US=United States National Herbarium.

Laplacea Humboldt, Bonpland & Kunth, Nov. Gen. Sp. **5**: 161 (207, ed. folio), *t. 461.* 1822. — DeCandolle, Prodr. 1: 527. 1824. — Sprengel, Syst. Veg. **2**: 631. 1825. — Cambessedes in St. Hilaire, Fl. Bras. Merid. **1**: 299. 1827. — Spach, Hist. Nat. Veg. **4**: 76. 1835. — Endlicher, Gen. Pl. 1020. 1840. — G. Don, Gen. Syst. **1**: 569. 1840. — Walpers, Repert. Bot. Syst. **1**: 372. 1842; **2**: 801. 1843; **7**: 367. 1868. — Bentham & Hooker, Gen. Pl. **1**: 186. 1862. — Wawra in Martius, Fl. Bras. **12**(1): 287. 1886. — Melchior in Nat. Pflanzenfam. ed. 2, **21**: 135. 1925. — O. C. Schmidt in Fedde, Rep. Spec. Nov. Reg. Veg. **29**: 14. 1931. — Lemée, Dict. Pl. Phan. **3**: 947. 1931. — Sprague et al. in Kew Bull. **1940**: 112. 1940. — Marie-Victorin in Contrib. Inst. Bot. Univ. Montréal **49**: 69. 1944. — Kobuski in Jour. Arnold Arb. **28**: 435. 1947.

Wikstroemia Schrader in Götting. Gel. Anzeig. **1821**(71): 710. May 5, 1821. — Pontin [Editor] in Vet. Akad. Handl. Stockholm **1821**: 168. 1821, obs. in footnote. — Blake in Contrib. Gray Herb. n. s. **53**: 36. 1918. — Urban, Fl. Ind. Occ. **8**: 759. 1921.

Lindleya Nees in Flora **4**: 299. May 21, 1821; op. cit. 328 (as syn. of *Wikstroemia*). June 7, 1821.

Haemocharis R. A. Salisbury, Paradisus Lond. **1**: sub *t. 56.* 1806. — Martius & Zuccarini, Nov. Gen. Sp. **1**: 106. 1826. — Choisy in Mém. Soc. Phys. Hist. Nat. Genève **1**: 142 (Mém. Ternstr. 57). 1855. — Baillon, Hist. Pl. **4**: 253. 1873. — O. Kuntze, Rev. Gen. Pl. **1**: 62. 1891. — Szyszylowicz in Nat. Pflanzenfam. III. **6**: 185. 1893. — Urban in Bot. Jahrb. **21**: 545. 1896.

Closaschima Korthals, Verh. Nat. Gesch. Bot. ed. Temminck 139, *t. 28.* 1842.

Trees or shrubs. Leaves coriaceous, subcoriaceous or membranaceous, alternate, rarely asymmetrical, usually rounded or obtuse at the apex, often emarginate, tapering at the base into a short petiole, the margins denticulate or crenulate, rarely entire. Flowers solitary in the axils of the upper branches; bracteoles 2 (or more), sepaloid, arranged along the peduncle, quickly caducous; sepals 5 (rarely more), thick-coriaceous, unequal, graduating in size and shape from bracteoles to petals, usually appressed-pubescent on the dorsal surface, deciduous or persistent; petals 5, rarely more, unequal, usually membranaceous, usually emarginate at the apex and occasionally pubescent on the dorsal surface, the outer petal often resembling the inner sepal; stamens many, seriate, the filaments adnate to the base of the petals, the anthers versatile; ovary basically 5-celled, occasionally 4-celled, rarely 6–10-celled, sericeous, the ovules 4 or more in each cell; the styles usually 5, occasionally 3 or 6, rarely 1, the stigmas usually the same in number as the styles, 5 when the style is solitary. Fruit an elongate, more or less woody, loculicidal capsule with persistent columella; seeds flat or compressed, drawn out into an oblong, membranaceous wing.

TYPE SPECIES: *Laplacea speciosa* HBK.

Urban, in one of his earlier works, in Bot. Jahrb. **21**: 545–549. 1896, designated the flowers of *Laplacea* (under *Haemocharis*) as monoecious, and in all six of the species recorded (*L. Wrightii, L. Curtyana, L. haematoxylon, L. villosa, L. alpestris* and *L. portoricensis*) he carefully described both staminate and pistillate flowers. In this paper no reference has been made to monoecious flowers in either the generic or specific descriptions because no flowers were examined that were not hermaphroditic, according to my interpretation. If, in my study of the South and Central American species, I find material producing monoecious flowers, I will revise my generic description accordingly. It is interesting to note that in describing *L. cymatoneura* at a later date (1925), Urban made no mention of monoecious flowers. O. C. Schmidt reviewed the West Indian species of the genus *Laplacea* in 1931 and described *L. Samuelssonii* without designating staminate or pistillate flowers. Also in describing *L. Urbani* in 1925

Schmidt intimated that the flowers were hermaphroditic. Marie-Victorin (1944), who described the latest species (*L. moaensis*) attributed to the genus, found only hermaphroditic flowers.

As in most other genera of the Theaceae, the terminal leaf-bud in *Laplacea* appears to be the true criterion of pubescence. In some species the mature leaves may often appear glabrous, yet an examination of the leaf-bud will show that originally the leaves were appressed-pubescent, pilose or even villous. The only truly glabrous species in the West Indies is *L. Wrightii*.

The texture of the leaf is often very difficult to determine in the dried state. Seldom does one find a species with thin membranaceous leaves. The texture is such that when dried the leaf appears subcoriaceous, at least, even though the collector may have signified the texture to be membranaceous.

The apex of the leaf is usually obtuse or rounded, often retuse or emarginate. The base is usually long tapering, often very finely decurrent into a rather short petiole, which may appear longer on casual observation because of the deceptive decurrent base.

The margins are usually finely denticulate, often with a minute point at the end of the denticulation which is easily and often broken off. More rare are crenulate or entire margins.

The bracteoles, two or more in number, are as a rule quickly caducous. These may be distributed along the pedicel or close to the calyx. They are sepaloid in appearance and grade into the sepals. Like the sepals, they are usually subligneous and pubescent on the dorsal surface. The sepals themselves grade from the bracteoles into the outer petals. The inner sepals tend to have a more membranaceous margin and occasionally it is difficult to distinguish between the inner sepal and the outer petal. The inner petals are considerably larger than the sepals, white in color, thinner in texture, and usually deeply emarginate at the apex. Occasionally one may find the outer petal to be entire and narrower at the apex. Pubescence on the dorsal surface of the petals is common but to a lesser degree than is found on the sepals.

The stamens of the various species are quite similar, differing mostly in the length of the filament and the number of series. The ovary, always sericeous, offers little variation. The accepted number of cells is five, but occasionally there are four. *Laplacea portoricensis* is an extreme exception, having six to ten cells in the ovary.

The style offers considerable variation. In most species the styles number five with an individual stigma on each style. In *L. Samuelssonii* the styles number three, while in *L. benitoensis* the styles are joined in a single entire style which is topped by five stigmas. Usually the styles are erect. Exceptions are found in *L. alpestris* and *L. cymatoneura*, where the styles are horizontal and the stigmas considerably enlarged.

The capsule offers little variation. In most species the number of valves, corresponding with the number of cells in the ovary, is five. In *L. porto-*

ricensis the valves number six to ten. The surface of the capsule is usually appressed-pubescent or glabrescent, never, as far as I know, sericeous. The length of the capsule is usually more than two centimeters. In *L. alpestris* and *L. cymatoneura* the capsule measures approximately one centimeter.

KEY TO THE SPECIES

A. Terminal leaf-bud pubescent.
  B. Ovary and fruit 4–5-celled.
    C. Styles horizontal, the stigmas flattened and considerably dilated.
      D. Leaves 1–1.5 cm. wide, long-pilose beneath; petals lightly pubescent on the dorsal surface. (Haiti) . 1. *L. alpestris.*
      DD. Leaves 2–2.5 cm. wide, glabrous beneath; petals glabrous on the dorsal surface. (Haiti; Dominican Republic) . . . . .2. *L. cymatoneura.*
    C. Styles erect, the stigmas not flattened and dilated as above.
      D. Leaves linear-lanceolate or oblong-elliptic, acute at the apex, about five times longer than broad. (Cuba) . . . . .4. *L. angustifolia.*
      DD. Leaves obtuse or rounded at the apex, not linear-lanceolate or oblong-elliptic, seldom more than three times longer than broad.
        E. Style entire, topped by several stigmas. (Cuba) . . . . .6. *L. benitoensis.*
        EE. Styles free to the base.
          F. Styles 3 in number, ca. 0.6 mm. long. (Haiti) . . . . .3. *L. Samuelssonii.*
          FF. Styles 5 in number, usually ca. 1 cm. long.
            G. Leaf-margin crenate-undulate; upper pair of veins arching, first upward and out toward the margin, then back toward the midrib, appearing to join near the point of a deep emargination, forming a heart-shaped figure. (Cuba) . . . . .7. *L. Urbani.*
            GG. Leaf-margin entire, denticulate or denticulate-crenulate; upper pair of veins not as above.
              H. Petals 8–10 mm. long, approximately equaling the calyx-lobes in length; leaf-margin denticulate-crenulate along the upper half of one side of the margin, the other side entire; leaves often oblique. (Cuba) . . . . .8. *L. moaensis.*
              HH. Petals 15–30 mm. long, always greatly exceeding the calyx-lobes; leaf-margins entire or denticulate along both sides; leaves symmetrical.
                I. Leaf-margin entire; the under surface villous when young and clearly showing the original folds of the leaf. (Cuba) . . . .10. *L. Curtyana.*

II. Leaf-margin denticulate; the under surface pubescent or glabrous but not showing the original folds of the leaf.
J. Branchlets and stems villous at maturity. (Jamaica) .... 11. *L. villosa.*
JJ. Branchlets and stems pubescent when very young, glabrescent at maturity.
K. Leaves chartaceous; petals glabrous or nearly so on the external surface; stamens 4–5-seriate; peduncles 2–5 mm. long. (Jamaica) ....12. *L. haematoxylon.*
KK. Leaves coriaceous; petals pubescent on the external surface; stamens 3-seriate; peduncles ca. 1 mm. long. (Cuba)...9. *L. Ekmani.*

BB. Ovary and fruit 6–10-celled. (Porto Rico)..13. *L. portoricensis.*
AA. Terminal leaf-buds glabrous. (Cuba)..............5. *L. Wrightii.*

1. **Laplacea alpestris** (Krug & Urban) Dyer in Index Kew. Suppl. **2**: 86. 1904. — Melchior in Nat. Pflanzenfam. ed. 2, **21**: 136. 1925. — O. C. Schmidt in Fedde, Rep. Spec. Nov. Reg. Veg. **29**: 16. 1931. — Moscoso, Cat. Fl. Doming. **1**: 377. 1943.

Haemocharis alpestris Krug & Urban in Bot. Jahrb. **21**: 547. 1896. — Urban, Fl. Ind. Occ. **8**: 436. 1920.

Wikstroemia alpestris (Krug & Urban) Blake in Contrib. Gray Herb. n. s. **53**: 38. 1918. — Urban, Fl. Ind. Occ. **8**: 759. 1921.

Small tree 2–3 m. high. Terminal leaf-bud gray-sericeous. Young branchlets long-pilose, the older branchlets glabrescent, strigose. Leaves chartaceous, elliptic to elliptic-obovate, 2.5–4 cm. long, 1–1.5 cm. wide, obtuse, rarely rounded at the apex, long-tapering at the base, glabrous, dark green above, long-pilose and lighter green beneath, the margin quite flat, occasionally subrevolute, finely denticulate especially toward the apex, the midrib slightly canaliculate above, the veins 8–10 pairs, conspicuous above, very outstanding below forming a sharp network over the entire lower surface, the petiole 2–4 mm. long. Flowers few, solitary, in axils near the apex of the branchlets; peduncles very brief, ca. 2 mm. long; bracteoles quickly caducous; sepals ca. 5, broadly ovate to subrotund, the larger ones 5–6 mm. long, pilose on the external surface; petals 5, obovate, ca. 15 mm. long, 8–10 mm. wide, unequal, deeply emarginate at the apex, pubescent on the median portion of the external surface; stamens biseriate, the filaments glabrous, 4–5 mm. long, the anthers subglobose, ca.

1 mm. long; ovary ovate, white-pilose, 4–5-celled, with ca. 3 ovules in each cell, the styles 4–5, horizontal, ca. 1 mm. long, glabrous except at the extreme base, the stigmas considerably dilated, semiorbicular. Capsule oblong, ca. 10 mm. long, 4–5 mm. diam., very short-appressed-pubescent, 4–5-celled, 2–3 seeds in each cell; seeds with wing ca. 7–8 mm. long, 2 mm. wide.

HAITI: Morne des Commissaires, Gros Cheval, alt. 1500 m., *L. R. Holdridge 1260* (US), June 9, 1942 (tree 10 m. tall; petals white, ca. 2 cm. long, deeply emarginate; old capsules persistent). — Morne des Commissaires, alt. 5800 ft., *J. T. Curtis s.n.* (US), July 24, 1944. — Massif de la Pelle, Marigot, Jardins Bois-Pin, alt. 1800–1900 m., *E. L. Ekman H1622* (US), Aug. 24, 1924.

Laplacea alpestris was the first species of the genus described from the republics of Haiti and Santo Domingo. Since then two more species, *L. Samuelssonii* Schmidt and *L. cymatoneura* Urban, have been described. Upon studying the genus as a whole one is struck by the close relationship of these three species, and the study of further collections may show *L. cymatoneura* to be, at the most, only a variety of *L. alpestris*.

Distinctive characters of this species are: (1) the horizontal styles and broadened stigmas; (2) the long-pilose hairs on the under surface of the mature leaves; (3) the petals pubescent on the dorsal surface; and (4) the fine, extensive and pronounced reticulation on the under surface of the leaves.

Laplacea Samuelssonii can be separated from this species by the styles which are three in number and erect and by the stigmas which are somewhat capitate but not broadened. Also the pubescence when present on the under surface of the leaves is appressed, rather than loose-pilose and turns dark in color.

Laplacea cymatoneura possesses the five horizontal styles and broadened stigmas and the pronounced reticulation on the under surface of the leaf. However, this reticulation is confined more to the outer half of the leaf. The under surface of the leaf is quite glabrous, as is the dorsal surface of the petals.

Krug and Urban, in their original description of *L. alpestris* and Urban in the description of *L. cymatoneura* describe in detail staminate and pistillate flowers. In all the flowers I examined or dissected there was no instance of sexual distinction in the individual flowers.

2. **Laplacea cymatoneura** Urban in Fedde, Rep. Spec. Nov. Reg. Veg. 20: 34. 1924. — O. C. Schmidt in Fedde, Rep. Spec. Nov. Reg. Veg. 29: 16. 1931; 33: 176. 1933. — Moscoso, Cat. Fl. Doming. 1: 377. 1943.

Large forest tree. Terminal leaf-bud appressed-pubescent, the branchlets of the current year's growth appressed-pubescent, glabrous when mature, erect, brown, terete, lightly striate. Leaves coriaceous, obovate, 4–5 cm. long, 2–2.5 cm. wide, obtuse or rounded at the apex, emarginate, cuneate at the base into a petiole 4–5 mm. long, dark green, shining, glabrous above, lighter green, glabrescent below, pilose especially along the midrib and margin when young, the margin subrevolute appearing crenulate on the upper surface but distinctly denticulate on the under surface, the midrib deeply canaliculate on the upper surface, broad and prominent beneath, the veins 8–10 pairs, obvious above, very distinct below, nearly horizontal with the midrib, anastomosing near the margin forming a sharply defined network of lesser veins. Flower solitary, axillary near the ends of the branchlets; peduncles ca. 8 mm. long, appressed-pubescent; bracteoles quickly caducous, the scars prominent on the peduncle; sepals unequal, subrotund, the outer sepals 5–6 mm. long, 6–7 mm. wide, the inner ones larger, up to 10 mm. long, 9 mm. wide, appressed-pubescent on the dorsal surface; petals obovate, glabrous, deeply emarginate, up to 23 mm. long, 13 mm. wide; stamens 2-seriate, the filaments 2.5–3 mm. long, glabrous, the anthers minute, less than 0.5 mm. long, globular; ovary ovoid, sericeous, 5-celled, the cells 3-ovulate, the styles 5, horizontal, glabrous, ca. 0.5 mm. long, the stigmas expanding considerably beyond the styles. Capsules narrow-elliptic, ca. 1.5 cm. long, the seeds ca. 3 mm. long with the wing ca. 7 mm. long.

DOMINICAN REPUBLIC: Prov. Pacificador, vicinity of San Francisco de Macorís, Quita Espuela, alt. 400–1000 m., *W. L. Abbot 2093* (US, ISOTYPE), April 5–17, 1922 (large forest tree). HAITI: Massif du Nord, Port-de-Paix, Haut-Piton, on laterite, alt. ca. 800 m., *E. L. Ekman H3688* (US), April 6, 1925.

This species was described by Urban (1924) from very fragmentary material and is consequently incomplete. He stated that he had seen only two leaves. Knowing the variations that are frequently found in this family, it is surprising that he separated the species from *L. alpestris* (to which it is obviously closely related) on the basis of such scanty material. Abbot's isotype in the U. S. National Museum is very similar to the material seen by Urban. It consists merely of a packet containing two leaves and a few petals, and on the sheet a piece of wood which evidently came from a very large tree, as is stated on the label.

Later, in 1933, O. C. Schmidt amplified the description by including the fruit and by citing two more specimens, *Ekman H3688* and *H4635*. *Ekman H3688* is represented in the U. S. National Herbarium. Before seeing Schmidt's work I had difficulty in identifying *Ekman H3688,* finally deciding to place it with *L. cymatoneura,* even though the petals measured only 11 or 12 mm. in length and the veins rose less horizontally from the midrib. In the two leaves of the type the veins are strikingly horizontal. In *Ekman H3688,* although the majority of the veins appear to rise subhorizontally to the midrib, many leaves show veins which leave the midrib at an angle of 60° or even 45°. It is quite probable that Abbot's few leaves may have been collected from a tree which exhibited the same variation in veining as *Ekman H3688.* I was pleased to find that Schmidt reached the same conclusion as I regarding the Ekman specimen, although in his added description he did not mention the variations recorded above.

In his mention of *Ekman H4635,* a specimen which I have not seen, he described only the fruit.

This species can be separated from *L. Samuelssonii* by the horizontal styles, which number five. In *L. Samuelssonii* the styles are three in number and erect, and the stigmas are capitate rather than broadened.

From *L. alpestris* the species can be separated at present by the larger (wider) leaves and their glabrous under surface and by the glabrous dorsal surface of the petals. The leaves of *L. alpestris,* even in maturity, are distinctly long-pilose below, and narrower, with an over-all reticulation. The petals are lightly pubescent on the dorsal surface. In most characters, however, these two species agree. However, since small petals (11 or 12 mm.) have been found in *Ekman H3688,* it may eventually be necessary, on the basis of additional material, to combine the two species, recognizing this one as a variety of *L. alpestris.*

3. **Laplacea Samuelssonii** O. C. Schmidt in Fedde, Rep. Spec. Nov. Reg. Veg. 29: 16. 1931. — Moscoso, Cat. Fl. Doming. 1: 377. 1943.

Small tree. Terminal leaf-bud and young branchlets of the current year densely appressed-pilose, the older branchlets terete, glabrous, brown-gray. Leaves chartaceous, oblanceolate or narrowly obovate, 2–4 cm. long, 1–1.5 cm. wide, narrowed at the apex, rounded, occasionally emarginate, cuneate at the base, elongate-tapering at the extreme base into a very short petiole 1 mm. long, glabrous above, sparsely appressed, very short pubescent below, darkening with age and appearing black in the dried state, the margin subrevolute, finely denticulate, the veins 10–12 pairs, rather inconspicuous above, prominent below, rising nearly horizontally from the midrib, anastomosing near the margin, forming a narrow network of veins. Flowers solitary, axillary near the ends of the branchlets; peduncles short, 1–1.5 mm. long; bracteoles quickly caducous; sepals unequal, suborbicular, 5–7 mm. long, 7–8 mm. wide, appressed-pubescent on the dorsal surface; petals 5, white (Ekman), obovate, ca. 12 mm. long, 8–10 mm. wide near the apex, emarginate, lightly appressed-pubescent in the median portion of the external surface; stamens apparently tri-seriate, the filaments glabrous, unequal, those of the outer row 3 mm. long and those of the inner row ca. 4 mm. long, the anthers subglobose, ca. 0.8 mm. long; ovary subglobose, densely sericeous, 6-angled (Schmidt), the styles 3, thick, ca. 0.6 mm. long, erect, glabrous. Fruit not known.

HAITI: Massif des Matheux, l'Arcahaie, Morne Delpech, alt. ca. 4000 m., *E. L. Ekman 9320* (US, ISOTYPE), Nov. 14, 1927.

Two mounted sheets of *Ekman 9320,* the type of the species, are deposited in the U. S. National Herbarium. One specimen has leaves up to 4 cm. long and 1.5 cm. wide, while on the second specimen all the leaves are much smaller, none measuring more than 2 cm. long and 0.8 cm. wide. In other characters there is complete agreement.

Distinctive characters are: (1) the sharp reticulate veining on the under surface of the leaf; (2) the short scattered appressed pubescence (eventually darkening) on the under surface of the leaf; (3) the three erect, short styles; and (4) the tri-seriate stamens.

The species is closely allied to *L. alpestris* (Krug & Urban) Dyer and to *L. cymatoneura* Urban. It can be distinguished from *L. alpestris* by the three erect, very short (0.6 mm.) styles. In *L. alpestris* the styles number ca. 5 and lie horizontal to the ovary, and the stigmas are pronouncedly dilated. The leaves are noticeably much longer pilose on the under surface of the leaf, especially along the midrib.

4. **Laplacea angustifolia** (Britton & Wilson) O. C. Schmidt in Fedde, Rep. Spec. Nov. Reg. Veg. **22**: 94. 1925. — Marie-Victorin in Contrib. Inst. Bot. Univ. Montréal **49**: 70, 75. 1944.

Haemocharis angustifolia Britton & Wilson in Bull. Torrey Bot. Club. **50**: 43. 1923.

Tree 20–30 m. Terminal leaf-bud slender, appressed-pubescent. Young branchlets slender, grayish brown, terete, appressed-pubescent, the older branchlets glabrous. Leaves coriaceous or subcoriaceous, oblong-elliptic to linear-lanceolate, 3–4 cm. long, 0.6–0.8 cm. wide (also 5.5–6 cm. long and 1.3–1.4 cm. wide), acute at the apex, not sharply so, finely apiculate, tapering gradually at the base into a petiole 1 mm. long, glabrous above, the younger leaves covered underneath with a light spreading pubescence, at maturity pubescent on the midrib only, the margin entire, subrevolute, the veins ca. 12 pairs, lightly elevated on both surfaces, anastomosing near the margin. Flowers solitary, axillary near the apices of the branchlets; peduncles very short, terete, 1 mm. long, appressed-pubescent; bracteoles 2, sepaloid, broadly ovate, 2–3 mm. long, appressed-pubescent on the external surface; calyx-lobes 5, suborbicular, 4.5–6 mm. long, 4–6 mm. wide, appressed-pubescent on the external surface; petals 5, obovate, 1.5–1.7 cm. long, ca. 1.3 cm. wide, deeply emarginate at the apex, pubescent on the median portion of the external surface; stamens bi-seriate, ca. 30, the filaments quite equal, filiform, ca. 5 mm. long, glabrous, the anthers subglobular, 0.5 mm. or less long; ovary globose, densely white-villous, 5-celled, the styles 5, distinct, glabrous, ca. 1 mm. long. Fruit not seen.

CUBA: Oriente: Pico Turquino, Maestra Ridge, alt. 1300 m., *Fr. Leon 11072* (NY, TYPE), July 1922 (tree 20–30 m.). — Pico Turquino, slope of First Peak, *G. C. Bucher 77* (NY), Oct. 12–14, 1924.

The narrow oblong-elliptic leaves of this species are its most distinctive feature. Closely resembling these leaves in appearance are those of the narrower-leaved specimens of *L. Wrightii* Grisebach. The terminal leaf-buds of the latter species are glabrous, whereas in this species they are pubescent.

5. **Laplacea Wrightii** Grisebach in Mem. Amer. Acad. n. s. **8**: 166 (Pl. Wright.). 1860. — Walpers, Repert. Bot. Syst. **7**: 367. 1868. — Sauvalle, Fl. Cuba. 10. 1873. — Melchior in Nat. Pflanzenfam. ed. 2, **21**: 136. 1925. — O. C. Schmidt in Fedde, Rep. Spec. Nov. Reg. Veg. **29**: 17. 1931. — Marie-Victorin in Contrib. Inst. Bot. Univ. Montréal **49**: 70, 75. 1944.

Haemocharis Wrighti (Grisebach) Gomez de la Meza, Dicc. Bot. Nom. Vulg. Cub. Puerto Riq. 15. 1889; Ensayo Farm. Cuba 26. 1889; in Anal. Hist. Nat. Madrid **19:** 222. 1890. — Urban in Bot. Jahrb. **21:** 545. 1896.

Wikstroemia Wrightii (Grisebach) Blake in Contrib. Gray Herb. n. s. **53:** 41. 1918.

Slender tree. Terminal buds small, glabrous on the external surface. Branchlets glabrous (current year's growth appressed-pubescent), terete. Leaves coriaceous, obovate to obovate-elliptic, 5–9 cm. long, 2–3 cm. wide, glabrous on both surfaces, obtuse or rounded at the apex, usually lightly emarginate, tapering at the base into a short petiole 2–3 mm. long, the margin entire or rarely minutely serrulate toward the apex, the veins 8–12 pairs, quite inconspicuous on both surfaces. Flowers solitary, axillary; peduncles glabrous, 4–6 mm. long, terete; bracteoles caducous; sepals 5, ovate to orbicular, ca. 10 mm. long, sericeous on the external surface, appressed-pilose on the internal surface, shortly apiculate at the apex; petals 5, obovate, white, 15–17 mm. long, ca. 10 mm. wide, appressed-pubescent on the external surface; stamens ca. 50, the filaments bi-seriate, the anthers ovate; ovary 5-celled, densely sericeous, oval, few-ovulate. Capsule ovoid, obtuse at the apex, 2–3 cm. long, glabrescent, 5-angled, 5-celled; seeds (including wing) 12–15 mm. long.

CUBA: Oriente: near Monte Verde, in forest, *C. Wright 48* (ISOTYPES, G, NY, MO), Jan.-July 1859 and 1860–1864 (slender tree with white flowers). — South of Sierra Moa, Camp La Gloria, *J. A. Shafer 8195* (NY, US), *8203* (NY, US), Dec. 24–30, 1910 (slender shrub 5 ft. high with white flowers).

The distinguishing characters are: (1) glabrous terminal leaf-buds; (2) coriaceous leaves; (3) large fruit and seeds; and (4) sepals pubescent on both the external and internal surfaces. The glabrous terminal buds distinguish this species from all other Cuban species.

From the Sierra Moa region of Oriente are two specimens, *J. A. Shafer 8195* and *8203,* which probably belong here but possess neither fruit nor mature flowers. The leaves are more narrow (sometimes only a single centimeter wide) and resemble *L. angustifolia.* However, in the latter species the terminal buds are distinctly pubescent. I do not believe that this Shafer material should be given varietal status even though the leaf difference seems distinctive. Too little material has been examined.

Six sheets of *"Wright 48"* have been examined in this study. It is very obvious that this group of specimens does not comprise a single collection. There are four different labels with this number, all from Oriente:

1. "prope villam *Monte Verde* dictam, Cuba Orientali, Jan.-Jul. 1859." This is printed on a blue label with a written number 48. A blue field label accompanies the printed label and states that the habit is that of a slender tree and that the flowers are white. The abbreviation "M. V. Dec. 8" on this field label agrees in locality (M. V. standing for Monte Verde) but the date "Dec. 8" does not agree with the printed label. A single specimen is found at the Gray Herbarium.

2. "1856–7, in Cuba Orientali." Another single specimen with a blue label in the Gray Herbarium. Besides the number "48" is also found the number "64" both on the label and in a packet at the top of the sheet.

3. "Sept. 1859-Jan. 1860." This is on a white label with no further information. There are two sheets of this collection in the herbaria of the New York Botanical Garden and the Missouri Botanical Garden.

4. "1860–64." On a white label, and found at Gray, Missouri, and New York. The Gray specimen possesses an added field label which states that the specimen was collected at Cachillas de Baracoa on May 14, and that it was arborescent with white flowers. However, the Gray and Missouri specimens possess very mature fruits with no flowers, while the New York specimen possesses a few unattached flower-buds.

Fortunately, since this "number 48" is the type of the species, these specimens all truly belong to the same species. However, until the species is re-collected we cannot be sure of the true type-locality.

6. **Laplacea benitoensis** (Britton & Wilson) O. C. Schmidt in Fedde, Rep. Spec. Nov. Reg. Veg. **24**: 78. 1927; **29**: 16. 1931.— Marie-Victorin in Contrib. Inst. Bot. Univ. Montréal **49**: 70, 75. 1944.

Haemocharis benitoensis Britton & Wilson in Mem. Torrey Bot. Club **16**: 82. 1920.

Straggling shrub 1–3 m. high. Terminal leaf-bud small, ca. 5 mm. long, villous. Branches slender, terete, the very young branchlets appressed-pubescent. Leaves coriaceous, obovate, 3–5 cm. long, 1–1.6 cm. wide, rounded at the apex, cuneate at the base, glabrous, light green above, loosely appressed-pubescent beneath, glabrescent, the margin entire, revolute, the veins few (ca. 8) in number, occasionally evident on both surfaces, usually not conspicuous, the petiole slender, 5–7 mm. long, pubescent in the younger leaves. Flowers solitary, axillary near the tips of the branchlets; bracteoles quickly caducous; sepals 5, small, suborbicular, 3–4 mm. long and wide, appressed-pubescent on the external surface; petals (fide Britton & Wilson) 5, white, elliptic-obovate, 10 mm. long, 5–6 mm. wide; stamens 2- or 3-seriate, glabrous, the filaments unequal, ca. 2 mm. long, the anthers globular, minute, ca. 0.25 mm. long; ovary subglobose, covered with a dense white-silver pubescence, glabrous at the apex and tapering broadly into an entire glabrous style which is topped by several stigmas. Fruit not seen.

CUBA: Oriente: vicinity of Camp San Benito, west of camp, in thicket, alt. 900 m., *J. A. Shafer 4063* (NY, TYPE), Feb. 24, 1910 (straggling shrub 4 ft. high; flowers white).— South of Sierra Moa, Camp La Gloria, *J. A. Shafer 8208* (Ch, NY, US), *8272* (G, NY), Dec. 24–30, 1910 (shrub 6–10 ft.).

A few of the outstanding characteristics of this species are: (1) the small calyx-lobes and corolla-lobes; (2) the small pubescent terminal leaf-buds; (3) the very short peduncles; (4) the entire revolute margins of the small thick leaves; (5) the very small stamens; and (6) the entire style.

Although six specimens were available for this study, none offered mature flowers for dissection. Fortunately, the type specimen (*J. A. Shafer 4063*), deposited in the New York Botanical Garden, possessed remnants of a partially dissected flower, and it was from this and the diagnosis of the original authors that the above description was drawn up.

7. **Laplacea Urbani** O. C. Schmidt in Fedde, Rep. Spec. Nov. Reg. Veg. **22**: 93. 1925; **29**: 17. 1931. — Marie-Victorin in Contrib. Inst. Bot. Univ. Montréal **49**: 70, 75. 1944.

Small tree. Terminal leaf-buds elongate, conspicuously gray-appressed-pubescent. Branches brown-gray, terete, glabrous, conspicuously marked by leaf-scars, the very young branchlets short-appressed-pubescent, quickly glabrous. Leaves disposed at the ends of the branchlets, obovate, 6–10 cm. long, 2.5–4 cm. wide, rounded and deeply emarginate at the apex, tapering at the base, glabrous above, appressed-pubescent below (on the midribs only in mature leaves), the margin crenate, nearly undulate, the veins prominent on both surfaces, ca. 15 pairs, branching and anastomosing near the margin appearing reticulate, the upper pair arching back and terminating near the deepest point of emargination, the actual petiole short, 3–4 mm. long, pubescent below. Flowers solitary, axillary, the peduncle 10–12 mm. long, terete, pubescent with a number of scars along the side, the scars probably those of the caducous bracteoles; sepals 5, obovate to rounded, sericeous-pubescent on the external surface, unequal, the outer ones 7–8 mm. long and ca. 6 mm. wide, the inner ones 9–12 mm. long, 6–8 mm. wide; petals 5 (fide Urban), white, obovate, 2.3–2.5 cm. long, 1.5–1.7 cm. wide, deeply emarginate at the apex, pubescent on the dorsal surface; stamens many, 3 (or more)-seriate, the filaments glabrous, somewhat unequal, 7–10 mm. long, the anthers oblong-elliptic ca. 1 mm. long; ovary ovoid, sericeous-pubescent, 2.5–3 mm. long, 5-celled; styles 5, 1–1.5 mm. long, glabrous; stigmas 5. Fruit not seen.

CUBA: Oriente, Sierra Maestra, Pinar de Caridad, southeast of Yara, pine patch at edge of brook, *E. L. Ekman 14687* (NY, ISOTYPE), July 31, 1922.

This species is characterized by large leaves, 6–10 cm. long, 2.5–4 cm. wide, rounded and deeply emarginate at the apex. The margin is very outstanding for the genus in that it is softly crenulate, without any evidence of glands. The veining also is distinctive. Conspicuous on both surfaces, the veins join about half-way to the margin, becoming reticulate. The upper pair arch upward, then back again toward the midrib, and appear to join near the point of emargination, forming a nearly heart-shaped figure. The complete arc is not always obvious or truly formed.

The corolla is deeply emarginate. The stamens are more numerous than those found in most species and appear to be 3- or 4-seriate. Along the peduncle were found scars caused by caducous bracteoles, farther spaced, however, than is usual, scattered over the entire length of the peduncle.

Several characters are mentioned above with an element of uncertainty. Only a single, partially dissected flower was attached to the specimen. No attempt at boiling up the flower or dissections was made. The description was drawn up from that of the original author and supplemented by observations on the type whenever possible.

7a. **Laplacea Urbani** O. C. Schmidt var. **subserrulata,** var. nov.

A typo recedit foliis margine subserrulatis vel leviter crenulatis et apice minus profunde emarginatis vel integris.

CUBA: Oriente: Firmesa to Gran Piedra, *J. A. Shafer 8974* (NY, US), Mar. 4–5, 1911 (shrub 8 ft.). — Range of Sierra Maestra, Loma del Gato, alt. 900–1000 m., *Fr. Leon, Clement & M. Roca 9858* (NY, TYPE), *10015* (NY), July 11-Aug. 14, 1921 (small tree 5–6 m.). — Cobre range of Sierra Maestra, Loma del Gato, *Fr. Leon, Clement & M. Roca 10125* (NY), July 11-Aug. 14, 1921 (shrub 4–5 m.).

The material cited above, like most of the earlier collections, has long been identified with *Laplacea Curtyana,* a species of western Cuba. Although it appears to resemble *L. Curtyana* in many respects, I feel that its true relationship is with one of the Oriente species, namely, *L. Urbani.* Any one of three species, *L. Urbani, L. Ekmani,* and *L. moaensis,* might well be the type from which this variety has derived. However, in *L. moaensis* the leaves have a tendency toward obliqueness and in *L. Ekmani* the leaves are coriaceous, both characters strong for any species of this group but lacking in this variety.

From typical *L. Urbani* the variety differs in the apex, margin, and venation of the leaf. Otherwise the two entities are very similar. At the apex of the leaf in the species a deep and very marked emargination is found, the margin is decidedly crenate, and the top pair of veins turn back to the midrib to form a heart-shaped figure. In the variety the apex of the leaf may be slightly emarginate or entire, the margin may be lightly crenulate, but usually is subserrulate, and the upper pair of veins do not turn back toward the midrib.

This variety differs nearly as much from the species as do *L. Urbani, L. Ekmani,* and *L. moaensis* from one another. Only four specimens were available for study of the three species listed above: two for *L. Ekmani* and one each for *L. Urbani* and *L. moaensis.* As many specimens were available for this variety alone.

8. **Laplacea moaensis** Marie-Victorin in Contrib. Inst. Bot. Univ. Montréal **49**: 72. 1944.

Tree 3–5 m. high. Terminal leaf-bud with a fulvous or silvery appressed pubescence. Branchlets terete, reddish brown, pubescent when young, soon becoming glabrous. Leaves disposed at the ends of the branchlets, chartaceous, obovate or oblanceolate, 6–12 cm. long, 2–3.5 cm. wide, obtuse and slightly emarginate at the apex, narrowed at the base, glabrous above, fulvous-pubescent beneath, especially on the lower portion of the prominent midrib, the margin subrevolute, lightly denticulate-crenulate along one side especially toward the apex, entire along the other side, the veins (20–30 pairs) inconspicuous, the petiole very short, ca. 2 mm. long. Flowers solitary, axillary; peduncle short, ca. 6 mm. long, with bracteole scars disposed along the sides, appressed-pubescent; bracteoles quickly caducous (not seen); sepals subrotund, unequal, 8–10 mm. long, nearly as wide, appressed-pubescent over the entire external surface; petals (fide Marie-Victorin) white within, slightly purple without, 8–10 mm. long; stamens with the filaments (ca. 10 mm. long) gradually attenuated from the base to the apex; ovary subspherical, 3–4 mm. long, white-sericeous-pubescent, 4–5-celled. Capsule oblong-elliptic, 2.5–3 cm. long, 4–5-celled; seeds dark-colored, glabrous, ca. 6 mm. long, with wing about 18 mm. long.

CUBA: Oriente: "Region de Moa, chemin des hauteurs à l'ouest du rio Cayoguan, sur la limonite argileuse recouvrant la serpentine," *Marie-Victorin, Clément & Alain 21630* (G, ISOTYPE), April 16–23, 1943.

Laplacea moaensis, the most recent species of the genus, has been amply described and illustrated by Marie-Victorin in Contrib. Inst. Bot. Univ. Montréal **49**: 69–75, *figs 1* and *2*, 1944. Although an isotype of the species was available for this study, no mature flowers or fruit were to be had for dissection; hence much of the above description was drawn from that of Marie-Victorin.

Coming from the serpentine region of Moa in the state of Oriente, like many other novelties from the same area it appears quite distinct. The peduncles are short (ca. 6 mm. long) and the bracteole-scars are found only along the upper half of the peduncle. The veins, although quite inconspicuous, are more numerous (20–30 pairs) than those in most other species of the genus. The margin is subrevolute. Along one side of the leaf the margin is entire, while along the other half a light crenulation can be found toward the apex. This margin condition, although not especially rare in the family, is distinctive for the genus.

A fine reddish dust from the serpentine region overlies most of the specimen, giving a brownish red color to the branchlets, midrib of the leaf, etc., and may be mistaken for a specific character. This dust can easily be wiped off with a cloth.

9. **Laplacea Ekmani** O. C. Schmidt in Fedde, Rep. Spec. Nov. Reg. Veg. **22**: 94. 1925; **29**: 17. 1931. — Marie-Victorin in Contrib. Inst. Bot. Univ. Montréal **49**: 70; 75. 1944.

Small tree. Terminal leaf-bud silver-white sericeous-pubescent, ca. 6 mm. long. Young branchlets appressed-pubescent, glabrous when older. Leaves coriaceous, obovate, 4–8 cm. long, 2.3–3.5(–4.5) cm. wide, rounded at the apex, tapering at the base, glabrous above, appressed-pubescent on the midrib below, also occasionally under the revolute margin, inconspicuously denticulate with slight evidences of glandular teeth (on the upper denticulations), the veins inconspicuous on both surfaces, ca. 12 pairs, the petiole short, 4–5 mm. long. Flowers axillary, solitary; peduncle ca. 1 cm. long, terete, appressed-pubescent; bracteoles several, disposed along the peduncle, quickly caducous, broadly ovate to rounded, the outer ones ca. 7 mm. long, sericeous-pubescent on the exterior surface, gradating in size into the sepals; sepals ovate, ca. 10 mm. long, 6–7 mm. wide, sericeous-pubescent on the exterior surface; petals (bud) pubescent on the exterior surface; stamens (bud) 3-seriate, the filaments glabrous, the anthers subglobular; ovary (bud) subconical, densely silvery sericeous-pubescent, 5 (or 6)-celled, tapering at the apex into 5 (or 6) styles. Capsule oblong, 2.5–2.8 cm. long, glabrescent, 5 (or 6)-celled, each locule with ca. 5 seeds; seeds ca. 5 mm. long with the wing 10–12 mm. long.

CUBA: Oriente: Sierra de Nipa, Woodfred, in forest bordering on pinelands, on left side of Arroya del Medio, *E. L. Ekman 15283* (NY, ISOTYPE), Sept. 25, 1922 (small tree). — Palmarito de Cauto, *A. Cuebelo 6230* (NY), June 2, 1932 (high tree).

This species was described from a fruiting specimen (*Ekman 15283*), a duplicate of which was available for this study. A second specimen (*Cuebelo 6230*), collected in the same general region as the type, possessed buds only, and these were very young. Dissections of the buds furnished only general information, but added somewhat to the original diagnosis of Schmidt.

The species appears to be most closely allied to *L. Urbani* Schmidt, differing mostly in the leaves, which are definitely coriaceous, not chartaceous as originally described. They are rounded at the apex and only rarely even slightly emarginate, not deeply so as is the case in *L. Urbani*. Also the leaf-margin is revolute, with hairs protruding from beneath the revolute portion of the margin. A very slight denticulation occurs along this margin. In *L. Urbani* the leaves are more nearly chartaceous, the margin distinctively crenate, and the pubescence on the mature leaves is confined to the midrib of the lower surface.

10. **Laplacea Curtyana** A. Richard, Ess. Fl. Cuba 1: (in Sagra, Hist. Ile Cuba 2:) 225. 1845. — Walpers, Repert. Bot. Syst. 5: 132. 1846. — Sauvalle, Fl. Cuba. 10. 1873. — Melchior in Nat. Pflanzenfam. ed. 2, 21: 136. 1925. — O. C. Schmidt in Fedde, Rep. Spec. Nov. Reg. Veg. 29: 17. 1931. — Marie-Victorin in Contrib. Inst. Bot. Univ. Montréal 49: 75. 1944.

Haemocharis Curtyana (A. Richard) Maza, Dicc. Bot. Nom. Vulg. Cub. Puerto-Riq. 15. 1889; Ens. Farm. Cuba 26. 1889; in Anal. Hist. Nat. Madrid **19:** 222. 1890; in Estac. Exp. Agron. Cuba Bol. (Fl. Cuba) **22:** 74. 1914. — Kuntze Rev. Gen. Pl. **1:** 62. 1891, as *H. Courtyana*. — Urban in Bot. Jahrb. **21:** 546. 1896. — Millspaugh in Field Columb. Mus. Bot. **1:** 430. 1900.

Laplacea Courtyana Kuntze, Rev. Gen. Pl. **1:** 62. 1891.

Wikstroemia Curtyana (A. Richard) Blake in Contrib. Gray Herb. n. s. **53:** 39. 1918.

Tree up to 15 m. high. Terminal leaf-buds elongate, 1–1.5 cm. long, densely pubescent. Branches terete, pubescent when very young, later glabrous. Leaves coriaceous or subcoriaceous, elliptic to obovate, 6–8 cm. long, 2.3–3 cm. wide (occasionally up to 10×3.8 cm.), obtuse or subobtuse at the apex, tapering toward the base, glabrous and shining above (occasionally pubescent at base of midrib), pubescent below, glabrescent, the margin entire or subentire, the veins 12–15 pairs, curving upward near the margin, the petiole short, 4–7 mm. long, pubescent. Flowers solitary; peduncle thick, terete, ca. 2 mm. long, pubescent; bracteoles 2, quickly caducous, when present unequal, the outer one smaller, broadly ovate, ca. 4 mm. long, 3.5 mm. wide, the inner one subrotund, ca. 5 mm. long and wide, both appressed-pubescent on the external surface; calyx-lobes 5, imbricate, very unequal in size and shape, outer lobes subrotund 6–8 mm. long, 6–7 mm. wide, the inner lobes increasing in both length and width, the innermost lobe broadly obovate to subrotund, ca. 18 mm. long, 10 mm. wide, with a wide membranaceous margin, very slightly emarginate, all appressed-pubescent on the dorsal surface; petals 5, unequal, the outer one obovate, the smallest 1.5 cm. long and 1.3 cm. wide, only slightly emarginate at the apex, the inner four more nearly equal, obovate to obcordate, ca. 2.2 cm. long and 1.5 cm. wide, deeply emarginate at the apex, all lightly pubescent on the external surface at least at point of emargination; stamens bi-seriate, ca. 40, the filaments of about equal length, free, glabrous, 5–6 mm. long, the anthers subglobose, ca. 1.5 mm. long; ovary semi-globose, densely white pubescent, 5-ribbed, 5-celled, tapering abruptly at the apex into fine short glabrous styles with 5 stigmas. Fruit woody ovoid, 5-ribbed, ca. 2 cm. long, 1 cm. wide, glabrous except within the ridges, the seeds with wings ca. 1.5 cm. long, the wing 9–10 mm. long.

CUBA: Isle of Pines: vicinity of Los Indios, arroya, *N. L. Britton, E. G. Britton & P. Wilson 14247* (Ch, G, Mo, NY, US), Feb. 13, 1916 (tree 15 m., flowers white). — No definite locality, *José Blain 22* (Ch). "Western Cuba": "prope Vuelta de Abajo," *C. Wright 2109* (G, Mo, NY, US), April 2, 1865.

Laplacea Curtyana is the first species described from Cuba and as such has been much confused and recorded over a range far too extensive. According to this study it is confined to the western part of Cuba and the Isle of Pines.

The species does not possess what might be termed truly outstanding characteristics. Some of the better characters to help in determination are: (1) the elongated, narrow, densely pubescent terminal leaf-bud; (2) the pubescence in waves (parallel to the margin) of density on the lower surface of the leaf; and (3) the entire or nearly entire margin of the leaf.

The specimens of *L. Curtyana* offered a good opportunity to observe the gradual change in form from the outer bracteole to the inner corolla-lobe. The inner calyx-lobe resembles very much the outer corolla-lobe. All the corolla-lobes except the outer one are deeply emarginate. The outer lobe is only slightly so.

Of the specimens cited above no locality was given on the sheet, *Wright 2109*. The quotation "prope Vuelta de Abajo" given in the citation above was taken from Urban's publication.

11. **Laplacea villosa** (Macfadyen) Grisebach, Fl. Brit. W. Ind. 104. 1859. — Walpers, Repert. Bot. Syst. 7: 367. 1868. — Fawcett, Fl. Pl. Jamaica 3. 1893. — Melchior in Nat. Pflanzenfam. ed. 2, **21**: 136.

1925. — Fawcett & Rendle, Fl. Jamaica 5(3): 188. 1926. — Schmidt in Fedde, Rep. Spec. Nov. Reg. Veg. **29**: 16. 1931.

Gordonia villosa Macfadyen, Fl. Jamaica **1**: 117. 1837. — Walpers, Repert. Bot. Syst. **1**: 375. 1842.

Haemocharis villosa (Macfadyen) Choisy in Mém. Soc. Phys. Hist. Nat. Genève **1**: 144 (Mém. Ternstr. 56). 1855. — O. Kuntze, Rev. Gen. Pl. **1**: 62. 1891. — Urban in Bot. Jahrb. **21**: 547. 1896.

Laplacea viscosa Hooker & Jackson, Index Kew. **2**: 30. 1894, *lapsu.*

Wikstroemia Macfadyenii Blake in Contrib. Gray Herb. n. s. **53**: 40. 1918.

Shrub 1.5–3 m. Terminal bud tawny-villous, the young branchlets terete, villous. Leaves coriaceous, pilose beneath, especially along the midrib, obovate, 7–10 cm. long, 3.5–5 cm. wide, obtuse or rounded at the apex, occasionally very short and bluntly acuminate, broadly cuneate at the base, appearing subauriculate, the margin revolute and crenulate, the midrib canaliculate above, raised below, widening toward the base, the veins 8–10 pairs, rather unobtrusive, the petiole thick, 1–3 mm. long, densely pilose on the under surface. Flowers solitary in the upper axils of the leaves; peduncles stout, 5–8 mm. long, pilose; bracteoles quickly caducous; sepals 5, imbricate, deeply concave, rounded, ca. 1.5 cm. long, 1.0–1.7 cm. wide, villous-sericeous, deciduous; petals 5^{+}, obovate, 17–20 mm. long, 10–12 mm. wide, emarginate, pubescent on the external surface; stamens very numerous, pluri-seriate, the filaments unequal, up to 9 mm. long, the anthers oval, 2–2.5 mm. long; ovary villous-sericeous, 5-celled, the loculi 6–7-ovulate, the styles 5, glabrous, ca. 1 mm. or less long. Capsule subligneous, oblong, 2–2.5 cm. long, 1 cm. diam., obtuse, 5-angled at the apex, the seeds "5 in each cell."

JAMAICA: Newhouse Gap, *J. Hart 987* (NY, US), 1886. — Locality indefinite, *J. Hart 351* (US). — Locality indefinite, *Macfadyen s. n.* (G).

This second species from Jamaica, although quite distinct from *L. haematoxylon* (Swartz) G. Don, has been less collected and is not known as well. A comparison of the two species can be found under the latter.

The size of the petals is probably recorded for the first time above. The dissection from boiled material shows them to be considerably smaller than those of *L. haematoxylon* and much less showy.

12. **Laplacea haematoxylon** (Swartz) G. Don, Gen. Syst. **1**: 569. 1840. — Grisebach, Fl. Brit. W. Indies, 104. 1859. — Fawcett, Fl. Pl. Jamaica 3. 1893. — Melchior in Nat. Pflanzenfam. ed. 2, **21**: 136. 1925. — Fawcett & Rendle, Fl. Jamaica 5(3): 188, *fig. 72.* 1926. — Schmidt in Fedde, Rep. Spec. Nov. Reg. Veg. **29**: 17. 1931.

Gordonia haematoxylon Swartz, Fl. Ind. Occ. **2**: 1199. 1800. — Lunan, Hort. Jam. **1**: 461. 1814. — DeCandolle, Prodr. **1**: 528. 1824. — Macfadyen, Fl. Jamaica 116. 1837.

Haemocharis haematoxylon (Swartz) Choisy in Mém. Soc. Phys. Hist. Nat. Genève **1**: 144 (Mém. Ternstr. 56). 1855. — O. Kuntze, Rev. Gen. Pl. **1**: 62. 1891. — Szyszylowicz in Nat. Pflanzenfam. III. **6**: 185. 1893. — Urban in Bot. Jahrb. **21**: 546. 1896.

Wikstroemia haematoxylon (Swartz) Blake in Contrib. Gray Herb. n. s. 53: 40. 1918.

Tree 10–15 m. high. Terminal buds hirsute. Young branchlets pubescent. Leaves membranaceous to subcoriaceous, ovate to elliptic, 5–10 cm. long, 2.5–4 cm. wide, obtuse or obtusely acuminate at the apex, narrowed at the base into a petiole 4–8 mm. long, the margin serrate or crenate-serrate, especially along the upper half, generally glabrescent with inconspicuous hairs along the under side of the petiole and the midrib, the veins rather obscure, 10–12 pairs. Flowers large, solitary in the upper axils, white, ca. 4–6 cm. in diameter when open, ca. 0.6 cm. in diam. in bud; peduncles stout, 2–5 mm. long, puberulent; bracteoles apparently 2, quickly caducous, sepaloid; sepals 5, imbricate, rounded, concave, lightly puberulous on the outer surface, unequal, varying in size from bracteoles to petals, ca. 1 cm. long, 1.2 cm. wide, the margin scarious; petals 5–8, white, obovate, unequal, 2–3 cm. long, varying in width 1–2 cm. on the same flower, the wider petals deeply emarginate, the narrow petals often entire at the apex, subglabrous; stamens apparently 4- or 5-seriate, the filaments glabrous, unequal, the outer row ca. 5 mm. long, connate for various short distances at the base, very rarely joined the entire length, the inner filaments ca. 9 mm. long, not joined, the anthers subrotund, ca. 1 mm. across; ovary globose, hirsute, 5-celled, few-ovulate, styles 5, glabrous, very short, 1 mm. or less long, channeled, spreading at the apex into the stigmas. Capsule woody, oblong, subpentagonal, pubescent, ca. 2 cm. long, 1 cm. or less in diameter, the seeds ca. 3 in each cell, the wing and seed 8–12 mm. long.

JAMAICA: eastern slope of John Crow Mts., woodlands, alt. 520 m., *N. L. Britton 4162* (NY), Mar. 9–11, 1909 (tree 12 m. high; petals white). — Vinegar Hill, alt. 1100 m., *W. Harris 5493* (Ch, NY, US), Nov. 21, 1894 (tree 15 ft. high). — Near Woodcutters Gap, alt. 1450 m., *W. Harris 6736* (A, Ch, US), Nov. 6, 1896 (tree 5 m. high). — Hardware Gap, alt. 1350 m., *W. Harris 10124* (Ch, NY, US), Feb. 19, 1908 (tree 50 ft. high; flowers white). — Tom's River Wood, Upper Clarendon, alt. 800 m., *W. Harris 10852* (Ch, NY, US), Mar. 1, 1910 (tree 40 ft. high; flowers white). — John Crow Mts., alt. 600 m., *W. Harris & N. L. Britton 10763* (Ch, NY, US), Mar. 10, 1909 (tree 36 ft. high; corolla pure white). — Blue Mts., Marces Gap, alt. 1650 m., *J. R. Perkins 1469* (G), Mar. 31, 1916. — Blue Mts. near Marces Gap, alt. 1600 m., *A. Rehder s. n.* (A), Feb. 10, 1903. — Marces Gap, *F. Shreve s. n.* (NY), Feb. 7, 1906. — Indefinite locality, *J. Hart 609* (Ch, US), 1886.

Described under *Gordonia* in 1800, this is the oldest species in the genus. It was referred to *Laplacea* by G. Don in 1840.

Some of the salient characters of the species are: (1) large white flowers, 4–6 cm. across, the petals glabrous or nearly so, the wider petals emarginate at the apex and the narrower petals entire, and (2) the leaves ovate or elliptic, 5–10 cm. long, quite glabrous beneath with occasional scattered pubescence along the lower midrib.

A closely related species, also from Jamaica, is *L. villosa*. The latter species is characterized by a villous pubescence on most of the parts (branchlets, lower surface of the leaves, pedicel, calyx-lobes, and external surface of the corolla). The leaves are obovate, rounded or bluntly acuminate at the apex, and broadly cuneate at the base, appearing subauriculate.

13. **Laplacea portoricensis** (Krug & Urban) Dyer in Index Kew. Suppl. **2**: 86. 1904. — Melchior in Nat. Pflanzenfam. ed. 2, **21**: 136. 1925. — O. C. Schmidt in Fedde, Rep. Spec. Nov. Reg. Veg. **29**: 17. 1931.

Haemocharis portoricensis Krug & Urban in Bot. Jahrb. **21**: 548. 1896. — Urban, Fl. Ind. Occ. **4**: 411. 1910. — Britton & Wilson, Sci. Surv. Porto Rico & Virgin Isl. **5**: 582. 1924. — L. R. Holdridge in U. S. D. A. For. Serv. Occ. Pap. (Trees Puerto Rico 2) **2**: 53, *fig.* 1942.

Wikstroemia portoricensis (Krug & Urban) Blake in Contrib. Gray Herb. n. s. **53**: 40. 1918.

Tree 5–20 m. high with gray, fissured bark. Terminal leaf-bud appressed-pubescent, elongate. Younger branchlets finely appressed-pubescent, the older branchlets becoming glabrous. Leaves chartaceous or subchartaceous, elliptic to obovate, 5–12 cm. long, 2.5–4.5 cm. wide, obtuse to rounded at the apex, occasionally slightly emarginate, long-tapering at the base, glabrous above, glabrescent (rarely appressed-pubescent) below, the margin crenulate along the upper half, entire along the lower portion, the midrib canaliculate above, the veins 15–20 pairs, rather inconspicuous above, prominent below, anastomosing near the margin and becoming reticulate, the petiole 2–5 mm. long. Flowers solitary near the apex, axillary; peduncle short, 1–4 mm. long, appressed-pubescent; bracteoles quickly caducous; sepals unequal, the larger or inner sepals suborbicular, 10–12 mm. long, sericeous on the external surface; petals 6–9, white, obovate, unequal, 18–22 mm. long, 15–18 mm. wide, some deeply emarginate at the apex, others rounded, glabrous on the external surface, the outer petals thickened in the medial area; stamens 3–4-seriate, many (over 100), the filaments glabrous, unequal, 5–7 mm. long, the anthers ovate to subglobose, ca. 1 mm. long; ovary globose, white-tomentose, 6–10-celled, tapering at the apex into the 5 or more glabrous styles, the stigmas recurved, reniform. Capsule woody, narrow-ovate, 15–25 mm. long, ca. 10 mm. diam., short-appressed-pubescent to glabrescent, 6–10-celled; seeds 4 or 5 in each cell, 10–13 mm. long with wings.

Porto Rico: El Yunque, *F. H. Sargent 541* (US), July 4, 1938 (tree). — Catalina-Yunque Trail, Luquillo Mts., in forest, alt. 600–850 m., *N. L. Britton & E. M. Bruner 7579* (NY, US), *7604* (NY), Feb. 23–26, 1923 (tree 10 m. high; petals white, fugacious). — Jajoma Alta, *W. E. Hess 5591* (NY), Dec. 3, 1913. — Sierra de Naguabo, Loma Icaco, edge of woods, alt. 210–675 m., *J. A. Shafer 3426* (NY, US), July 24, 1914 (tree 30 ft. high; corolla white). — Sierra de Naguabo, Rio Icaco and adjacent hills, forest, alt. 465–720 m., *J. A. Shafer 3517* (G, Mo, NY, US), July 30-Aug. 5, 1914 (tree 25 ft. high). — Sierra de Naguabo, Barrio de Maizales, mountain forest, alt. 900 m., *N. L. Britton & W. E. Hess 2277* (Ch, G, NY, US), March

9, 1914 (tree 15 m. high; flowers white, 4 cm. wide). — Sierra de Luquillo, Jimenez, in mountain forest, *P. Sintenis 1326* (Ch, G, Mo, NY, US), May 26, 1885. — Sierra de Naguabo, in primary forest, *P. Sintenis 5318* (Ch, G, Mo, NY, US), Nov. 5, 1886. — Coco Valley, Maricao Verde, *L. E. Gregory 57* (NY), Aug. 2, 1940 (tree 14 ft. high). — Indefinite locality, *A. A. Heller s. n.* (Ch, NY), 1910.

Of the above cited specimens, *Sintenis 1326* and *5318* and *Heller s. n.* were cited by Krug & Urban in the original publication of this species. No specimen was designated as the type. Krug & Urban carefully distinguished between pistillate and staminate flowers. I sought both types but was unsuccessful in finding any that could be designated as either pistillate or staminate. The flowers dissected for this study possessed not only developed ovary, style, and stigma, but also anthers (over 100) which had produced pollen. Krug & Urban state that in the staminate flowers the stamens were 3–4-seriate, the filaments 5–7 mm. long, the styles 1.5 mm. long, and the stigmas scarcely evolute. The pistillate flowers were described as having filaments 4 mm. long and the anthers without pollen. The styles were designated as 2.5–3 mm. long, and the stigmas as reniform, recurved. The individual flowers which I examined possessed all the fertile characters listed by these authors.

Some of the distinctive characters of this species are: (1) the pubescent terminal leaf-bud; (2) chartaceous leaves with prominent veins (15–20 pairs) underneath, which anastomose near the margin and form a conspicuous network near the margin; (3) the 6–10-celled ovary and fruit with 5 or 6 styles; (4) glabrous petals, emarginate or obtuse at the apex, thickened at the median portion; and (5) the very numerous stamens 3–4-seriate. Another leaf-character, usually present, which is distinctive, is a pair of lines midway between the midrib and the margin and somewhat parallel to the margins of the leaves. This probably is caused by the folds of the leaf in the bud. In some species of other genera of the Theaceae, especially in species with a noticeable pubescence on the under surface, this character is more pronounced because of a heavier growth of pubescence along this line. Other species exhibit more than a single pair of lines.

According to L. R. Holdridge (loc. cit.) this species is restricted to the eastern mountains of Porto Rico above 300 m. in elevation. So far as is known, *L. portoricensis* is the sole representative of the genus in Porto Rico. Vernacular names are *Maricao verde* and *Maricao*.

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THE MORPHOLOGY AND RELATIONSHIPS OF CERCIDIPHYLLUM

B. G. L. Swamy and I. W. Bailey

With two plates and eight text-figures

INTRODUCTION

Of the five formerly associated genera, *Trochodendron, Tetracentron, Euptelea, Cercidiphyllum* and *Eucommia,* the first three have recently been thoroughly re-investigated by A. C. Smith (29, 30), Bailey and Nast (3) and Nast and Bailey (24, 25). The totality of evidence from all organs and parts of these plants indicates that, although the vesselless genera *Trochodendron* and *Tetracentron* are related, they exhibit no close affinities either to *Euptelea* or to the Magnoliaceae (*sensu stricto*), Winteraceae, Illiciaceae, or Schisandraceae.

There has been much speculation regarding the relationships of *Cercidiphyllum,* and it is desirable that this genus also be re-examined from a broad morphological point of view.

LEAF: EXTERNAL FORM

One of the most conspicuous characteristics of *Cercidiphyllum japonicum* Sieb. et Zucc. is its dimorphic foliage, *Fig. 1.* The broadly cordate or reniform, palmately veined leaves with crenate margins, that are referred to in the generic name as Cercis-like, are borne on short shoots. On the contrary, the long shoots of the current year's growth bear leaves which fluctuate from elliptic to deltoid to broadly ovate and have entire or finely rounded-serrate margins. In leaves of the short shoots (*d-i*), the primary veins diverge from a single locus at the base of the leaf, whereas in leaves of the long shoots (*j-p*), they frequently diverge in pairs at successive levels. Although both kinds of leaves fluctuate considerably in size, the ranges of variability in form, venation, and character of the margin are much wider in the case of the leaves of the long shoots than in those of the short shoots. The leaves of seedlings have fewer marginal glands and therefore fewer and relatively much coarser appearing crenulations (*b-c*). The cotyledons are oblong-obtuse with entire margins (*a*).

Brown (5) has performed a highly significant paleobotanical task in re-investigating fossil floras and in demonstrating by the occurrence of associated fruits, seeds and leaves that *Cercidiphyllum* was widely distributed in the Northern Hemisphere during the Upper Cretaceous and Tertiary. The fossil leaves had previously been assigned to twenty-one different genera, including *Boehmeria, Ceanothus, Cercis, Cissus, Dombeyopsis, Ficus, Grewia, Hakea, Hedera, Paliurus, Piper, Populus, Smilax, Viburnum,* and *Zizyphus,* and the fruits and seeds to suggested relation-

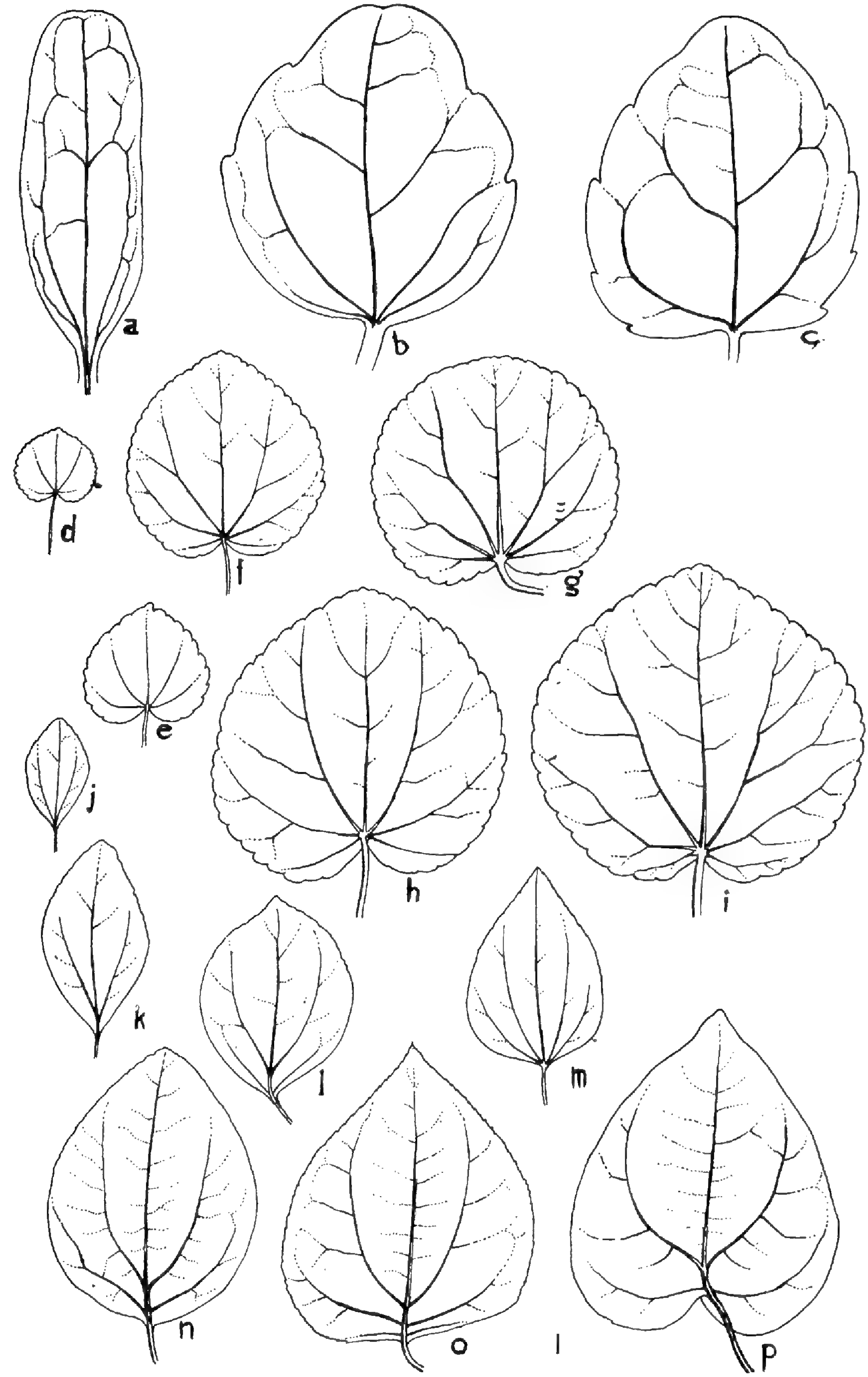


FIG. 1. a-c. Cotyledon and seedling leaves, *a*, × 7, *b*, × 6, *c*, × 5. *d-i*. Outline tracings of the leaves of the short shoot, × ½. *j-p*. Same, of long shoot, × ½. In each figure, only the prominent veins are shown.

ships with such diversified plants as the conifers, palms, Leguminosae, Nyssaceae, Tiliaceae, Proteaceae, etc.

In view of the obvious polymorphism of the leaves of the surviving species of *Cercidiphyllum,* and in order to avoid overloading the literature with a host of fossil species based upon minor variations of leaf morphology, Brown recognized four fossil species based upon norms of foliar form; (1) elliptic to broad-ovate-elliptic with rounded or cuneate base in *C. ellipticum* (Newberry) Brown of the Upper Cretaceous and Paleocene, (2) deltoid with tendency to elongate apex and incipient cordate base in *C. arcticum* (Heer) Brown from the Paleocene to the middle Eocene, (3) elongate broad-lanceolate with cordate base in *C. elongatum* Brown from the middle or late Eocene to the upper Oligocene or lower Miocene and (4) cordate, slightly elongate and asymmetric in *C. crenatum* (Unger) Brown from the Oligocene to the late Miocene.

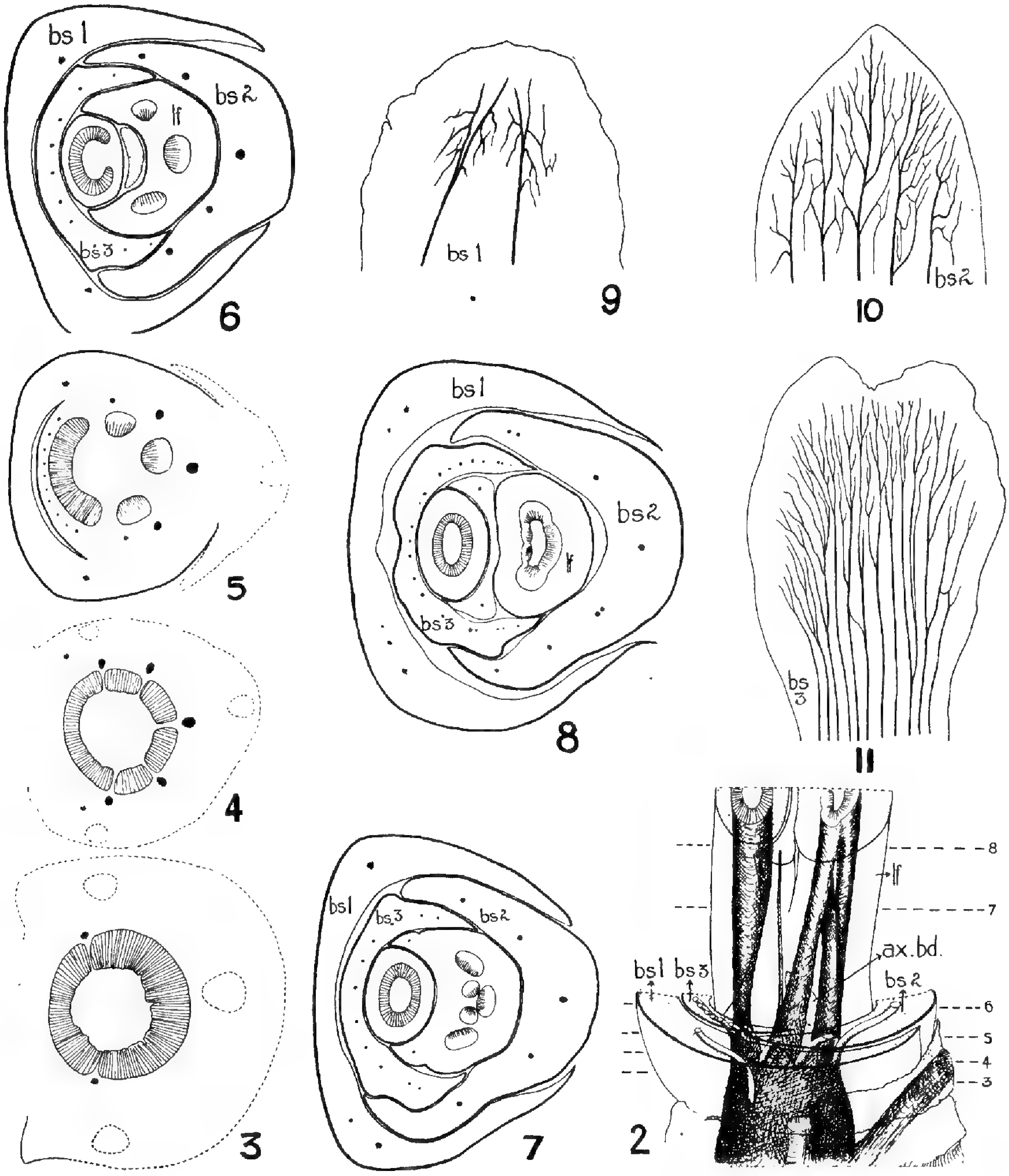
Although all five species of *Cercidiphyllum* exhibit wide ranges of foliar variability, it is evident that the frequency of occurrence of specific leaf forms changes in passing from the Upper Cretaceous *C. ellipticum* to the living *C. japonicum.* The broadly cordate leaves with crenate margins that Brown adopts as the norm of the latter species occur on the short shoots, whereas the leaves of the long shoots exhibit a much wider range of morphological variability which simulates that which occurs in the older fossil species. It appears likely that one of the extreme variant forms of the ancestral species may have stabilized on the short shoots of *C. japonicum* and possibly also of *C. crenatum.* This suggests that all of the leaves of *C. ellipticum* and *C. arcticum* may have been borne on long shoots. In any case, there are two norms of foliar form in *C. japonicum,* one characteristic of the short shoots and the other of the long shoots; the ratios of the two types of leaves fluctuating on a tree during successive parts of a growing season.

LEAF: VASCULATURE

Each of the cotyledons of *C. japonicum* is vascularized by two dichotomizing strands, the central branches of the dichotomies fusing to form the midvein of the cotyledon, *Fig. 1a.* The two strands are related to a single gap in the eustele of the cotyledonary node, *Fig. 55.* On the contrary, each of the paired primary leaves of the seedling is vascularized by three strands that are related to three separate gaps in the eustele, *Fig. 56.* The leaves of subsequently formed long shoots similarly are vascularized by three strands that are related to trilacunar nodes, *Fig. 57.* In contrast the leaves of the short shoots differ markedly in having three strands that are related to unilacunar nodes, *Figs. 5, 6.* The three strands behave similarly, however, in the petiole and lamina of leaves of both long and short shoots. In the basal part of the petiole two branches of the median strand pass* into an adaxial position with inverted orienta-

*The phraseologies used in this paper are descriptive of changes observed in successive serial sections and have no implications regarding ontogenetic or directional differentiation of the vascular elements.

tion of xylem and phloem, *Figs. 7 and 58.* These small strands with the three larger ones become aggregated into a vascular cylinder, *Figs. 8 and 59,* which extends throughout the central part of the petiole. Toward the base of the lamina, this vascular cylinder becomes invaginated on its adaxial side, *Fig. 60,* and gives rise to from five to seven U-shaped or concentric strands, *Figs. 61 and 62,* that constitute the primary veins of the palmate lamina.



FIGS. 2–11. *Fig. 2.* Diagrammatic reconstruction of the pattern of vasculature of a short shoot. *Figs. 3–8.* Transverse sections of the short shoot at levels as indicated by corresponding numbers in *Fig. 2. Figs. 9–11.* Drawings made from cleared preparations of the first, second and third bud scales to show the method of vascularization. (*bs1* — outermost bud scale; *bs2* — inner bud scale; *bs3* — innermost bud scale; *lf* — leaf; *ax. bd.* — axillary bud.)

LEAF: MISCELLANEOUS STRUCTURES

As observed and figured by Harms (13), there is a precocious development of concrescent stipules and large marginal glands even in leaf primordia that are still enclosed within the bud. As the leaf expands the adaxially oriented, conspicuously forked stipular appendage drops off and the glistening, hyaline glands abort, leaving more or less conspicuous depressions in the margin of the matured leaf. As noted by Solereder (31), the stomata are confined to the lower epidermis and are surrounded by from four to six ordinary epidermal cells. Rarely, however, one or two of the latter cells may undergo anticlinal division to form cells of smaller dimensions. The leaves do not contain secretory idioblasts or sclereids, nor do they form characteristic types of hairs or trichomes.

"FLOWER BUD" OF THE SHORT SHOOT

The bud of the sympodially elongating short shoot has three conspicuous reddish scales. The outermost of these (*bs1*) is connivent, viz. oriented with its dorsal side toward the main axis of the preceding year's growth, *Figs. 2, 6, and 8.* The second scale (*bs2*) is opposite the first and the third (*bs3*) in conformity with the first. A leaf (*lf*) with a bud (*ax bd*) in its axil forms opposite the innermost scale. The inflorescence is terminal. Thus, each year's elongation of the short shoot is produced by the activity of an axillary bud.

The outermost bud scale (*bs1*) contains two main veins that are related to two widely separated lacunae of the vascular cylinder, *Figs. 3–7.* These veins remain unbranched for some distance and then bifurcate, *Fig. 9.* Most of the branches arising from the veins tend to spread in a downward direction. The second bud scale (*bs2*) has five main veins that are associated with a corresponding number of lacunae, *Figs. 4–8.* The veins branch more or less profusely in the lamina and the branches anastomose forming a reticulate system, *Fig. 10.* The innermost bud scale (*bs3*) is supplied with from seven to eleven veins, arising from closely spaced but distinct lacunae, *Figs. 4–8.* The veins run parallel for a greater distance in the bud scale and then branch in a predominantly dichotomous manner, *Fig. 11.*

The parenchymatous tissue between the stelar bundles that alternate with those of the third bud scale soon become bridged by the activity of the cambium, and at a higher level the stele appears as a continuous arc on the adaxial side, *Fig. 5.* Conversely, on the side of the second bud scale, cambium fails to differentiate in the inter-fascicular regions excepting in the parenchyma flanking the median vein of the second bud scale. Thus, the vasculature on this side (right hand side in *Fig. 5*) becomes organized into three large strands. These enter the petiole, *Fig. 6.* It is evident, accordingly, that the three veins of the leaf of the short shoot are related to a single lacuna of the eustele in contrast to the nodal situation of the long shoot, where the three veins are related to three separate lacunae, *Figs. 56, 57.* The arc-shaped segment of the stele on the side of the third bud scale soon becomes cylindrical, *Figs. 6, 7,* and continues into the reproductive axis.

THE FEMALE INFLORESCENCE

The reproductive axis is highly condensed and bears either carpels or stamens in conformity with the unisexuality of the plant. In the female inflorescence, the axis bears from two to six carpels, whose ventral sutures are characteristically directed away from the axis, *Figs. 12, 16.* At first sight the carpels seem to be aggregated in a cycle, but a careful examination reveals a more or less decussate arrangement, *Fig. 12.* Each carpel is subtended by a membranous bract. The relation of bracts to carpels is especially significant in those instances where more than four carpels are involved. As noted by Harms (13) and as is evident in *Fig. 20,* the bracts of the inner two "pairs" of carpels are distinct, originate at higher levels and do not represent parts of a single involucre.

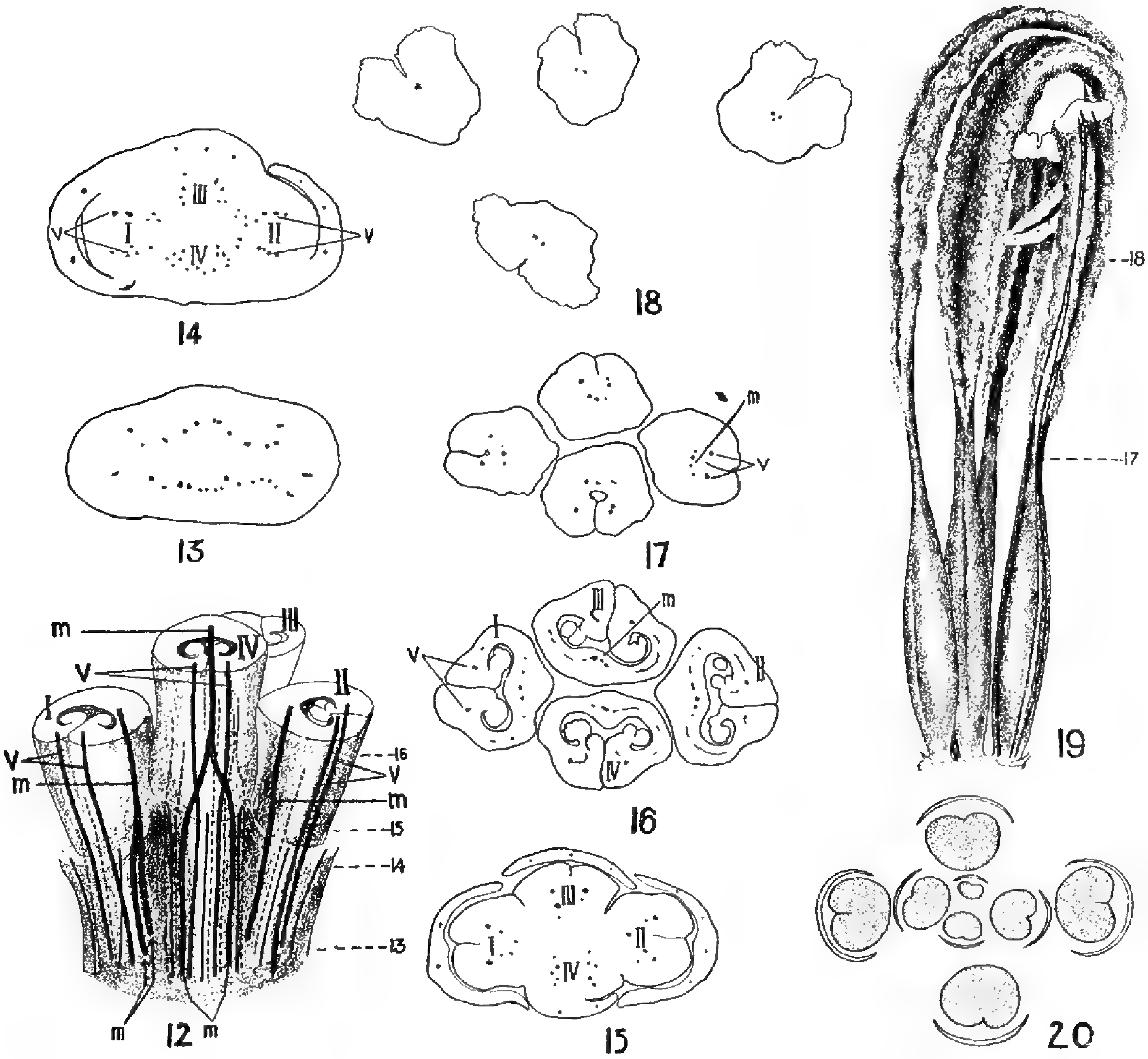
The shape, size and vascular supply of the bracts vary considerably. The bracts related to the outermost carpels generally are larger and more deeply lobed than those accompanying the inner carpels. The larger bracts usually receive three veins from the eustele of the reproductive axis, *Figs. 13, 14;* however, either the median or a lateral may be absent. The bracts subtending the inner carpels very rarely receive all three veins. Especially when the bracts are very much reduced, they may be unvascularized.

The carpel of *Cercidiphyllum* exhibits a particular trend of specialization of the primitive conduplicate megasporophyll* of the Tasmannia-Degeneria type. It has acquired a much elongated form with a cylindrical ovule-bearing part and a long slender style having two extensively "decurrent" stigmatic ridges, *Fig. 19.* The external double stigmatic crests of the Tasmannia type have been completely eliminated from the fertile part of the carpel, and the inner ventral surfaces beyond the placentae remain tightly adpressed, *Figs. 12, 16,* until dehiscence of the fruit. The stigmatic part of the carpel exhibits some flaring of the conduplicate surfaces, *Fig. 18.*

A reproductive axis bearing four carpels is illustrated in *Figs. 12–19.* After vascularization of the bracts, the bundles of the eustele resolve themselves into four groups, *Fig. 14* (*i, ii, iii, iv*). The peripherally situated bundles of each group (marked *v* in the figures) form the ventral veins of the corresponding carpels. The bundles that are situated towards the interior of the groups (marked *m* in the figures) give rise to the median vein. In the majority of cases, a single bundle from the stele departs into the carpel as its median vein, as in the carpel marked *ii* in the figures. Frequently, however, the median vein may be a fused product of two distinct stelar bundles, as in the carpels marked *i* and *iv* in the figures. Carpels exhibiting one or the other of these types of median veins fluctuate widely in distribution; some reproductive axes may have one type or both

*It seems wise to retain the terms megasporophyll and microsporophyll for descriptive purposes in dealing with the broader forms of angiospermic fertile appendages, without implications of their derivation from leaves.

types in varying proportions. A few of the remaining stelar bundles of each group disappear at the bases of the respective carpels, although some of these veins may occasionally traverse the tissue of the carpel for a short distance (such veins are indicated by broken lines in *Fig. 12*).

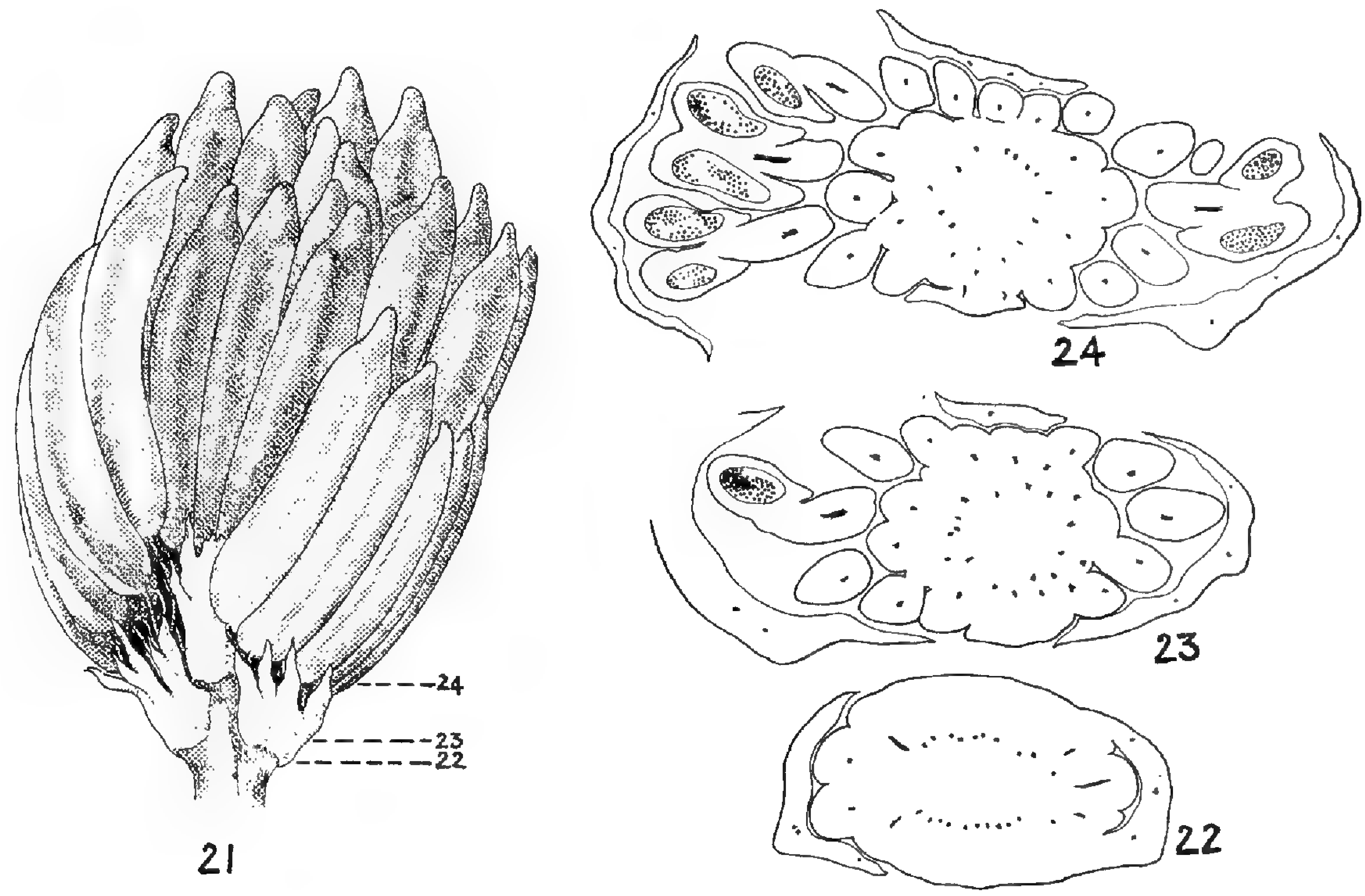


FIGS. 12–20. *Fig. 12.* Three-dimensional drawing of the vascular system of the female reproductive axis and carpels (vasculature of carpel marked III is not shown). *Figs. 13–18.* Transverse sections of the female reproductive axis and carpels as indicated by corresponding numbers in *Figs. 12* and *19*. *Fig. 19.* Four carpels from a reproductive axis, showing the general form. Vasculature is shown only for the carpel on the right-hand side. *Fig. 20.* An optical transverse section of a female reproductive axis bearing eight carpels, showing the relationship of the carpels and bracts. (*m* — median vein of the carpel; *v* — ventral vein).

It may be noted that generally a larger number of stelar bundles are aggregated below the ultimate carpel (number *iv* in the case illustrated in *Figs. 12, 14*). In addition to forming the median and ventral veins of the carpel, many of these bundles continue into the base of the carpellary wall (veins indicated by broken lines in carpel *iv, Fig. 12*). Within the carpel, the median vein gives off lateral branches that spread in the ovary wall. The ventral veins, after vascularizing the ovules, extend upward in the style for more than half its length, *Fig. 17;* (also, carpel on the right hand side in *Fig. 19*).

THE MALE INFLORESCENCE

The male reproductive axis terminates in a cluster of stamens, subtended not infrequently by four membranous bracts corresponding to those associated with the carpels. It is important to note that the bracts tend to be arranged in opposite pairs on the reproductive axis, at slightly different levels and not in a truly cyclic manner, *Figs. 21, 22.* Furthermore, each bract appears to subtend an individual aggregation of stamens, the number of stamens in each aggregate varying from 8 to 13. The relation of the bract to the aggregation of stamens is particularly evident in the lower part of the axis, *Fig. 21.*



FIGS. 21–24. *Fig. 21.* Male reproductive axis. Note the arrangement of stamens in bunches, each bunch being related to a bract. *Figs. 22–24.* Transverse sections of the same from levels as marked by corresponding numbers in *Fig. 21.*

Although each bract in general is supplied with three vascular strands from the stele of the reproductive axis, the range of variation cited in connection with the bracts of the female reproductive axis is often encountered here also. After the vascularization of the bracts, the remaining bundles of the stele soon become centrifugally distributed, and each bundle supplies a single stamen, *Figs. 22–24.*

In the young condition, before the opening of the bud scales, the stamens have relatively long anthers and very short "filaments," *Fig. 21.* On the contrary, at anthesis the "filaments" become greatly elongated and are nearly as long or even longer than the anthers. The "connective" is much reduced and the elongated sporangia are oriented in a latrose position. However, the microsporophyll broadens beyond the sporangial region forming a short conical apex. The staminal vascular bundle runs unbranched almost to the distal extremity of the stamen.

NATURE OF THE "FLOWERS"

As emphasized by Solereder (31) and subsequently by Harms (13), the abaxial orientation of the ventral sutures of the carpels in *Cercidiphyllum japonicum* is a serious, if not an insuperable, obstacle to interpreting the female reproductive structures as a single flower. A detailed study of successive stages in the development of carpels and fruits reveals no evidence of "twisting," Hutchinson (18), or resupination. Furthermore, the vascularization pattern of the reproductive parts negates any assumption of torsion or rotation. As previously indicated the ventral veins of the carpel are derived from bundles situated toward the periphery of the axis whereas the dorsal vein arises from a more centrally situated bundle or bundles, *Figs. 14, 15*. The decussate arrangement of paired carpels with their subtending bracts — particularly where six carpels are present — invalidates any interpretation of the bracts as parts of a single involucre, as noted by Harms (13).

That the reproductive structures of *Cercidiphyllum japonicum* were actually derived by extreme reduction of an inflorescence is clearly demonstrated by paleobotanical evidence, Brown (5). In *Cercidiphyllum ellipticum, C. arcticum* and *C. elongatum* the fruits were borne on a much elongated axis and in the case of the first species on a branching inflorescense. Indeed, Brown concludes that "The fruits, at least in the early species, were borne in racemes, the individuals being indiscriminately alternate and opposite in the same raceme." Thus, each carpel of *C. japonicum* represents the vestige of a much reduced female flower and by homology each of the smaller aggregates of stamens with its subtending bract is the remains of a single male flower.

Two different trends in the reduction of the female flower to a single carpel with a subtending bract have been suggested by Solereder (31) and Harms (13). The two possibilities are graphically illustrated in *Fig. 25*. According to Solereder, the ancestral female flower of *Cercidiphyllum* might have possessed at least two carpels whose ventral sutures faced one another, *Fig. 25,A*. In each flower, the particular carpel which has its ventral suture adaxially oriented disappeared during subsequent evolution, *Fig. 25,B,* and the carpel which has its ventral suture abaxially oriented survived, *Fig. 25,C*.

On the contrary, Harms emphasized the similarity between the orientation of the carpel on the axis of the reduced inflorescence and that of the first bud scale on the vegetative axis. He hypothesized that the bud scale became fertile and transformed into a carpel and that the vegetative leaf or its stipular appendage became the subtending bract of the carpel, *Fig. 25,D-F.*

Both of these suggestions are obviously highly speculative, but Solereder's concept is preferable owing to its directness and simplicity, involving merely loss of parts and not calling upon complex transformations of bud scales into carpels and of leaves into bracts. Unfortunately there are no reliable data available for thoroughly substantiating what actually occurred. Although the supernumerary bundles at the base of the carpels are indicative of a loss of parts, reduction has progressed to a stage where it is impossible to determine with certainty the number and character of the appendages that may have been eliminated. Through the courtesy of Dr. Roland W. Brown, we have been able to examine the inflorescences of fossil species. Some of these bear paired carpels (fruits), but the preservation of the material is such (compressions and casts) that there is no conclusive evidence to indicate whether the ventral sutures of the paired carpels face one another or are oriented as in the much compressed inflorescence of *C. japonicum.* The discovery of favorably preserved material may clarify the issue.

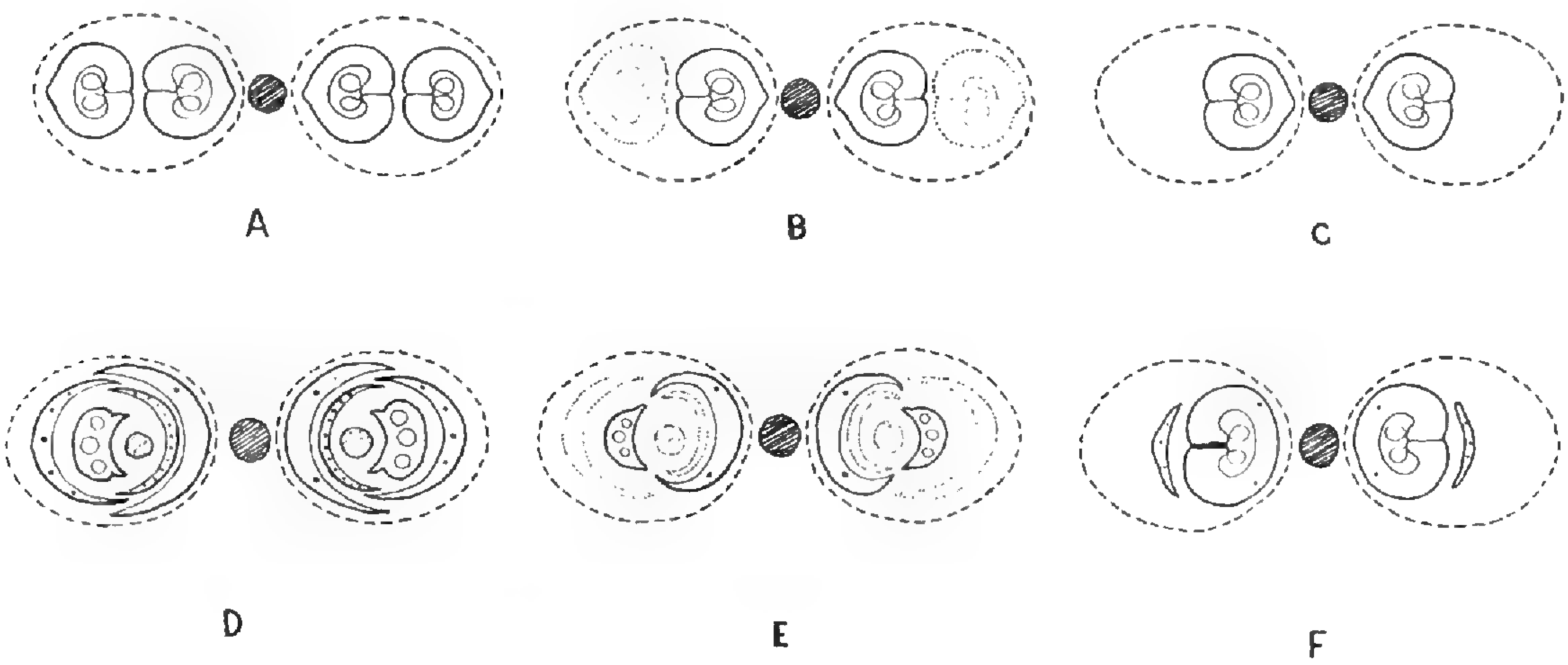


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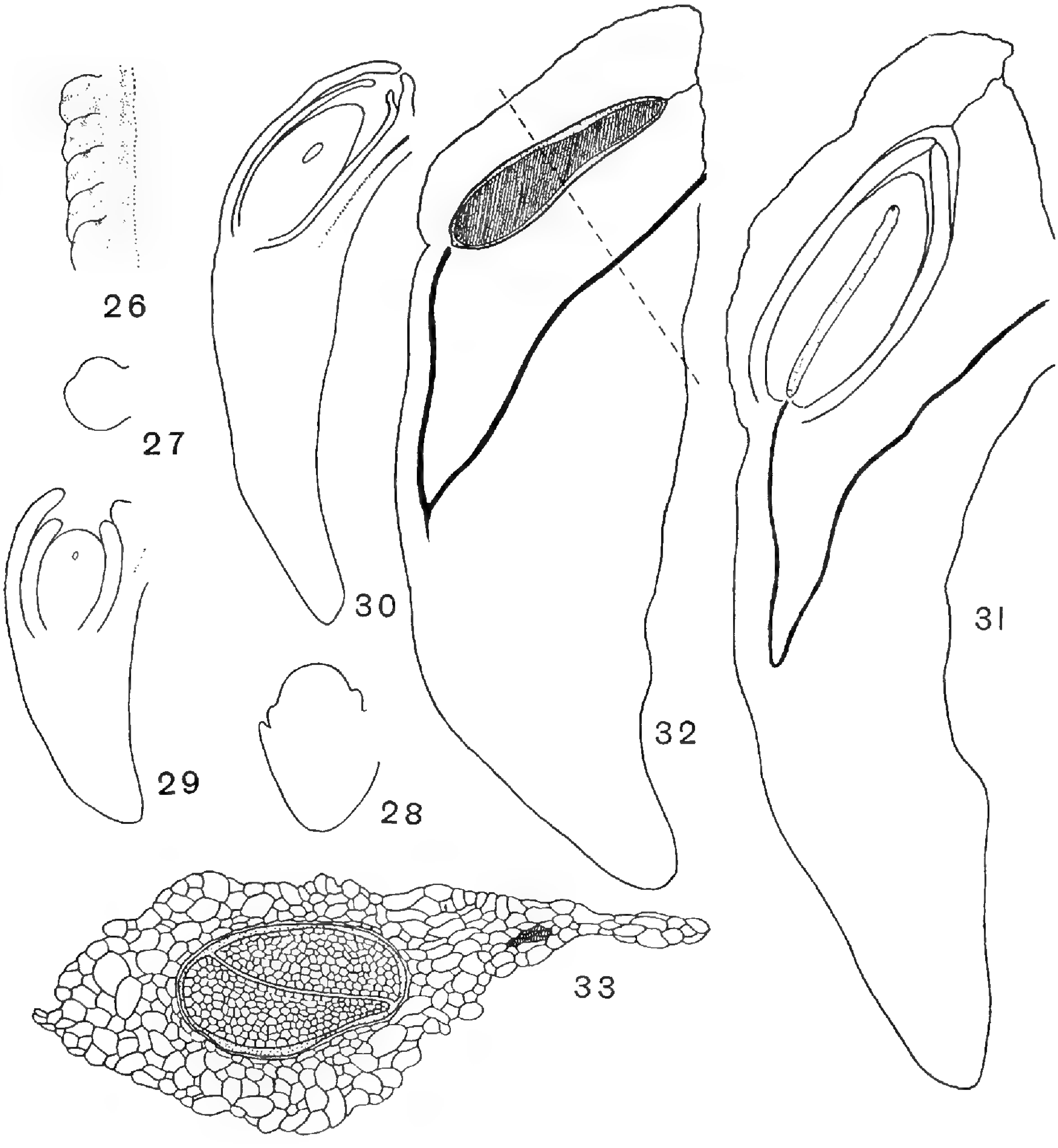
FIG. 25. Schematic representation of the two interpretations of the "flower" of *Cercidiphyllum.* A-C conveys Solereder's view and D-F, that of Harms.

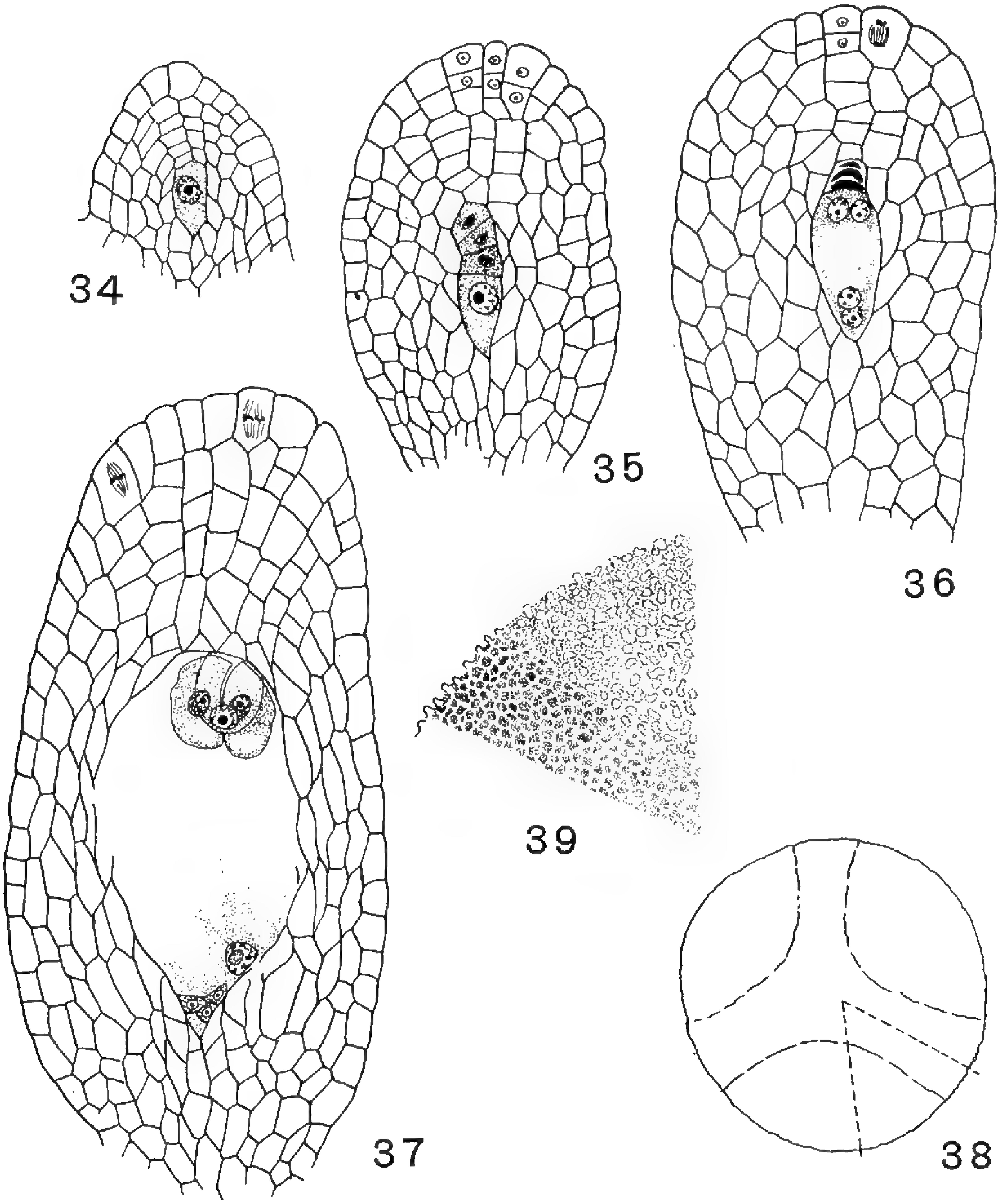
EMBRYOLOGY

A single row of ovular primordia originates on each placenta. At first, the ovules appear as tiny knobs, *Fig. 26,* and even before the differentiation of the integuments, assume an orientation more or less parallel to the placenta, *Fig. 27.* During the development of the integuments, *Fig. 28,* the chalazal end of the ovule grows at a very rapid rate in the form of a flattened tapering projection, *Figs. 29–32,* which later develops into a wing. The differentiation of the vascular bundle in the ovule is rather late. The procambium of the bundle appears first in the funicular region, when the embryo sac is already in the 2- to 4-nucleate stage, *Fig. 29.* Even at the time of fertilization, the procambium does not extend as far as the nucellus, nor have many of the constituent cells of the bundle become differentiated as spiral elements, *Fig. 30*. It is only after fertilization that the bundle undergoes a rapid and complete development. It first proceeds in the direction of the chalaza, and in the middle of the wing takes a circuitous course to reach the base of the nucellus, *Figs. 31, 32*.



FIGS. 26–33. *Fig. 26.* Ovular primordia on a placenta as seen in dissected preparations, × 70. *Fig. 27.* Longitudinal section of an ovular primordium at a slightly later stage than in the previous figure, × 35. *Fig. 28.* Same, at the time of the origin of integuments, × 35. *Fig. 29.* Longitudinal section of an ovule when the megaspore mother cell is differentiating in the nucellus, × 35. *Fig. 30.* Same, at the time of fertilization, × 35. *Fig. 31.* Same, at an early stage in the formation of the endosperm, × 35. *Fig. 32.* Longitudinal section of a mature seed, × 20. *Fig. 33.* A section of the seed passing along the broken line in *Fig. 32,* × 70.

The two integuments arise more or less simultaneously, *Fig. 28*. The outer integument grows beyond the inner, *Fig. 29*, and both the integuments take part in the construction of the micropyle, *Fig. 30*. The inner integument is from two to three layers of cells in thickness and the outer from four to five layers of cells at the time of anthesis. During subse-



FIGS. 34–39. *Fig. 34.* Longitudinal section of the nucellus showing the megaspore mother cell, × 240. *Fig. 35.* Same, showing linear tetrad of megaspores, × 240. *Fig. 36.* Same, showing 4-nucleate embryo sac, × 240. *Fig. 37.* Same, showing mature embryo sac, × 240. *Fig. 38.* Outline drawing of the polar view of a pollen grain, × 1500. *Fig. 39.* Portion of the pollen grain, enclosed within the broken lines in *Fig. 38,* enlarged to show the sculpturing, × 3000.

quent development, the inner integument becomes crushed and the outer one undergoes certain modifications which will be described in connection with the seed.

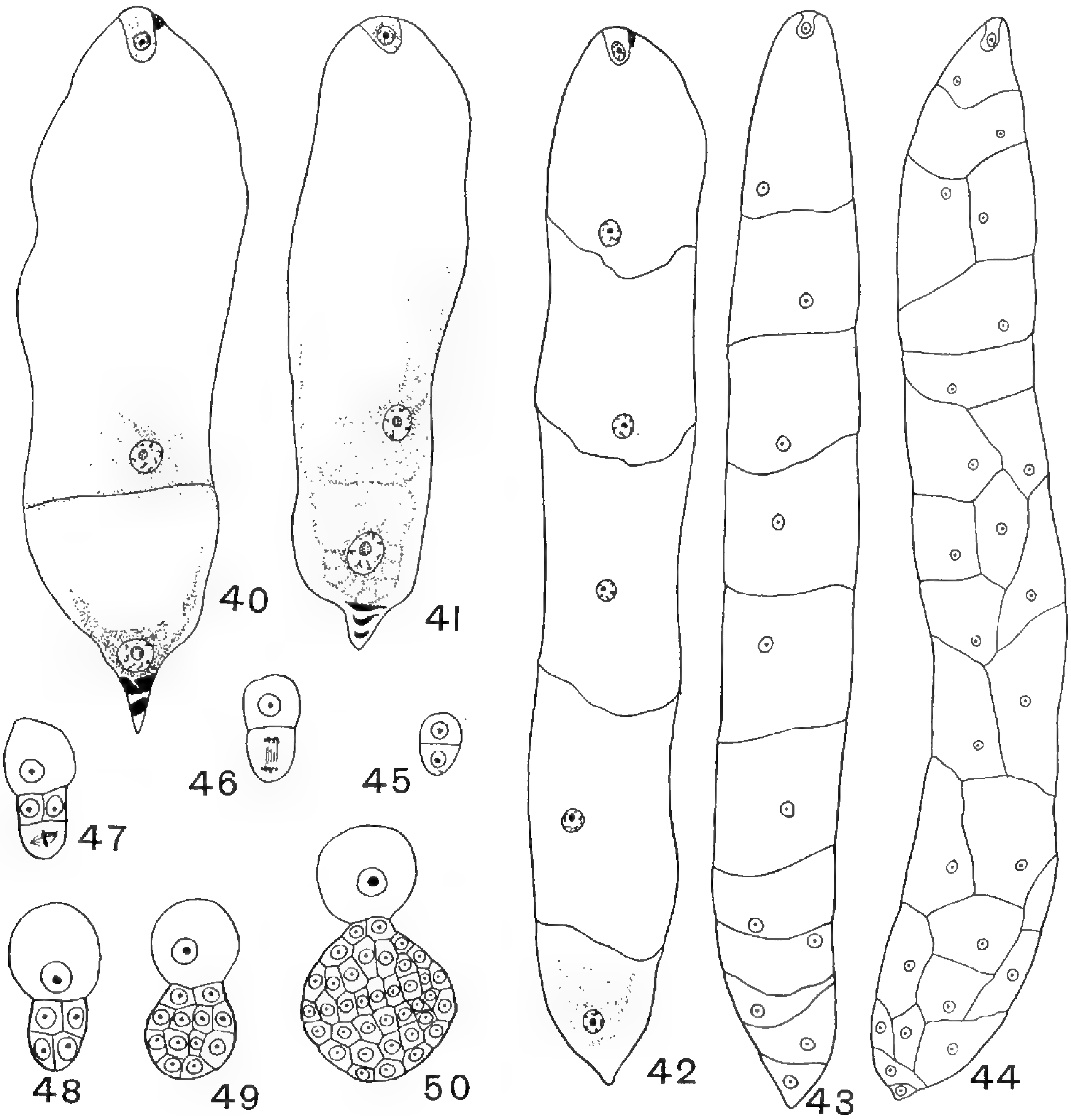
The primary archesporial cell differentiates in the hypodermal layer of the nucellus and divides by a periclinal wall into primary parietal and sporogenous cells. The former cell further divides in the same plane to give rise to from four to five parietal cells, *Fig. 34.* The epidermal cells capping the parietal tissue also undergo periclinal divisions to produce two or three additional layers that merge with the nucellus, *Figs. 35–37.* The sporogenous cell functions as the megaspore mother cell, *Fig. 34.* It divides meiotically to produce a linear tetrad of megaspores, *Fig. 35,* the chalazal megaspore further developing into the 8-nucleate embryo sac, *Figs. 36–37.* The antipodal nuclei organize into cells and the polar nuclei fuse before fertilization, *Fig. 37.*

The structure of the anther and the development of the male gametophyte do not deviate from the usual method known for the majority of dicotyledons. The anther tapetum is of the binucleate and secretory type. Microspore tetrads are formed by a simultaneous method of reduction divisions. After the formation of the vegetative and generative cells, the microspores are ready to be shed, and the division leading to the formation of the gametes takes place in the pollen tube.

The spherical and tricolpate pollen grains of *Cercidiphyllum* are very distinctive. The furrows are so broad that they occupy more than half the surface of the grain, *Fig. 38.* It frequently is difficult to determine where the furrows begin and where the exine ends. The exine is finely pitted. The floor of the furrow is flecked with minute granulations, *Fig. 39.*

After fertilization, the embryo sac expands in a direction parallel to the long axis of the ovule. The primary endosperm nucleus moves towards the chalazal end of the sac and divides; the division being followed by the deposition of a wall. As a result, the embryo sac becomes transversely partitioned into a larger micropylar chamber and a smaller chalazal cell, *Fig. 40.* The latter often shows a denser accumulation of cytoplasm with characteristic vacuolation, *Fig. 41.* However, by the time the upper chamber divides into four to six cells, *Fig. 42,* the cytoplasm of the chalazal cell thins down and the cell begins to divide. The early divisions in both the cells of the 2-celled endosperm, *Figs. 40, 41,* take place essentially by transverse walls until from two to twelve endosperm cells are formed, *Fig. 43.* Simultaneously with these divisions, the embryo sac undergoes considerable longitudinal stretching and presents a very much elongated structure as shown in *Figs. 42–44;* so that the antipodal end of the embryo sac comes in contact with the vascular bundle of the ovule, *Fig. 31.* Subsequent divisions in the endosperm cells take place in various oblique planes, *Fig. 44,* and finally produce a compact mass of nutritive tissue, a large proportion of which, however, is used up by the embryo.

The zygote divides only after the endosperm cells begin dividing in oblique planes, as represented in *Fig. 44*. The basal cell of the 2-celled proembryo, *Fig. 45,* does not divide further but undergoes conspicuous enlargement, *Figs. 47–50*. The terminal cell divides by a wall parallel to the first, *Fig. 46,* so that the proembryo now consists of a linear row of three cells. The next division in the two derivatives of the terminal cell



FIGS. 40–50. *Figs. 40–44.* Stages in the development of the endosperm, × 140. *Figs. 45–50.* Stages in the development of the embryo, × 560.

takes place by vertical walls, *Figs. 47, 48*. Subsequent divisions in these cells result in the quadrant and octant stages, which by further development give rise to the mature embryo. At the stage of dispersal of the seed, the embryo is well differentiated and possesses a long hypocotyl and two cotyledons that enclose the primary shoot apex. A few layers of endosperm cells may persist as remnants around the embryo, but are insignificant, *Figs. 32, 33*.

In the mature seed, the outer integument becomes slightly compressed in the plane of the flattened wing; therefore, the chalazal wing appears to be extended on either side of the seed, *Fig. 33*. In the chalazal region of the wing, the cells are unequally and variously enlarged so as to present a more or less spongy texture. The vascular bundle retains its downwardly projecting loop, *Fig. 32*.

SECONDARY XYLEM AND PHLOEM

The secondary xylem of *C. japonicum* has been described by a succession of investigators. Therefore, certain features only need be commented upon by us. The growth rings as seen in transverse sections of the wood, *Fig. 51,* are delimited by three to five layers of radially compressed imperforate tracheary elements. The thin-walled, angular vessels are diffusely scattered, but in some specimens those of the early-wood are conspicuously larger than those of the late-wood, *Fig. 51*. The vessel members are very long with extensively overlapping ends, indicative of their formation by a relatively primitive form of non-storied cambium. The "perforation plates" are scalariform with numerous slender bars, *Fig. 54*. The vessel members frequently extend beyond the perforated facets in the form of narrow tapered ends, having "tertiary" helical thickenings, *Fig. 54*. The intervascular pitting fluctuates between scalariform, transitional and opposite. The rays of the first-formed secondary xylem are closely spaced, longitudinally extensive and mostly uniseriate, but in passing outward radially soon develop biseriate parts, *Fig. 52*. The rays of the later formed wood are lower, more widely spaced and typically heterogeneous, *Fig. 53*. The ray-vessel pitting varies from scalariform to transitional to opposite. Relatively large crystals of calcium oxalate occur more or less sporadically in the erect cells of the heterogeneous rays. Xylem parenchyma is apotracheal, scanty, diffuse, and terminal. The imperforate tracheary cells have conspicuously bordered pits in both their radial and their tangential walls. Although the cambium, vessels and imperforate tracheary cells are of relatively primitive dicotyledonous types, the ray structure is of a form indicative of an advanced stage in the ontogenetic and phylogenetic reduction in width and height of the multiseriate rays, Barghoorn (2).

According to Solereder (31), the bark contains isolated strands of sclerenchyma. In old stems, however, the sclerenchyma of the secondary phloem occurs in the form of successive concentric bands of varying circumferential extension.

Among plant fossils from early Tertiary beds of East Greenland, is a fossil wood from Cape Dalton which was assigned to *Corylopsites groenlandicus* by Mathiesen (21). This wood closely resembles that of *Cercidiphyllum* and of certain species of *Corylopsis*. It bears evidences of crystals in its wood parenchyma and rays, and was referred to *Corylopsis* by Mathiesen owing to the absence of such crystals in wood of *Cercidiphyllum* examined by him. The abundance of leaves of *Cercidiphyllum* in early Tertiary strata of northern lands suggests, as noted by Brown (5), that *Corylopsites groenlandicus* is in all probability the wood of *Cercidiphyllum.*

AFFINITIES OF CERCIDIPHYLLUM

Although the genus *Cercidiphyllum* was established by Siebold and Zuccarini in 1846, the plant *C. japonicum* remained without a specific name until Hoffman and Schultes (17) formalized its binomial, but no attempt was made to determine its affinities. In his remarks on the Hamamelidaceae, Baillon (1) casually raised the question whether *Cercidiphyllum* should be included under that family, noting foliar similarities with *Disanthus.* However, he also called attention to analogies with *Spiraeanthemum* of the Cunoniaceae (Saxifragaceae), viz. opposite leaves, hypogynous and apocarpous ovary and winged seeds. Maximowicz (22) associated *Cercidiphyllum* with *Trochodendron,* and particularly with *Euptelea,* in the Magnoliaceae, stressing the occurrence of stipules as evidence of relationship to that family.

Subsequent authors generally follow the lead of either Baillon or Maximowicz. Thus, Solereder (31), Hallier (8, 9, 10, 11), Lotsy (20), McLaughlin (23) and Croizat (6) emphasize similarities to the Hamamelidaceae, whereas Prantl (26), Harms (12, 13, 14), Bessey (4), Hayata (16), Hutchinson (18), Diels (7), Lemesle (19) and others favor retaining *Cercidiphyllum* within the Ranales (or Magnoliales) either as a member of the Magnoliaceae or the Trochodendraceae or as the representative of a monotypic family, the Cercidiphyllaceae.

The first comprehensive comparative studies of *Trochodendron, Tetracentron, Euptelea, Cercidiphyllum* and *Eucommia* (both of their external morphological characters and their internal structures) are those of Harms (12) and van Tieghem (33). Although cognizant of outstanding differences between the five genera, Harms, owing to an evident prejudice against small families, placed *Tetracentron* in the Magnoliaceae and the remaining four genera in the Trochodendraceae. On the contrary, van Tieghem, utilizing similar comparative evidence, placed each of the five genera in an independent family, grouping the monotypic Trochodendraceae and Tetracentraceae with the vesselless Winteraceae in a new order, the Homoxylées. It should be noted in this connection that Harms (13) later recognized the necessity of removing *Tetracentron* from the Magnoliaceae, of placing *Cercidiphyllum* in a family of its own within the Ranales and (15) of transferring the monotypic Eucommiaceae to the Urticales where Tippo's (34) subsequent investigations indicate that it in all probability belongs. Harms' (13) comments upon the taxonomist's difficulties in dealing with such genera as *Cercidiphyllum, Trochodendron* and *Tetracentron* are particularly significant. He states regarding *Cercidiphyllum:*

"On the whole the genus gives us many a problem; its morphological structure shows so many peculiarities that it is hard to find the correct place in the system for the genus. But so it is with many other genera from eastern Asia. Often one does not know where to place these odd forms or to what more widely distributed and more richly developed families one should connect them. We may as well assume that these are old genera whose closer relations no longer exist. They are remainders of some more richly developed forms from former geological periods, now unknown to us, projecting into today's flora, in which they appear strange. Both the Japanese genus *Trochodendron* and *Tetracentron,* a genus growing with *Cercidiphyllum* in the mountains of central China and placed in the Magnoliaceae, where it does not belong, are isolated types."

This tendency among taxonomists and morphologists for gradually recognizing the necessity of segregating such relic genera in independent families of their own is in marked contrast to the highly speculative deductions of Hallier (11), who included *Trochodendron, Tetracentron, Euptelea, Ceridiphyllum* and *Eucommia* in the Hamamelidaceae along with the Balanopsidales, Batidales, Buxaceae, Geissolomataceae, *Daphniphyllum, Myrothamnus, Platanus* and other plants of doubtful affinities. Such a procedure stretches the family beyond the elastic limits of even a natural order.

Much of the confusion during the last fifty years in discussions of the angiosperms is due to the interjection of phylogenetic concepts into systems of classification that were not developed originally from an evolutionary point of view. The older systems are logical arrangements designed to facilitate accurate identification and to provide efficiency in the codification and use of specimens in large herbaria. The groupings of plants were primarily based upon morphological similarities in one or another of their parts. Modern attempts to arrange the larger groupings, viz. families and orders, in phylogenetic series, deriving one grouping directly from another, lead inevitably to increasing confusion and controversy. This is due to the fact that, in dealing with the survivors of very ancient angiospermic floras, such phylogenetic arrangements, based upon the study of specific selected parts of the plants, commonly are invalidated by evidence from other organs or parts of the same plants. The most that may be inferred from the *totality* of evidence from all organs and parts of the plants is, in a majority of cases, the conclusion that the related groups of plants were derived from common ancestors, now extinct. Furthermore, although *negations* of putative phylogenetic derivations are simple and conclusive, *positive* assertions regarding evolutionary derivations are difficult and uncertain owing to the common occurrence of parallel and convergent trends of morphological and anatomical specializations in all organs of the vascular plants. That similar end-products, resulting from such evolutionary trends, are of widespread and frequent occurrence among animals is becoming increasingly recognized by zoologists in dealing with both vertebrates and invertebrates.

Before attempting to arrange surviving angiosperms in phylogenetic series, it is essential to obtain reliable evidence regarding salient trends of evolutionary specialization in the various organs and internal structures of these plants. Such evidence can be acquired only by comprehensive and time-consuming investigations of the dicotyledons and monocotyledons *as a whole.* In the case of the vascular tissues, accumulated data indicate that an adequate record of the derivation of vessels from modified tracheids and of the varied trends of specialization of vessel-containing xylem is preserved among both living dicotyledons and monocotyledons. However, it is evident from this record that similar or parallel trends of structural specialization have occurred repeatedly and independently in remotely related dicotyledonous families.

The voluminous data accumulated by successive generations of taxonomists provide abundant material for the study of varied trends of cohesion and adnation of floral parts and of simplification and reduction of inflorescences and flowers. Furthermore, the study of new and neglected plants from northern Australia, New Guinea, New Caledonia, Fiji and adjacent regions is yielding significant clues regarding the primitive form of the angiospermic carpel and stamen. Here again, as also in the case of angiospermic pollen, it is becoming increasingly evident that similar end products of specialization frequently develop independently through parallel or convergent evolution. Although much less is known at present regarding reliable trends of phylogenetic specialization in leaves and seeds of dicotyledons, sufficient evidence is available to indicate that morphological and structural similarities, *by themselves,* are not indicative necessarily of close genetic relationship between plants in which they occur.

Although specific parts of *Cercidiphyllum* exhibit similarities to homologous parts of other plants, the totality of evidence from all parts of the plants is not indicative of close relationship of *Cercidiphyllum* to any particular family of the dicotyledons. Many of the similarities stressed by those desirous of including *Cercidiphyllum* in the Magnoliaceae, Trochodendraceae or Hamamelidaceae are superficial and lose their significance when closely analyzed. Stipules, palmate venation, marginal glands and trilacunar nodal attachments of leaves occur in diverse families of dicotyledons, yet the presence of stipules is utilized by some as evidence of relationship to the Magnoliaceae and by others to the Hamamelidaceae. Similarly, stipules and palmate venation are stressed by some as indicative of affinity to *Tetracentron* and by others to certain selected genera of the Hamamelidaceae. It should be emphasized in this connection, however, that more detailed studies of the leaves reveal significant differences in the vasculature of the petioles and in the stomata of *Cercidiphyllum.* In addition, the leaves of this genus do not form types of idioblasts and other cellular structures that occur characteristically in the Magnoliaceae, *Tetracentron, Trochodendron* and various genera of the Hamamelidaceae.

Excessive emphasis has been placed in the past upon superficial resemblances due to analogous stages in the reduction of the perianth and other floral structures. In *Trochodendron* and *Tetracentron,* where the totality of evidence is clearly indicative of relatively close relationship between the two genera, the unsealed conduplicate carpels exhibit incipient lateral cohesion, conspicuous nectariferous dorsal bulges and pronounced abaxial deformation either preceding or following anthesis. In contrast, the free, style-less carpels of *Euptelea* have elongated stipes and the stigmatic margins of the conduplicate megasporophyll are restricted by concrescence to a localized, more or less concave part of the ventral side of the carpel. In the Hamamelidaceae, as in many of the Cunoniaceae and Saxifragaceae, there is a marked tendency for the carpels to be reduced to pairs which have more or less extensive cohesion of their ventral surfaces. Thus, there are distinct and entirely different trends of specialization in the carpels of *Tetracentron* and *Trochodendron*, of *Euptelea*, and of the Hamamelidaceae, no evidence of which are detectable in the solitary carpel of *Cercidiphyllum*.

The pollen grains of *Tetracentron, Trochodendron* and certain of the Hamamelidaceae, as of many other dicotyledons, are tricolpate. Those of *Cercidiphyllum* are tricolpate, but differ markedly in the unusual breadth of their poorly defined furrows and in the detailed structure of their exine.

Embryological investigations have revealed no cogent evidence for including *Cercidiphyllum* in the Hamamelidaceae. The epidermal cells of the nucellus in *Cercidiphyllum* undergo a few periclinal divisions which result in an increased number of parietal layers, a phenomenon that has not been recorded in the Hamamelidaceae (27, 35). Following fertilization, the embryo sac of *Cercidiphyllum* undergoes a conspicuous elongation lengthwise, a feature which is unknown in the ovules of the Hamamelidaceae. The development of endosperm in *Hamamelis* (27), *Fothergilla* (35), and *Corylopsis* is strictly nuclear, whereas in *Cercidiphyllum* it is cellular.

The seeds of the Hamamelidaceae are of two different structural types: (1) those having a highly opaque, hard testa without wings, and (2) those that form a less opaque, relatively soft coat, whose margins become flattened to form a wing-like expansion. Seeds of the latter category are of less frequent occurrence in the family, being confined to the genera *Bucklandia, Liquidambar* and *Altingia*. The seeds of *Cercidiphyllum* are winged, but those who favor hamamelidaceous affinities for *Cercidiphyllum* have been too sanguine in citing this character as evidence in support of their contention. Winged seeds are of common occurrence and the presence of a wing in itself is not indicative necessarily of close relationship.

In the seeds of *Liquidambar* and *Altingia,* the outer integument surrounding the micropyle has undergone excessive flattening and considerable extension longitudinally to form the wing. The wing is radially symmetrical and its cells are uniform and more or less homogeneous. In *Bucklandia,* the histologically similar wing develops asymmetrically and diagonally from the outer integument on the side of the ovule opposite the raphe. There is no conspicuous extension of the chalazal end of the ovule or seed in these hamamelidaceous genera and the course of the raphe bundle is normal. On the contrary, the ovules of *Cercidiphyllum* initiate the development of a subchalazal projection at an early stage of their ontogeny, viz. megaspore mother cell stage. Subsequent longitudinal and unilateral expansion of this subchalazal outgrowth forms the conspicuous wing of the mature seed. The raphe bundle forms a circuitous loop in the wing before reaching the chalaza, comparable to the hair-pin bend of the vascular bundle in the subchalazal prolongations of the ovules and seeds of *Trochodendron* and *Tetracentron,* Nast and Bailey (24).

The seeds of the latter genera, however, differ from those of *Cercidiphyllum* in having slender subchalazal elongations without broad wing-like modifications, in forming sclerenchymatous layers of characteristically elongated cells, and in containing a rudimentary embryo embedded in abundant endosperm. In addition, the epidermis of the outer integument consists of longitudinally elongated cells which impart a striated appearance to the seeds, whereas in *Cercidiphyllum* the homologous tissue is composed of cells which by enlargement produce a spongy texture.

The haploid number of chromosomes is commonly 12 in Hamamelidaceae. According to Whitaker (36), the haploid number is 14 in *Euptelea, Illicium* and the Schisandraceae, and 19 in *Cercidiphyllum, Trochodendron, Tetracentron,* the Winteraceae and the Magnoliaceae (*sensu stricto*). However, the occurrence of 14 haploid chromosomes in one investigated species of *Michelia* (32) suggests that many additional representatives of the Winteraceae, Magnoliaceae, Schisandraceae, and Illiciaceae should be studied before relying upon chromosome numbers in discussions of relationships within the Ranales.

The wood of *Cercidiphyllum* closely resembles that of certain representatives of the Hamamelidaceae, e.g. *Corylopsis.* However, this similarity, *by itself,* is not indicative necessarily of close relationship, since similar combinations of anatomical characters occur in other families which have retained relatively primitive cambia, vessels and imperforate tracheary cells while undergoing analogous reductions in the width and height of their multiseriate rays. In fact, the similarities in the case of *Corylopsis* and *Cercidiphyllum* are no more remarkable than are those between the woods of such remotely related plants as *Maclura pomifera* (Raf.) Schneid. of the Moraceae and *Robinia pseudoacacia* L. of the Leguminosae.

Thus, a summation of evidence from all organs and parts of *Cercidiphyllum* provides no cogent arguments for including this genus in any particular family of the dicotyledons. Therefore, we agree with van Tieghem (33) and subsequent writers who place the genus in an independent family of its own, the Cercidiphyllaceae.

Having established an increasing number of new independent families, taxonomists are faced with the problem of incorporating them in some logical and useful major system of classification. The role of the morphologist, anatomist, paleobotanist or cytogeneticist should be to provide significant and helpful data rather than to attempt to dictate solutions of this difficult problem upon their own terms. As previously stated, premature efforts to arrange living angiosperms in putative phylogenetic series, deriving one family or order directly from another (Hallier and others) will lead only to increasing confusion and controversy. The study of major trends of phylogenetic modification of specific organs or parts of the dicotyledons and monocotyledons is yielding much significant information, but it should be recognized that no single one of these phylogenies can be utilized by itself in arranging plants in a similar linear series, since such a procedure is usually negated by evolutionary trends in other parts of the plants.

The Ranales, as broadly conceived by Engler and Prantl, obviously associates plants of widely varying degrees of relationship and of morphological and anatomical specialization. Two different categories of families may be recognized to advantage within the order: (1) the Winteraceae, Degeneriaceae, Magnoliaceae (*sensu stricto*), Himantandraceae, Eupomatiaceae, Annonaceae, Myristicaceae, Canellaceae, Calycanthaceae, Austrobaileyaceae, Monimiaceae, Gomortegaceae, Lauraceae, Hernandiaceae and Lactoridaceae, having characteristic secretory cells ("ethereal oil cells") and monocolpate pollen (or phylogenetically modified types of such pollen), and (2) the Ranunculaceae, Berberidaceae, Lardizabalaceae and Menispermaceae, having tricolpate pollen (or types derived from such pollen) and no "ethereal oil cells." Monocolpate pollen occurs in many seed ferns, Bennettitales, Cycadales, Ginkgoales and monocotyledons, whereas tricolpate pollen and its modifications characterizes most dicotyledons.

The plants of the first ranalian category are predominantly woody (normal trees and shrubs), having simple pinnately veined leaves (except the Hernandiaceae), syndetocheilic-appearing stomata, and seeds with copious endosperm and rudimentary embryos. They retain many early trends in the differentiation of sepals and petals and in the specialization of primitive conduplicate, unsealed carpels, broad microsporophylls and staminodes, as well as of vessels and other vascular structures. The second category of ranalian plants exhibits conspicuous trends toward the acquisition of herbaceous or scandent habits, have a high ratio of palmate venation, and form haplocheilic stomata. Although predominantly apocarpous, their flowers have in general attained advanced stages of modification, and their vascular tissues are highly specialized. However, they retain seeds with abundant endosperm and small embryos.

The Illiciaceae and Schisandraceae have abundant "ethereal oil cells" and other characters suggestive of the first category of Ranales, but form tricolpate or hexacolpate pollen. Furthermore, the Schisandraceae, as certain of the Monimiaceae and Hernandiaceae, exhibit transitions between syndetocheilic-appearing stomata and haplocheilic stomata. Conversely, the Nymphaeaceae are in general more nearly comparable to plants in the sub-order Ranunculineae, but the Cabomboideae and Nymphaeoideae have monocolpate types of pollen, whereas the Nelumbonoideae form tricolpate ones. It should be noted, in this connection, that although the Piperaceae and Saururaceae have attained a high degree of morphological specialization in most of their parts, they contain characteristic "ethereal oil cells" and have monocolpate pollen. They should be included in the Ranales, if this order is to be retained as broadly conceived of in the Englerian system.

The Tetracentraceae, Trochodendraceae (*sensu stricto*), Eupteleaceae and Cercidiphyllaceae have tricolpate pollen, haplocheilic stomata and, with the exception of *Tetracentron,* no secretory idioblasts. If these families are to be retained in the Ranales, it should not be upon unwarranted assumptions that they are closely related to, or directly derived from the Winteraceae, Magnoliaceae, or any other specific family of the order, but rather upon recognition of the order as a useful repository for relic plants that retain primitive, ancestral, dicotyledonous characters in one or more of their organs or parts. Nothing is to be gained by transferring such genera as *Tetracentron, Trochodendron, Euptelea,* and *Cercidiphyllum* into close relationship with the Hamamelidaceae or Saxifragaceae, since this would merely serve to expand another order into a less homogeneous assemblage. The only other alternatives are to include each relic genus in a special order of its own or to follow the lead of mycologists and establish a special assemblage, e.g. "Incognitales," comparable to the Fungi Imperfecti.

It should be emphasized in conclusion that much of the present confusion in literature dealing with the relationships and phylogeny of angiosperms is due to premature and unduly speculative generalization based upon excessively restricted and inadequate data. A much broader outlook is needed, involving the use of evidence from all organs and parts of plants and an accurate visualization of salient trends of specialization of such organs and parts in the angiosperms, and in the vascular plants, as a whole.

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EXPLANATION OF PLATES

Plate I. *Fig. 51.* Transverse section of the mature wood, × 120. *Fig. 52.* Tangential section near the early secondary xylem, × 120. *Fig. 53.* Same, old secondary xylem, × 120. *Fig. 54.* Part of a vessel member showing the spiral thickenings in the tapering end, × 320.

Plate II. *Fig. 55.* Transverse section of a seedling at the cotyledonary node, × 40. *Fig. 56.* Same, at the next node, × 40. *Fig. 57.* Transverse section at the node of a twig, × 10. *Figs. 58–60.* Transverse sections of the petiole at successive levels starting from the base, × 18. *Fig. 61.* Transverse section passing through the base of the lamina, × 18. *Fig. 62.* Same, at a slightly higher level, × 18.

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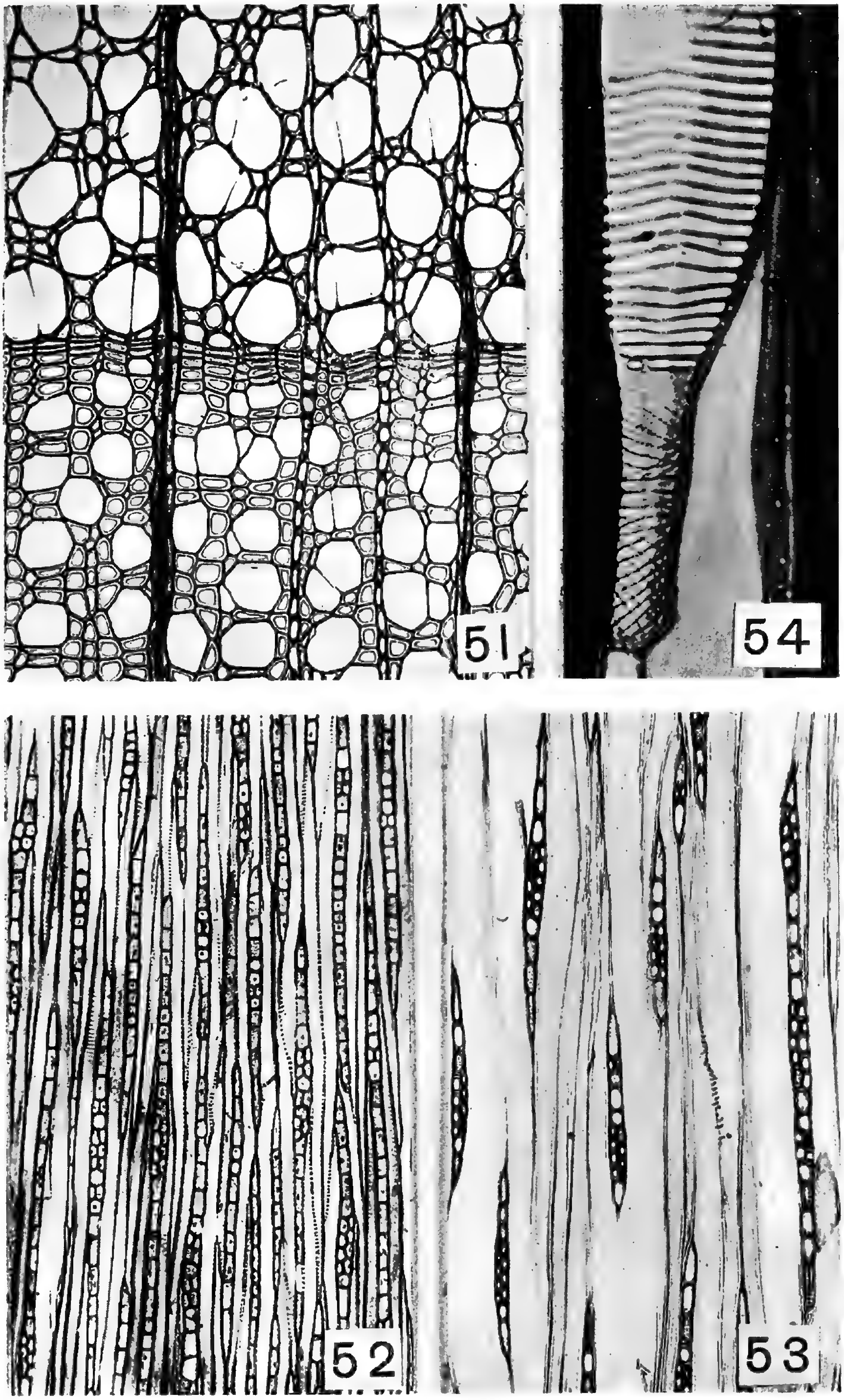
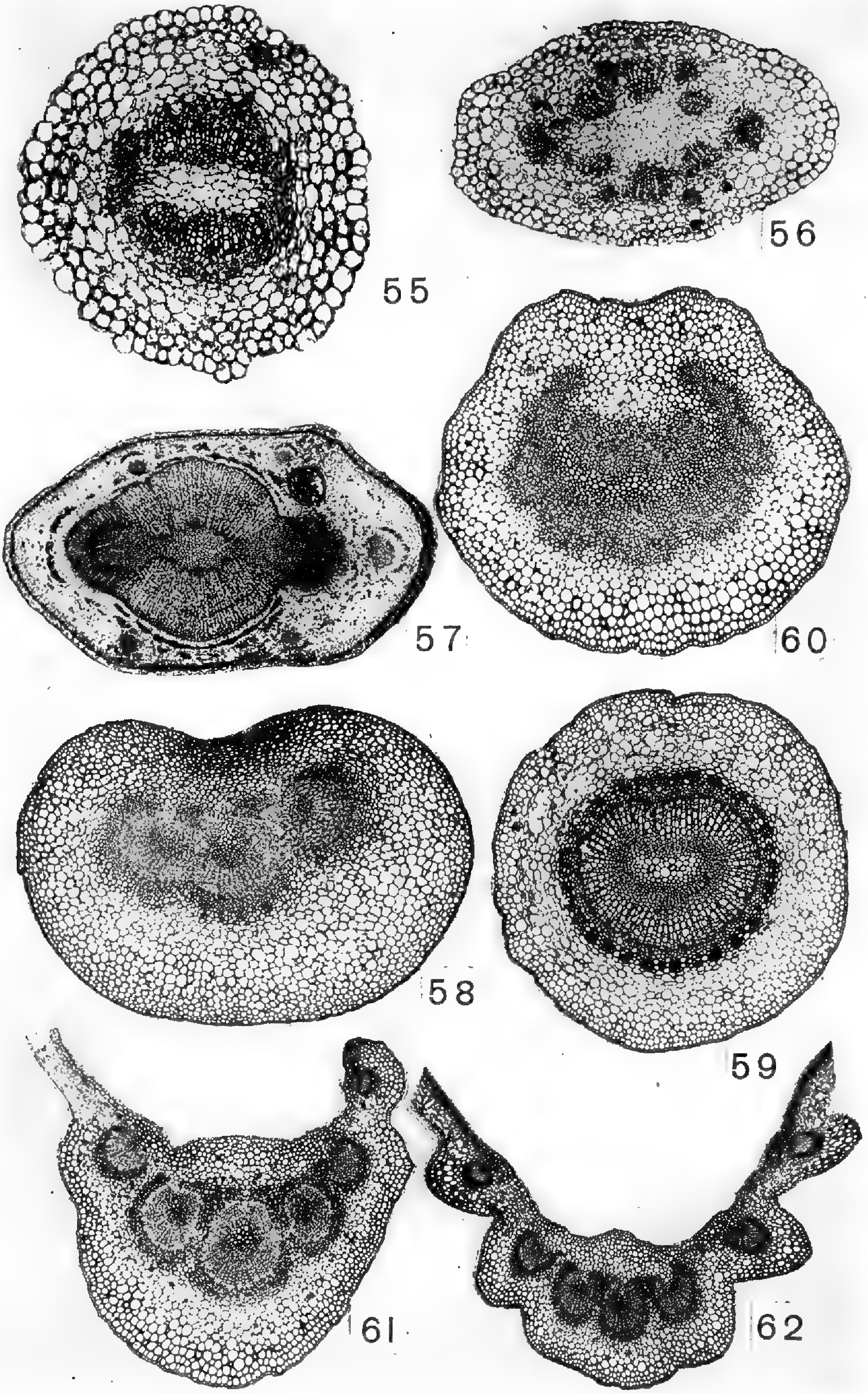


Morphology of Cercidiphyllum



MORPHOLOGY OF CERCIDIPHYLLUM

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THE MORPHOLOGY AND RELATIONSHIPS OF AUSTROBAILEYA

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With seven plates and three text-figures

INTRODUCTION

THE RELATIONSHIPS of this interesting genus have remained in doubt since it was first collected in 1929 by Kajewski on the Atherton Tableland in Northern Queensland. In his original description of the genus, White (11) stated:

"As Dr. Diels has done considerable work on the Magnoliales and allied groups, particularly those of the Papuan region, I sent specimens to him. He wrote me that he regarded the plant as undoubtedly belonging to the Magnoliaceae and allied to *Drimys*. He further suggested, though the fruits were unknown, that I should publish a provisional description in the account of Kajewski's collection. Unfortunately though Kajewski's specimens consist of several sheets of flowering specimens, the material has become extremely brittle in the process of drying with the result that the flowers are very difficult to soften and describe. It seems impossible also to section one of the carpels to see the number of ovules. Until living or spirit material of the flowers and ripe fruits can be obtained it will be impossible to place the plant in its correct botanical position. For the time being it is probably best placed at the end of the Magnoliaceae — even in a restricted sense — with position uncertain."

Subsequently, White modified this opinion in a letter written August 5, 1940 to Croizat: "Your letter of the 14th June to hand, and in reply I might state that when I was in England I spoke to Mr. Dandy at the British Museum, the recognized authority on the Magnoliaceae, about my *Austrobaileya*. I had, of course, only provisionally placed it in the Magnoliaceae. Specimens of the wood parts were examined at the Joddrell Laboratory by Dr. Metcalfe, and from floral structure and anatomy, we think there is no doubt the plant is a new family allied to Monimiaceae.

Dandy and I had intended to prepare a publication on it later on. I might have done something when I was over the other side, but the war upset plans a bit. It is most desirable, of course, that fruit should be found before it is raised to family rank."

Croizat (5) placed the genus in a new sub-family of the Dilleniaceae, viz., the Austrobaileyeae, and subsequently (6) in an independent family, the Austrobaileyaceae, without further discussion of its affinities.

It is evident, accordingly, that three different relationships have been suggested for *Austrobaileya,* 1. the Magnoliaceae, 2. the Monimiaceae and 3. the Dilleniaceae. The question whether the genus should be placed in one of these families or in an independent family of its own can be satisfactorily answered only by comprehensive morphological investigations of adequately preserved material. Through the efforts of Mr. L. J. Brass, and Mr. S. E. Stephens of the Department of Agriculture of North Queensland, we have succeeded in obtaining such material of the flowers and vegetative parts, collected at Lamonds Hill, close to the type locality of *Austrobaileya scandens* C. T. White.

MATERIAL EXAMINED

Our morphological investigations are based upon examination of the following material:

1. Isotype specimen of *A. scandens* C. T. White, *Kajewski 1269,* Arnold Arboretum.

2. Two isotype specimens of *A. scandens* C. T. White, *Kajewski 1269,* New York Botanical Garden.

3. Isotype specimen of *A. maculata* C. T. White (12), *White 10734,* Arnold Arboretum.

4. Stems and leaves of *A. maculata* C. T. White, *White 10734,* kindly sent by Mr. White.

5. Stems, terminal shoots and leaves of *A. scandens* C. T. White, collected and preserved in FAA fixative, *Brass 18160.*

6. Eleven herbarium specimens of *Brass 18160.*

7. Flowering shoots of *Austrobaileya,* preserved in FAA fixative, collected August 26, 1948 by Mr. Stephens in the Lamonds Hill area.

THE STEM

The largest scandent stem of *Austrobaileya, Brass 18160,* examined by us is 13 millimeters in diameter. Part of a transverse section of this stem is illustrated in *Plate I, Fig. 1.* The pith is composed of parenchymatous elements having thick, lignified, secondary walls. It is relatively homogeneous except for the presence of scattered cells having abundant starch and dark-colored phenolic material. In longitudinal sections, these cells are seen to occur in more or less extensive, vertically oriented files. The parenchymatous elements of the perimedullary region, *Fig. 1,* are slender, much elongated vertically, thick-walled and internally septate.

The cortex is composed of parenchymatous cells having thick, unlignified, primary walls and containing abundant starch and more or less calcium oxalate in the form of "crystal sand." A considerable number of the cortical cells also contain dark-colored phenolic material. In the outer cortex of young stems, before the development of an extensive periderm, conspicuous secretory cells, i.e., "ethereal oil cells," are visible. These idioblasts are more or less spherical and have a tenuous suberized inner membrane.

The eustele of the stem is composed of numerous discrete strands of primary xylem and phloem which are faced externally by thick-walled septate fibres. During enlargement of the stem, as seen in transverse sections, *Fig. 1,* these arcs of phloem fibres form parts of a composite ring of sclerenchyma; the widening intervening spaces between the arcs of fibres being bridged by the formation of sclerotic parenchyma. The conspicuous multiseriate rays of the secondary body, *Fig. 1,* extend outward from the parenchymatous interfascicular lacunae of the eustele and exhibit considerable flaring in the secondary phloem. As is so frequently the case in scandent stems, there is a relatively abrupt transition in the secondary xylem between an inner first-formed zone of denser tissue and a subsequently formed, more porous part having conspicuously larger vessels.

The cambium is of a relatively primitive type, containing long (up to 1500μ), extensively overlapping, fusiform initials. The derived sieve cells, vessel members and parenchyma strands are of equivalent lengths, but the imperforate tracheary cells, which elongate during maturation of the secondary xylem, are longer.

The parts of the secondary phloem between the flaring multiseriate rays, *Fig. 2,* are composed largely of alternating transverse bands of sieve cells and phloem parenchyma strands, the uniseriate rays being inconspicuous except where their cells contain dark-colored phenolic material. *The sieve cells have no companion cells.* Our observations regarding this important fact have been verified by Professor Katherine Esau to whom we sent preserved material for examination. The long, extensively overlapping sieve cells have numerous sieve plates in their lateral surfaces, those at the ends of the cells exhibiting no structural differences that might be interpreted as evidence of the presence of sieve tubes. There are no sclerenchymatous elements in the secondary phloem, all of the cells having primary walls only. Elongated secretory cells, i.e. "ethereal oil cells," are of sporadic occurrence.

The imperforate tracheary elements of the secondary xylem, *Fig. 3,* are of two types, 1. normal thick-walled tracheids which lose their living contents at maturity and 2. septate elements which contain several nuclei, more or less starch and dark-colored phenolic material. The former tracheary cells have numerous, conspicuously bordered pits (with included slit-like apertures) in both their radial and their tangential walls. However, the bordered pits fluctuate markedly in size in different tracheids, varying in diameter from 3μ to as much as 10μ. In the septate elements, the bordering areas of the pits fluctuate from conspicuous to vestigial.

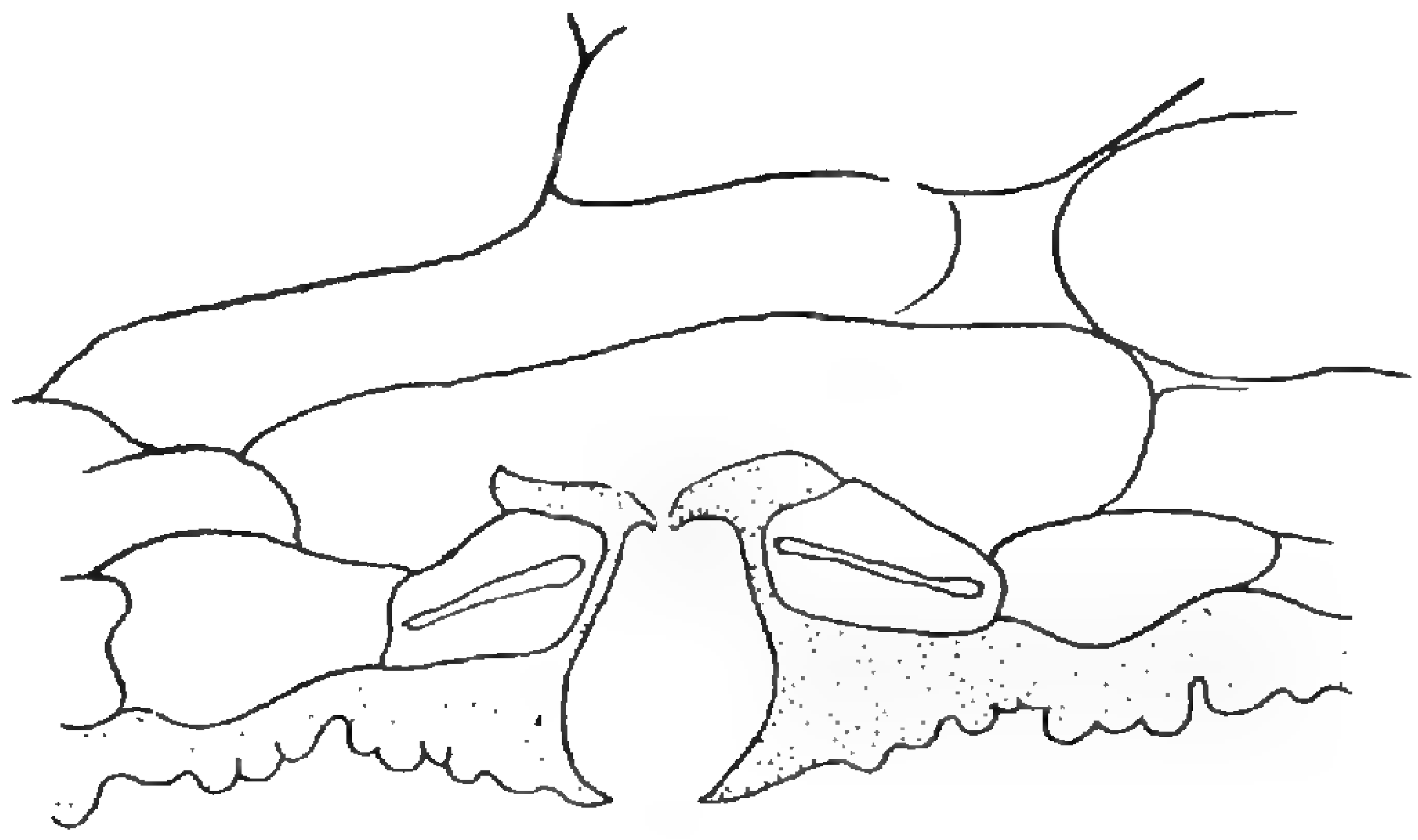
The vessels of the secondary xylem range in size from diameters approximating those of the largest tracheids, i.e. 30μ, to diameters of as much as 200μ. All of the vessels regardless of size have scalariform perforation plates, but the form of the vessel members, and the number, size and character of the perforations changes markedly with increasing diameter of the vessels. In those of minimal cross-sectional area, the constituent cells are tracheid-like in form, i.e. fusiform with gradually tapered ends as seen in tangential longitudinal sections of the stem. The aggregations of scalariform bordered pits in the radial facets of the vessel members, *Fig. 5,* differ from those of scalariformly pitted tracheids only in the dissolution of pit-membranes in a number of the fully bordered pit-pairs. With increase in the diameter of the vessels, the perforated pit-pairs are reduced in number, greatly enlarged and lose most of their borders, compare *Figs. 5, 6* and *7.* In the case of the smaller vessels, the perforated pits occur in radial walls that are only slightly inclined to the long axis of the vessels, and therefore are fully visible in thick, radial longitudinal sections of the stem. On the contrary, during the ontogenetic expansion of large vessels, restricted parts of the radial facets, i.e. those in which perforations will ultimately be formed, assume an increasingly diagonal orientation, *Fig. 4,* and are fully visible in surface view, *Fig. 7,* only in sections cut at an inclination of approximately 45 degrees to the longitudinal axis of the stem.

Most of the vessels are diffusely scattered, but a few of the larger ones occur in tangentially oriented pairs, *Figs. 1* and *3.* Where the vessels are in contact with tracheids, the imperforate bordered pits are relatively large and circular, where in contact with rays or wood parenchyma strands, the pits are smaller but clearly bordered. Where vessels are in contact laterally, the imperforate bordered pits are large, more or less transversely elongated and in opposite or alternating, multiseriate arrangement.

The wood parenchyma is paratracheal in distribution, *Fig. 3,* and, as frequently the case in scandent stems, tends to be more abundantly developed on the abaxial sides of the vessels. The multiseriate rays are extensive longitudinally, *Fig. 4,* having slender elongated cells on their flanks and high-celled uniseriate extensions on their upper and lower margins. The uniseriate rays exhibit evidences of phylogenetic reduction, particularly in the first-formed part of the secondary xylem, are low and composed of vertically much elongated cells.

THE LEAF AND NODAL ANATOMY

During early stages of the ontogeny of the vegetative shoot, the leaves are arranged in a typical decussate phyllotaxy. However, during subsequent growth of a shoot, the leaves of an individual pair may remain truly opposite or they may become sub-opposite or even widely separated by irregularities of interstitial elongation. The entire, glabrous, pinnately veined leaves are coriaceous at maturity, being provided with a thick and conspicuously striated cuticle in surface view. The relatively large stomata of the lower surface of the leaf may have subsidiary cells oriented parallel to the guard cells ("syndetocheilic" or "rubiaceous" appearing type) or they may be surrounded by ordinary epidermal cells ("haplocheilic" type). In anticlinical sections, cut at right angles to the long



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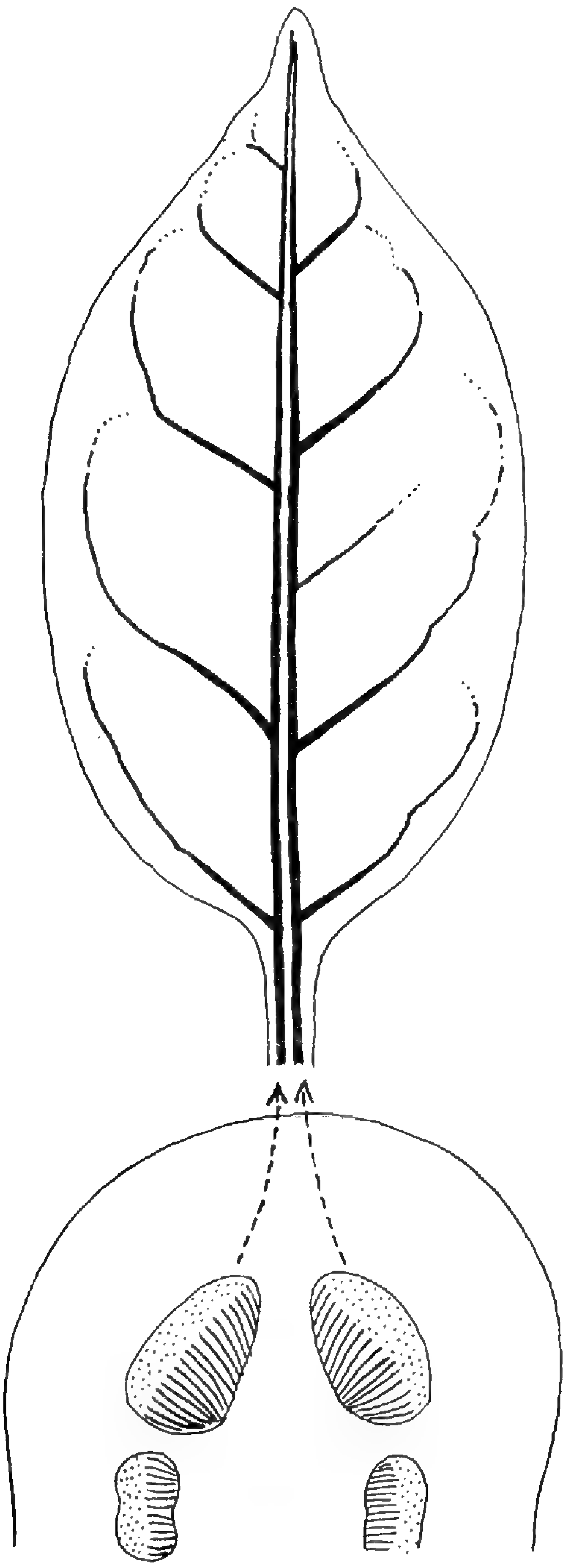

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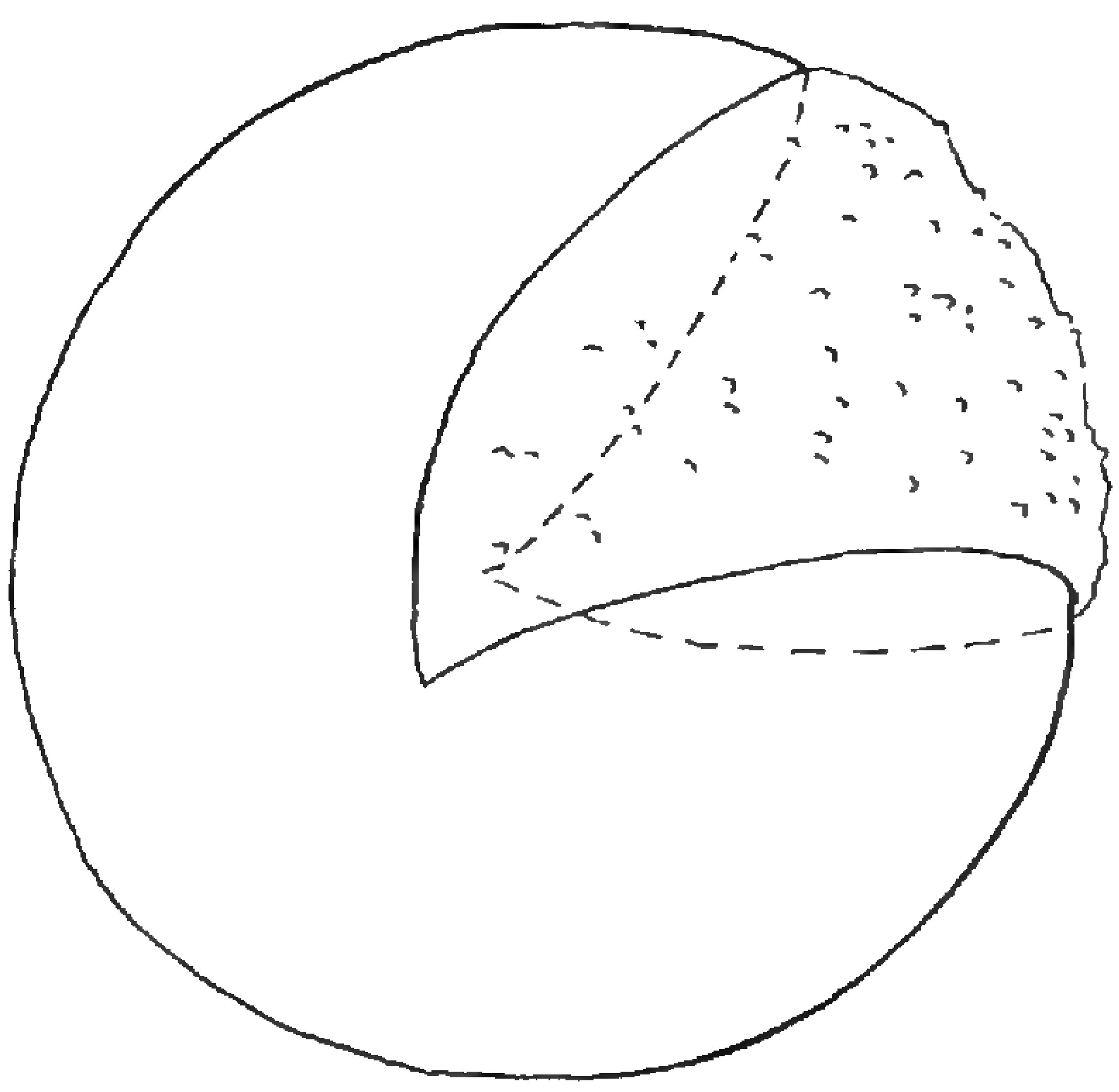

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TEXT-FIGURES 1–3. *Fig. 1.* Section of a stoma from the under surface of a leaf, × 690. *Fig. 2.* Diagrammatic representation of the transverse section of a node and the vascularization pattern of a leaf. *Fig. 3.* Mature pollen grain, × 982.

axis of the stomata, *Text-fig. 1,* a highly characteristic pattern of cuticularization is revealed. There is a conspicuous vestibule in the thick cuticle, and the cuticular substance extends inward along the surfaces of the guard cells forming two massive plates which subtend them. There is no clearly defined hypodermis or palisade tissue in the mature leaf. More or less spherical secretory idioblasts, i.e. "ethereal oil cells," are scattered through the mesophyll, and are particularly conspicuous in young developing leaves. Many of the cells of the mesophyll contain dark-colored, phenolic substances.

Each leaf is vascularized (as are so many cotyledons of angiosperms) by two discrete strands that are related to a single gap in the eustele, *Text-fig. 2.* In other words, the nodal anatomy of *Austrobaileya* is of a *unilacunar* type. The detailed behavior of the two vascular strands fluctuates considerably in different mature leaves, even in those of a single plant. In certain of them, the two strands remain separate throughout the petiole and the costa of the lamina, each half of the lamina being vascularized by the ramifications of an independent system, *Text-fig. 2.* In other leaves, the two strands may be closely approximated or they may fuse to form a single arc, particularly in the middle and terminal parts of the mid-rib. It is significant in this connection, however, that during early stages of the ontogenetic development of leaves, there are two separate strands of procambium, subsequent approximations and localized fusions occurring during the differentiation of metaxylem or of secondary xylem and phloem. Below the node, the two foliar traces (when traced downward in serial transverse sections of the stem) remain independent of each other and become attached to two independent parts of the eustele. In other words, *the two leaf traces do not originate as a dichotomy of a single vascular bundle.*

In mature leaves, the smaller veins are jacketed by thick-walled fibres, but these fibres decrease in number toward the base of the mid-vein and commonly are absent in the petiole.

THE FLOWER

The flower buds of *Austrobaileya* are borne in the axils of leaves and are solitary in all specimens examined by us. Those collected by Mr. Stephens, are globose, *Figs. 8–10,* the pedicels varying from 0.5 to 1.0 cm. in length, depending upon the age of the bud. The short pedicels of young flower buds bear 8 to 10 pairs of decussately arranged bracts. Subsequently during interstitial elongation of the pedicel, the bracts of one or two of the central pairs tend to be displaced. Thus, in older buds it is common to find 2 or 3 pairs of compactly and decussately arranged bracts at the base of the pedicel, 2 or 4 more or less widely spaced bracts in the middle of the pedicel, and 2 or 3 pairs of compactly and decussately arranged bracts subtending the perianth, *Fig. 9.* The penultimate and ultimate pairs of bracts are larger and more woody than the rest, *Figs. 8–11.*

The perianth, as also the inner appendages of the flower, are arranged on the floral axis in a much compressed spiral. There is no clearly defined differentiation of the perianth into calyx and corolla. In both species of *Austrobaileya,* the outermost tepal is somewhat larger than the subtending bracts. The central tepals of the series progressively attain larger dimensions, whereas the inner tepals become reduced in size to dimensions more nearly equivalent to those of the outer members of the series, *Figs. 20–32.* The tepals of *A. scandens, Kajewski 1269,* are much larger than those of *A. maculata, White 10734,* and the innermost ones tend to be of spatulate form.

The androecium of *A. maculata, White 10734* as of Stephens' collection, consists of 19 to 25 members, the outer 6 to 9 of which differentiate as stamens and the remainder as staminodia. The two categories merge into one another, one or two staminodia in the transition region not infrequently bearing degenerate sporangia, *Fig. 17.* The fertile male appendages are broad microsporophylls bearing protuberant sporangia on their conspicuously concave inner surface, *Figs. 15, 34, 36.*

The fertile microsporophylls and the staminodia of *A. maculata, White 10734* as of Stephens' collection, are characterized by having more or less numerous and conspicuously embossed purple spots, *Figs. 15–19* and *34.* These dark-colored areas tend to be more abundant on the staminodia than on the stamens, and on the adaxial than on the abaxial surface of the fertile microsporophylls. In the case of dried herbarium material, *White 10734,* the phenolic contents of the papillate epidermal cells, *Fig. 42,* of the purple areas turn black, and the spots become strikingly embossed, evidently through excessive contraction of surrounding tissue.

The stamens and staminodia of *A. scandens, Kajewski 1269,* are larger than those of *A. maculata, White 10734,* and differ from them in both form and texture, compare *Figs. 33* and *34.* They do not exhibit dark-colored embossed spots. Nor does Kajewski mention the occurrence of conspicuous purple areas in his field-notes on the color of freshly collected flowers.

The fact that the flowers collected by Mr. Stephens, close to the type locality of *A. scandens,* resemble those of *A. maculata* from Mt. Spurgeon raises the question whether there actually are two distinct species of overlapping ranges. Can the striking differences in size, form, texture and structure between the flowers of *A. scandens, Kajewski 1269,* and those of *A. maculata, White 10734* and Mr. Stephens' collection, be due to different developmental stages of the flowers at time of collection? In other words, is the larger size of the flowers of *A. scandens* and of their constituent parts due to the fact that the flowers were collected at anthesis, whereas those of *A. maculata* and the Stephens' collection had not attained their final stages of expansion? In order to answer this question, we have examined a young flower bud of *A. scandens, Kajewski 1269,* of approximately the same dimensions as the largest flower buds of *A. maculata, White 10734.* The stamens and staminodia of this immature flower exhibit the same differences in form and texture as the fully developed flowers, and do not have dark-colored embossed spots.

It should be noted in this connection, however, that the only conspicuous morphological difference between the vegetative organs of *A. scandens* and *A. maculata* is in the shape of the leaves. The internal anatomical characters of the stem and leaves are similar. The leaves of 11 duplicate sheets of *Brass 18160* are of uniform elliptic to lanceolate form regardless of marked variations in size, and thus resemble those of *A. scandens, Kajewski 1269*. The "nitid" character of the latter collection is due apparently to over-heating during drying. The leaves of *A. maculata* are elliptic-ovate to ovate.

The staminodia of *A. scandens* and *A. maculata* are irregularly ridged or folded longitudinally, *Figs. 17–19*. As seen in transverse sections, their basal part is solid and the ridges extend in diverse directions, *Fig. 36,* whereas their apical parts are characteristically conduplicate, *Fig. 35*.

Above the insertion of the staminodia, the floral axis terminates in a broad mound on the surface of which the free carpels are borne, *Figs. 12* and *38*. In *A. maculata, White 10734* and in Mr. Stephens' collection, the number of carpels ranges from 6–8, but as many as 14 may be present in *A. scandens, Kajewski 1269*. The dorsal outline of the carpel, *Fig. 13,* is more curved than the ventral surface which is nearly straight, the style being in line with the ventral side. The carpel has a more or less extensive solid basal part, *Figs. 14* and *37,* which may possibly represent a much modified stipe. The locule, situated in the dorsally more bulging part of the carpel, contains from 8 to 13 anatropous ovules in two series, *Figs. 14, 37* and *44*.

The carpels of *Austrobaileya* exhibit extreme phylogenetic modifications of the primitive conduplicate megasporophyll of the "Tasmannia-Degeneria" type, viz. 1. closure of the carpel, 2. differentiation of a hollow style and 3. elimination of the external, paired, stigmatic crests. Closure of the ovule-bearing part of the megasporophyll has progressed, as in the *Wintera* section of *Drimys,* Bailey and Nast (2), by concrescence of the stigmatic ventral surfaces of the conduplicate megasporophyll. Although closure by concrescence is complete externally, *Figs. 36* and *44,* evidences of the suture are preserved internally by a conspicuous cleft in the carpellary wall, *Fig. 44*. This cleft is jacketed by papillate cells that function in the downward extension of pollen tubes. Similar concrescence has occurred in the constricted stylar part of the primitively conduplicate megasporophyll, *Figs. 45* and *46,* forming a tubular extension whose cavity communicates with the locule, *Fig. 37,* and is lined by a more or less papillate and glandular appearing epidermis. The upper part of the style is bifid, *Fig. 13*. Just below the level of forking, the style is typically conduplicate and open on its ventral side. The ovules are anatropous and have two integuments, the outer being thicker, *Fig. 44*.

POLLEN

The wall of a young microsporangium of *A. maculata* in sectional view, *Fig. 39,* shows an epidermis subtended by three layers of wall cells which are subtended in turn by a single, or an irregularly 2-layered, tapetum. When the microspore mother cells are undergoing reduction divisions, the tapetal cells become binucleate, *Fig. 40.* During later stages, the walls and the cytoplasm of the tapetal cells become homogeneously granulate and lose cellular organization, *Fig. 41.* However, neither an amoeboid shape of the individual cells nor their migration into the cavity of the sporangium, as often happens with the periplasmodial type of tapetal organization, was seen. The nutritive layer is soon absorbed after the stage represented in *Fig. 41.*

The microspore mother cells undergo reduction divisions in a simultaneous manner and form tetrads of microspores. The thickening of the exine commences while the microspores still cling together in tetrads. This feature facilitates observation of the differentiation of the germinal furrow on the distal face of the grain. The generative cell is cut off towards the furrow-end of the grain and the pollen grains are two-celled at the time of shedding.

The mature pollen grain is spherical with a single germinal furrow running nearly from pole to pole. The exine is thick and appears to be finely pitted, occasionally 3–5 pits being arranged in variously curved lines. The external surface of the furrow is sparsely flecked with minute protuberances, *Text-fig. 3.*

VASCULARIZATION OF THE FLOWER

The following observations upon the vasculature of the flowers of *Austrobaileya* are based largely upon preserved specimens collected by Mr. Stephens. They have been supplemented, however, by an examination of cleared carpels and stamens from herbarium specimens of *A. scandens, Kajewski 1269,* and *A. maculata, White 10734.*

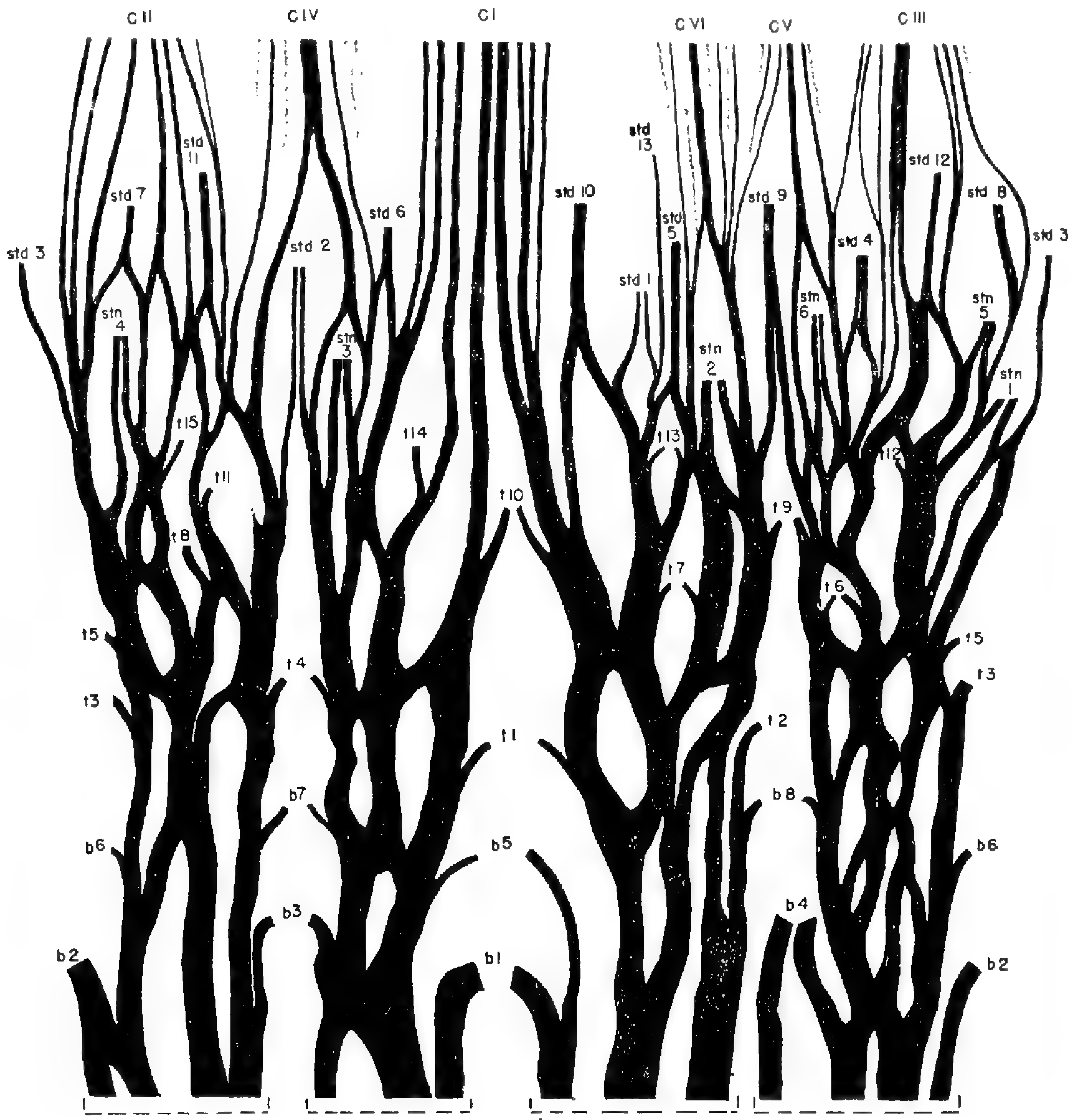
At the base of the pedicel, there are 10–14 vascular bundles arranged in four independent aggregations, *Text-fig. 4.* The parenchymatous lacunae between these aggregations of bundles correspond with the decussate arrangement of bracts on the pedicel, i.e. four orthostichies. Each bract receives a pair of strands, the individual members of the pair arising from independent systems of the eustele, *Text-fig. 4, b1–b8.*

The vasculature of the tepals is similar to that of the bracts. The distinctness of the individual members of the pair of strands is particularly clear in the bases of the outer tepals, *t1–t10;* in the inner tepals, one of the strands of the pair is either feebly developed, *t11,* or altogether absent, *t14, t15.* Within the tepal, the two strands fuse and then split into a large number of veins that vascularize the lamina.

The stamens and staminodia may show at their point of attachment either two distinct vascular strands, or a pair of closely approximated strands, or a single strand. Usually in the outer functional microsporophylls, the strands are distinctly double at least at the base, *stn 1–stn 6,* while in the inner androecial members, a section at a corresponding level usually shows a single strand, *std 5–std 11.* However, when this strand is followed downwards in the axis, it frequently is formed by the fusion of two bundles from independent systems, *std 9, std 10,* etc.

When a single vascular strand enters the microsporophyll, it soon trifurcates, the lateral strands again splitting at higher levels. On the other hand, when two strands supply the microsporophyll, they dichotomize at the base of the structure and the middle two branches fuse; the lateral branches also bifurcate at a slightly higher level, *Text-fig. 5.* In both instances, the strands remain close together as far as the level of the apexes of the sporangia and then spread in a fan-shaped manner.

In the case of flower buds collected by Mr. Stephens, the exact number and the behavior of the strands that enter the carpels could not be deter-



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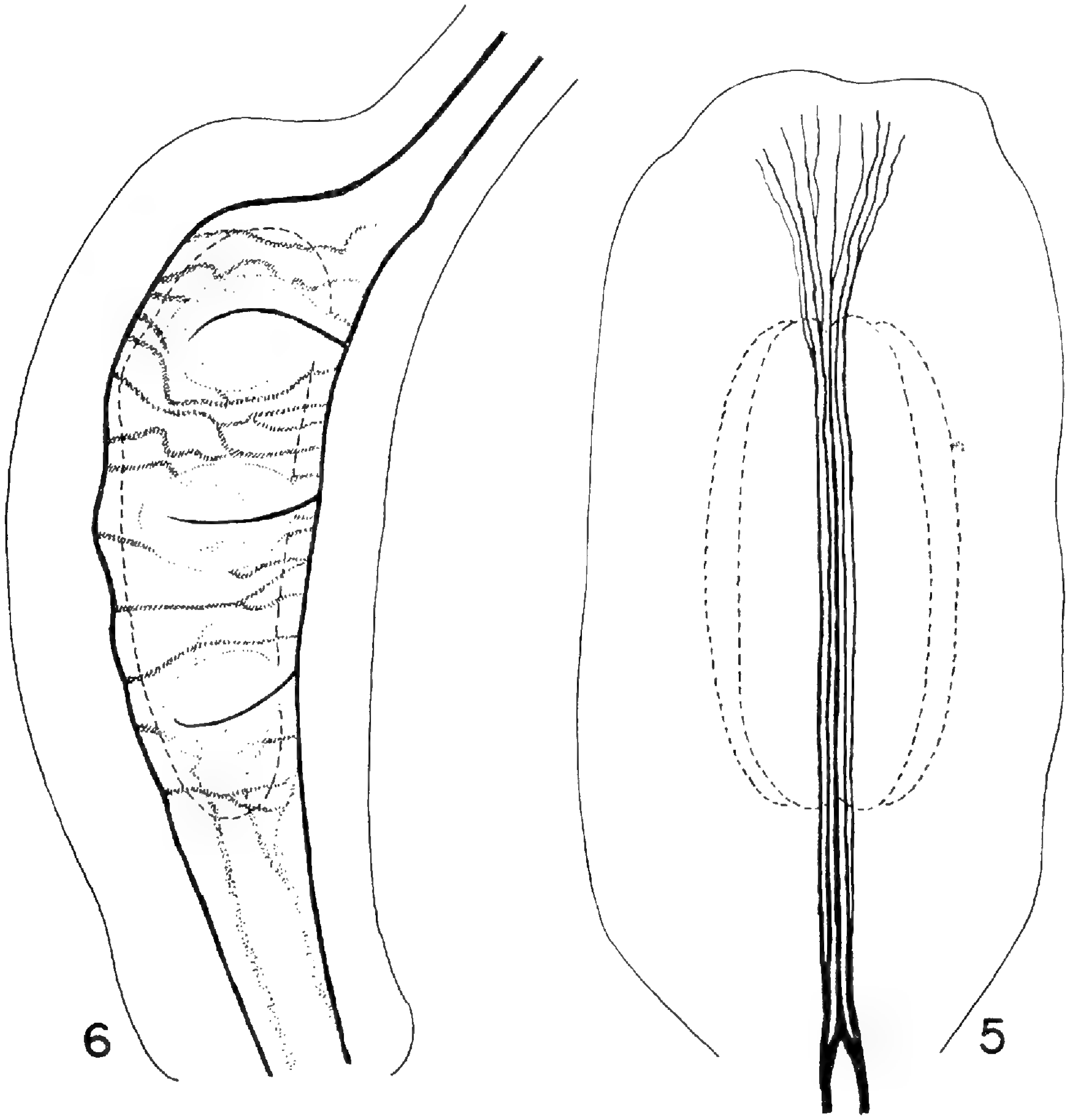
TEXT-FIGURE 4. Pattern of vascularization of a flower. The axis is shown as if longitudinally cut on one side and spread in one plane. *b1-b8,* bracts; *t1-t15,* tepals; *stn 1-stn 6,* stamens; *std 1-std 13,* staminodia; *C I-C VI,* carpels. The upward terminations of strands correspond approximately to the level of insertion of the respective appendage.

mined with certainty. Even in the oldest bud examined, *Text-fig. 4,* some of the vascular strands were still in the process of differentiation (indicated by stippled lines in the figure) and it is not possible at such a developmental stage to determine their true relationship either to the floral axis or to the carpels. However, in the buds examined by us, at least three vascular strands were well differentiated in most of the carpels. These strands occupied positions corresponding to the median and ventral veins. The median vein in some cases, *C I,* showed distinct doubleness at the point of entry into the carpel and when traced downwards, the two halves fused with two independent systems of bundles in the axis. In other carpels, the two strands gave indications of ontogenetic fusion,



TEXT-FIGURES 5, 6. *Fig. 5.* Vascularization pattern of microsporophyll; broken lines denote the position of the sporangia. *Fig. 6.* Vascularization pattern of carpel; broken line denotes the extent of the locule. Vascularization is shown in one longitudinal half of carpel which is cut in the plane of conduplication.

C III, C IV. In still others, the median strand had lost its paired appearance and its true double nature was demonstrable only far below in the axis, *C II, C VI*.

In the case of carpels from herbarium specimens, *Kajewski 1269* and *White 10734*, the vasculature appears to be well developed at anthesis. Three of such carpels showed a distinctly double median strand at the base, the halves of which fused at a higher level in the "stipe." In others, the corresponding strand was single. Along its course through the locular part of the carpel, the median strand sends out numerous branches laterally in a pinnate manner and the branches form a diffuse net-work within the carpellary wall; the ends of the branches usually anastomose with the ventral strands, *Text-fig. 6*. The extra strands that often enter the carpel from the axis also anastomose with the system of the median strand. The ventral strands supply the ovular traces and extend to varying distances in the style along with the median strand.

Taking the vascular pattern of the flower as a whole, it appears that although there may be considerable variation among the different appendages of the same flower, and even among those of the same whorl, the paired condition of the median strand is fundamental. In those instances where the strand appears single, it is often possible to demonstrate its double nature at lower levels of the floral axis. In other words, the doubleness of the median vascular strands of the floral appendages, as in the case of the vegetative leaves of *Austrobaileya*, is *not* a result of dichotomy of a single bundle, but of the approximation of two distinct strands originating from two separate systems of bundles.

DISCUSSION

The genus *Austrobaileya* has *monocolpate* pollen. This structural type of pollen occurs in many seed ferns, Bennettitales, Cycadales, Ginkgoales, monocotyledons and in certain families of the Ranales (sensu latu), Bailey and Nast (1), Swamy and Bailey (13). The rest of the dicotyledons, including the Dilleniaceae, have *tricolpate* pollen or phylogenetically modified types of such pollen. Thus, the occurrence of monocolpate pollen in *Austrobaileya*, coupled with the presence of "ethereal oil cells" and the absence of raphides, precludes any close relationship of the genus to the Dilleniaceae.

Among families of general ranalian affinities which have monocolpate pollen (or phylogenetically modified types of such pollen) all have "ethereal oil cells" of a characteristically similar type with the exception of the Cabomboideae and the Nymphaeoideae of the Nymphaeaceae. These secretory cells and monocolpate pollen occur in association in *Austrobaileya* which indicates that the genus belongs among this complex of families rather than among ranalian families having tricolpate pollen, viz. Trochodendraceae, Tetracentraceae, Eupteleaceae, Illiciaceae, Schisandraceae, Cercidiphyllaceae, Ranunculaceae, Berberidaceae, Lardizabalaceae or Menispermaceae.

The nodal anatomy of *Austrobaileya* is of a *unilacunar* type. Among ranalian families, having monocolpate pollen (or modified forms of such pollen) and "ethereal oil cells," this form of nodal structure occurs in the Monimiaceae, Gomortegaceae, Lauraceae, Hernandiaceae, Lactoridaceae and Chloranthaceae (*Ascarina* and *Hedyosmum*). On the contrary, the Winteraceae, Degeneriaceae, Himantandraceae, Magnoliaceae (sensu stricto), Annonaceae,* Eupomatiaceae, Myristicaceae,* Canellaceae, Piperaceae, and Saururaceae have dominantly *trilacunar* or *multilacunar* nodes or anomalous nodal structures, e.g. the Calycanthaceae.

Not only does *Austrobaileya* differ from the Winteraceae, Magnoliaceae, Annonaceae and other more or less closely related trilacunar and multilacunar ranalian families in its nodal anatomy and in the vascularization pattern of its leaves and floral appendages, but also in the structure of its xylem and phloem, its parenchymatous and sclerenchymatous tissues and in the form and internal structure of its floral appendages. The *totality* of general morphological, and of specific anatomical, evidence is not indicative of relationship to any of these families (i.e. except distantly as members of a common ranalian grouping), but rather to the assemblage of unilacunar families enumerated in the preceding paragraph.

Among these unilacunar families, the Monimiaceae are the most highly diversified, exhibiting numerous trends of morphological and anatomical specialization, in both their vegetative and reproductive parts, and affording significant clues regarding phylogenetic changes that occurred in the evolution of the Gomortegaceae, Lauraceae, and Hernandiaceae.

Austrobaileya is a vine and there is a scandent tendency in a number of the Monimiaceae. The simple, pinnately veined leaves of *Austrobaileya,* as of the Monimiaceae and Chloranthaceae, are opposite or sub-opposite and exhibit a typical decussate phyllotaxy at least during the earlier stages of the development of a shoot. The leaves of *Austrobaileya,* as of *Trimenia* and *Piptocalyx* of the Monimiaceae, *Lactoris* of the Lactoridaceae and *Ascarina* of the Chloranthaceae, are vascularized by two strands that are independent at the nodal level of the stem and are attached at lower levels to independent parts of the eustele. The stomata of *Austrobaileya,* as of many Monimiaceae, are transitional between "syndetocheilic" and "haplocheilic" appearing, and have a similar pattern of internal cuticularization, Money (7). The xylem of *Austrobaileya,* as we have shown, *Figs. 5–7,* has numerous transitional stages in the development of vessels from tracheids with unusually large bordered pits. Such imperforate tracheids occur in the vesselless xylem of *Amborella,* Bailey and Swamy (4). Furthermore, there are numerous transitions between tracheids and septate fibres, such as are characteristic features of many Monimiaceae. In addition, calcium oxalate is deposited in *Austrobaileya,* as in the Monimiaceae and the Lauraceae, in the form of numerous minute crystals, viz. in the form of "crystal sand" rather than as conspicuous druses or large, single, rhombic crystals.

* Mistakenly reported as unilacunar by Sinnott (10).

The totality of available evidence from all vegetative parts of *Austrobaileya* provides no significant evidence for excluding the genus from the Monimiaceae as constitued by Perkins (8), particularly if such genera as *Amborella, Trimenia* and *Piptocalyx* are retained within the family. It is the flower of *Austrobaileya* and specifically its multiovulate carpels that is the chief obstacle to such a procedure. It should be noted in this connection, however, that there is such a wide range of morphological variability in the stamens, staminodes and carpels of the Monimiaceae that excessive emphasis should not be placed upon differences in the external forms of these organs in *Austrobaileya.* Furthermore, the tribes Hortonieae and Trimenieae were obviously established for florally more primitive representatives of the family, specifically for genera having free perianth members and a broadly convex or only slightly concave torus. Therefore, it would not appear to be entirely illogical to include in the family a genus which has retained broad microsporophylls and carpels in which the ovules have not been reduced to one, particularly as the vesselless *Amborella* is considered to be a member of the family.

As stated by us in a previous paper, Bailey and Swamy (4), if such genera as *Trimenia, Piptocalyx* and *Amborella* are to be retained in the Monimiaceae then the present concept of the family could be broadened to include *Gomortega* and *Austrobaileya.* Conversely, if a narrow concept of the family is to be maintained, then *Trimenia, Piptocalyx* and *Amborella* should be excluded, as well as such genera as *Gomortega* and *Austrobaileya.* However, before such decisions are attempted, it is essential to assemble more comprehensive and reliable information regarding *Gomortega, Austrobaileya* and the various genera of the Monimiaceae. As stated by White, in passages quoted in the introduction to this paper, it is essential to study the fruits and seeds of *Austrobaileya* before attempting to segregate the genus in an independent family. Mr. Stephens is attempting to obtain fruits and seeds for us, and, in addition, material suitable for critical embryological and cytological investigations. The separation of *Amborella* in an independent family, the Amborellaceae, Pichon (9), upon the basis of our preliminary note (3), without waiting for the publication of our detailed investigation (4), was premature and singularly unfortunate since erroneous statements regarding the ray structure and orthotropous character of the ovule were included in the brief description of the new family.

ACKNOWLEDGMENTS

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EXPLANATION OF PLATES

PLATE I. *A. scandens, Brass 18160. Fig. 1.* Part of a transverse section of a large stem, × 20. *Fig. 2.* Secondary phloem of same more highly magnified, × 130.

PLATE II. *A. scandens, Brass 18160. Fig. 3.* Secondary xylem of *Fig. 1* more highly magnified, × 130. *Fig. 4.* Tangential longitudinal section of the secondary xylem, × 50.

PLATE III. *A. scandens, Brass 18160. Figs. 5–7.* Scalariform perforation plates of three vessels of different diameter, × 510.

PLATE IV. *A. maculata,* Stephens' collection. *Figs. 8, 9.* Flower buds, × 3. *Fig. 10.* Same, as seen from the stalk-end, × 3. *Fig. 11.* Group of stamens and other inner appendages after the removal of the perianth, × 5. *Fig. 12.* Group of carpels after the removal of the other floral appendages, × 5. *Fig. 13.* Carpel, × 12. *Fig. 14.* Same, longitudinal section passing through the plane of conduplication, to show the "stipe," locule and ovules, × 22. *Figs. 15, 16.* Adaxial and side views of fertile microsporophyll, × 8. *Figs. 17–19.* Staminodia; in *Fig. 17,* the structure bears degenerate sporangia, × 8. *Figs. 20–32.* Perianth members of a single flower. The order from the outermost to the innermost runs according to the serial numbers, × 1.

PLATE V. *Fig. 33. A. scandens, Kajewski 1269.* Stamen (middle) and staminodia (right and left), × 5. *Fig. 34. A. maculata, White 10734.* Stamens (right and left) and staminodia (middle), × 5.5.

PLATE VI. *A maculata,* Stephens' collection. *Fig. 35.* Transverse section of a flower bud at the apical region, × 50. *Fig. 36.* Same, at a central level, × 50.

PLATE VII. *A. maculata,* Stephens' collection. *Fig. 37.* Longitudinal section of two carpels, the left hand one cut in the plane of conduplication, and the right hand one, at right angles to the previous plane, × 50. *Fig. 38.* Longitudinal section of the floral apex, × 50. *Figs. 39–41.* Structure of the microsporangium and tapetal organization, × 130. *Fig. 42.* A portion of the epidermis of the microsporophyll, showing the histology of the pigment cells, × 130. *Figs. 43–46.* Transverse sections of a carpel cut at successively higher levels, × 100.

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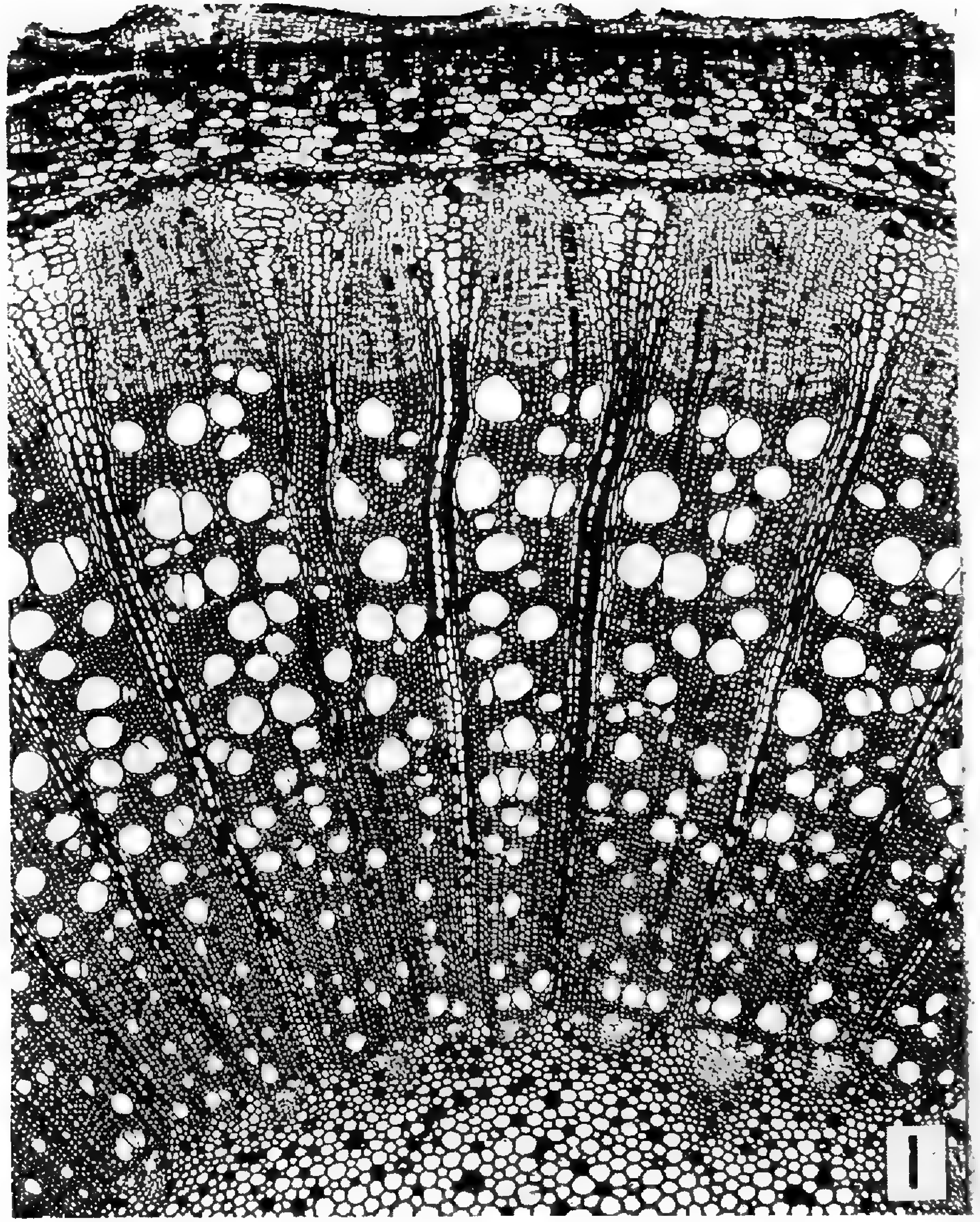

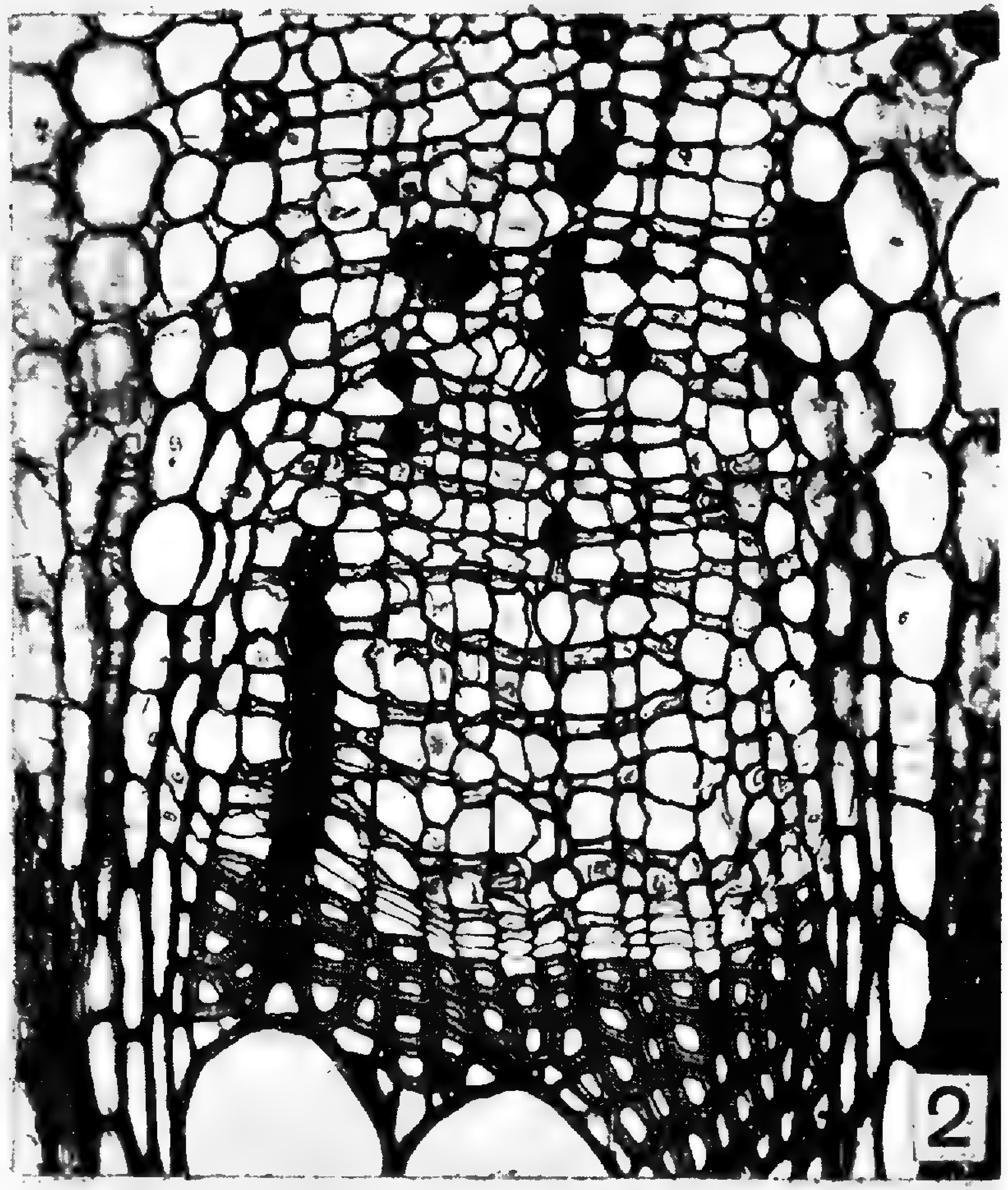

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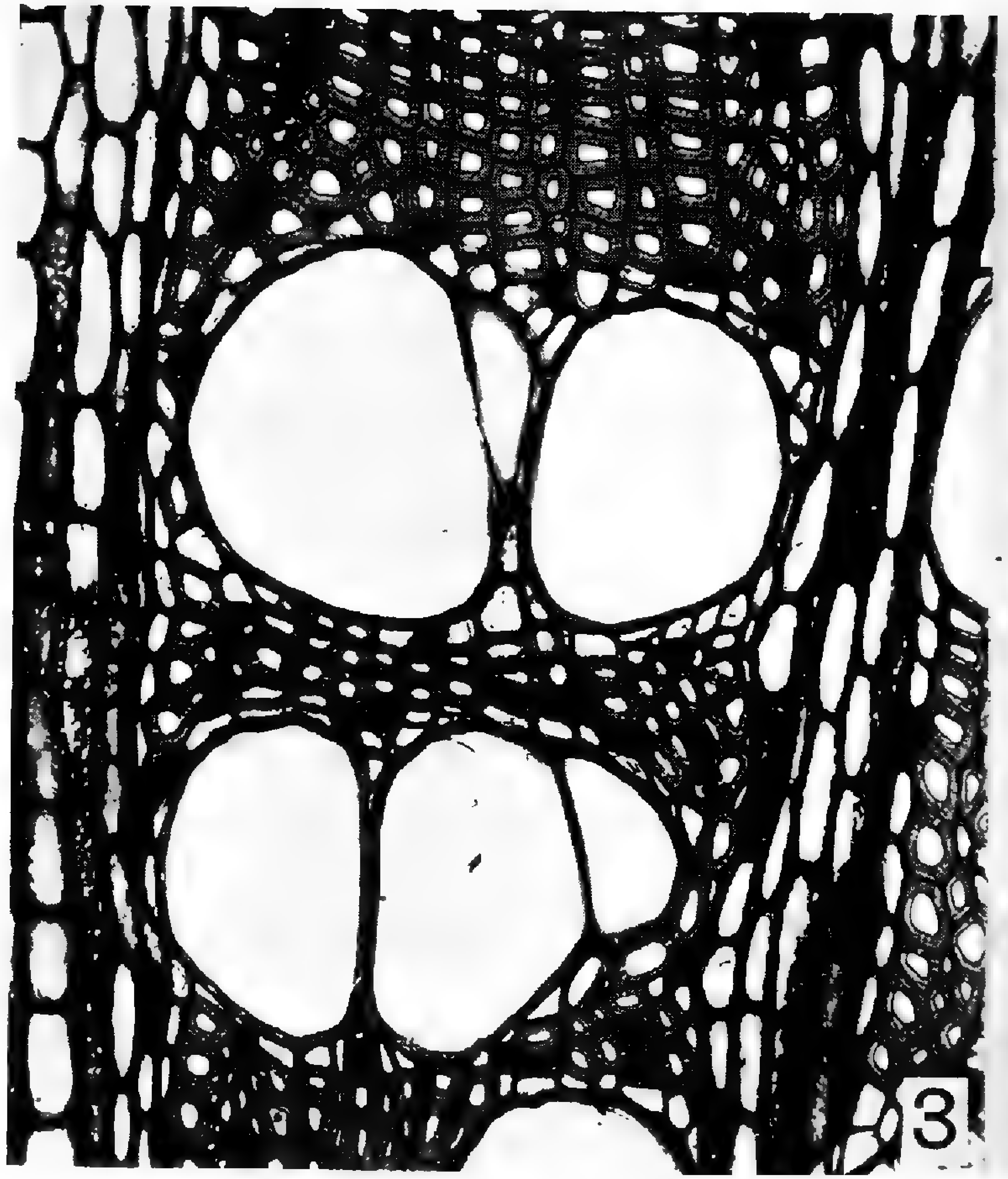

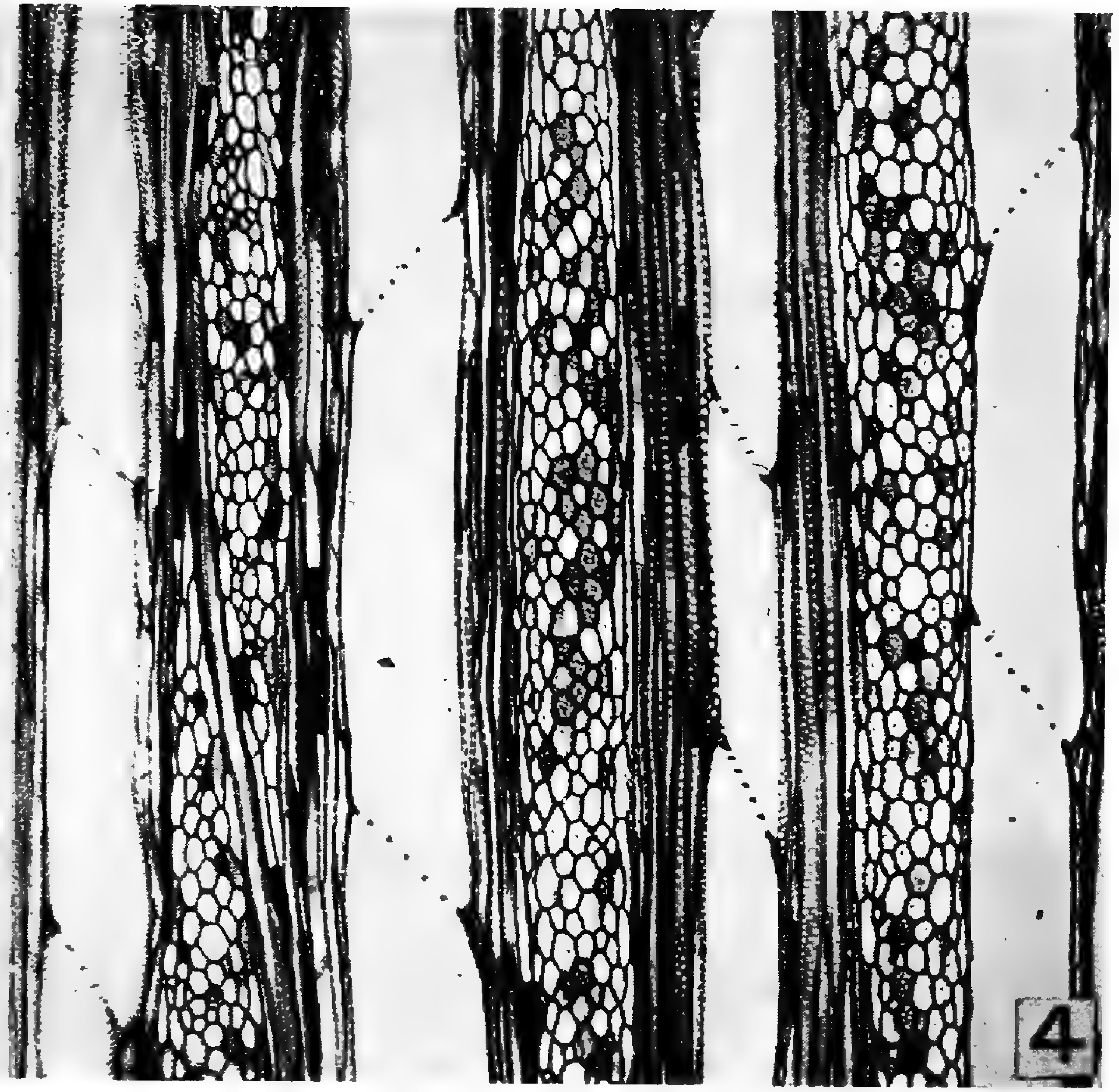

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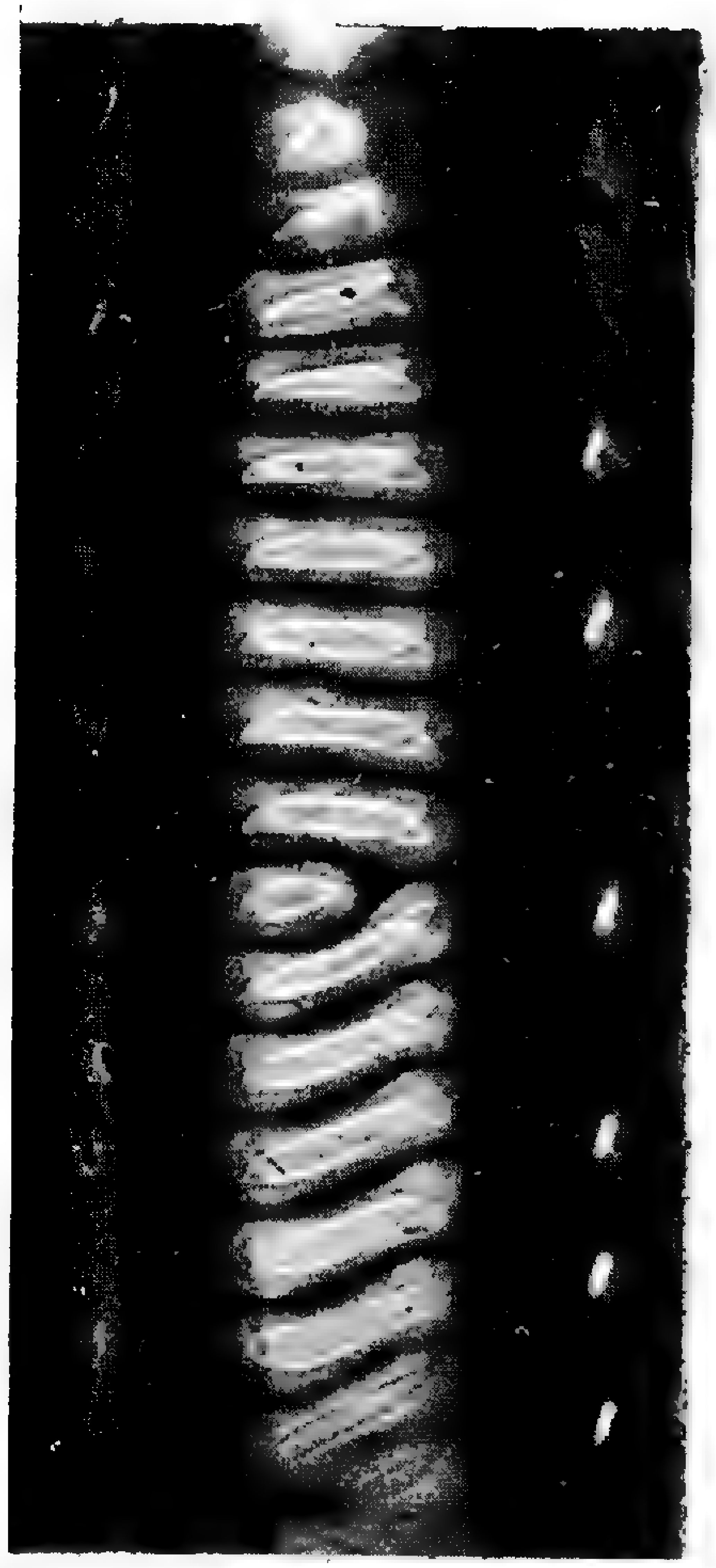

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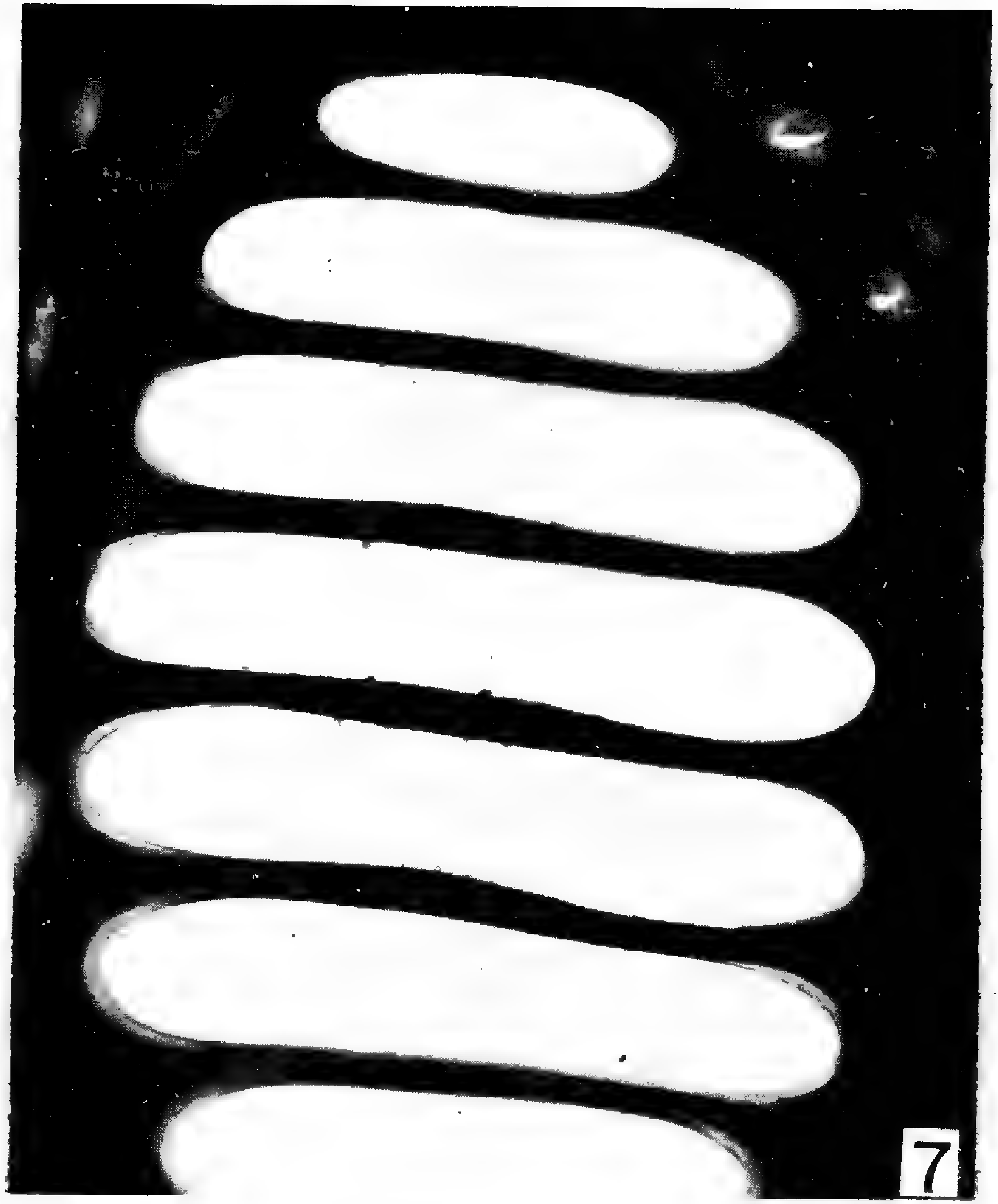

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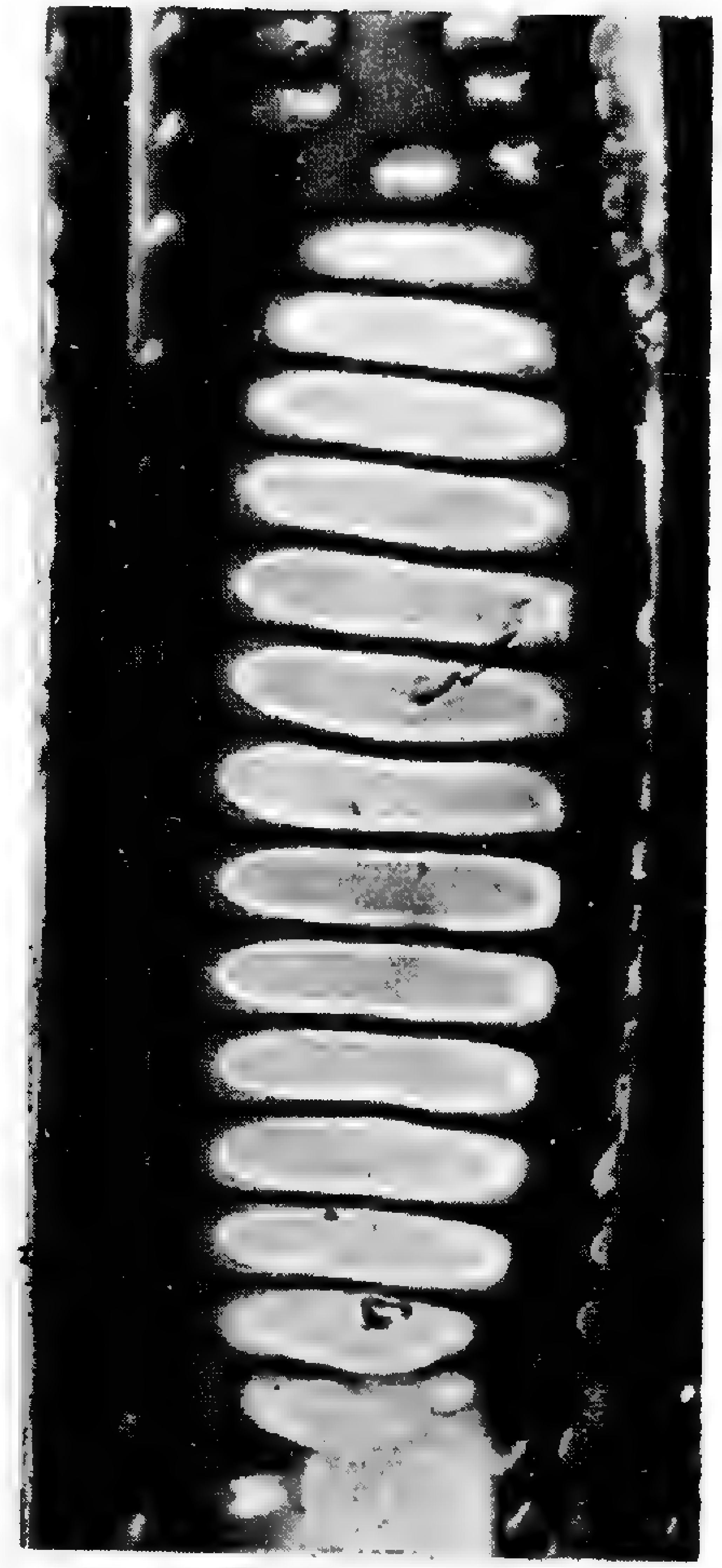

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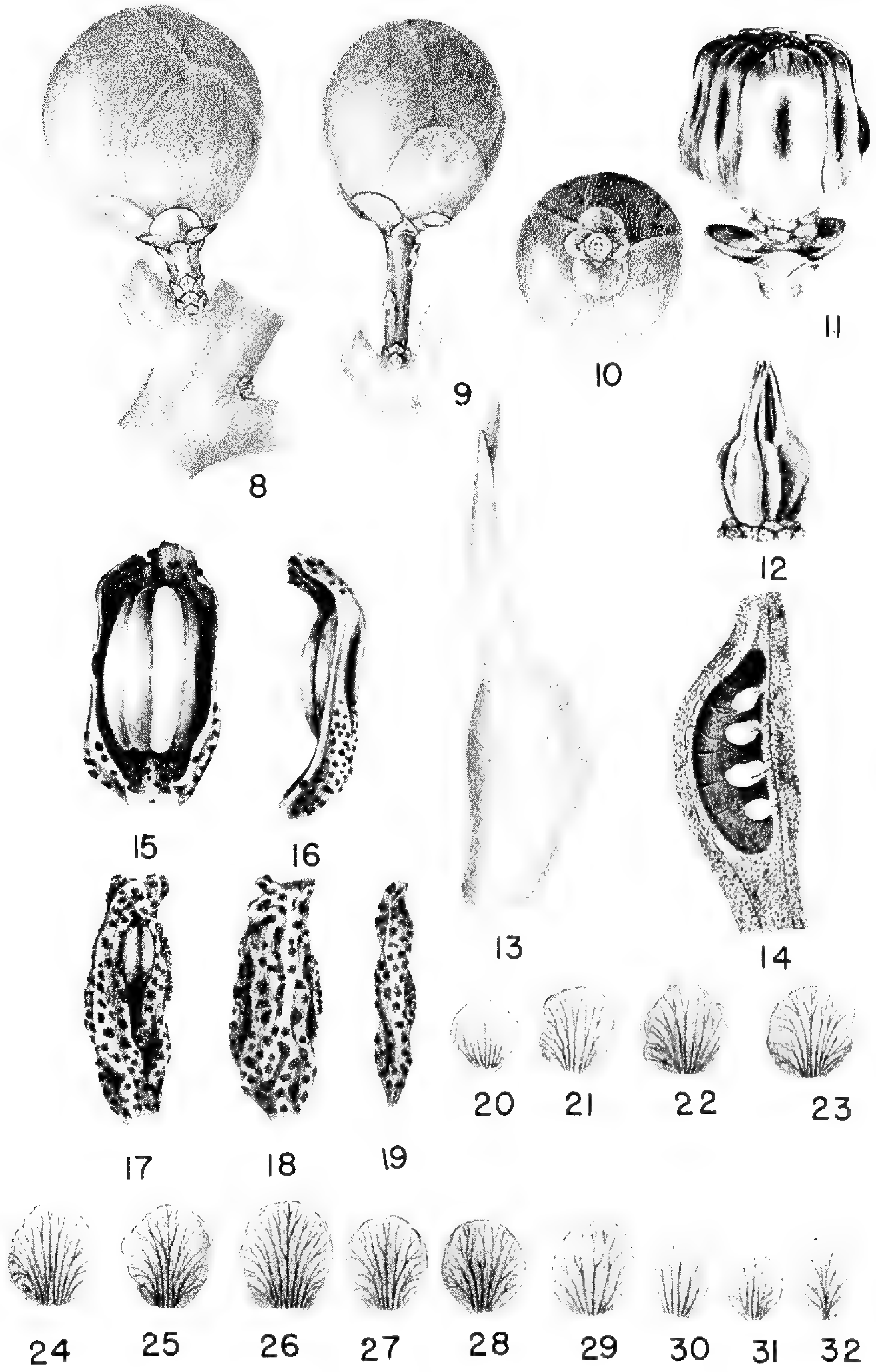
Bailey & Swamy, Morphology of Austrobaileya



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FULL-TONE—MERIDEN

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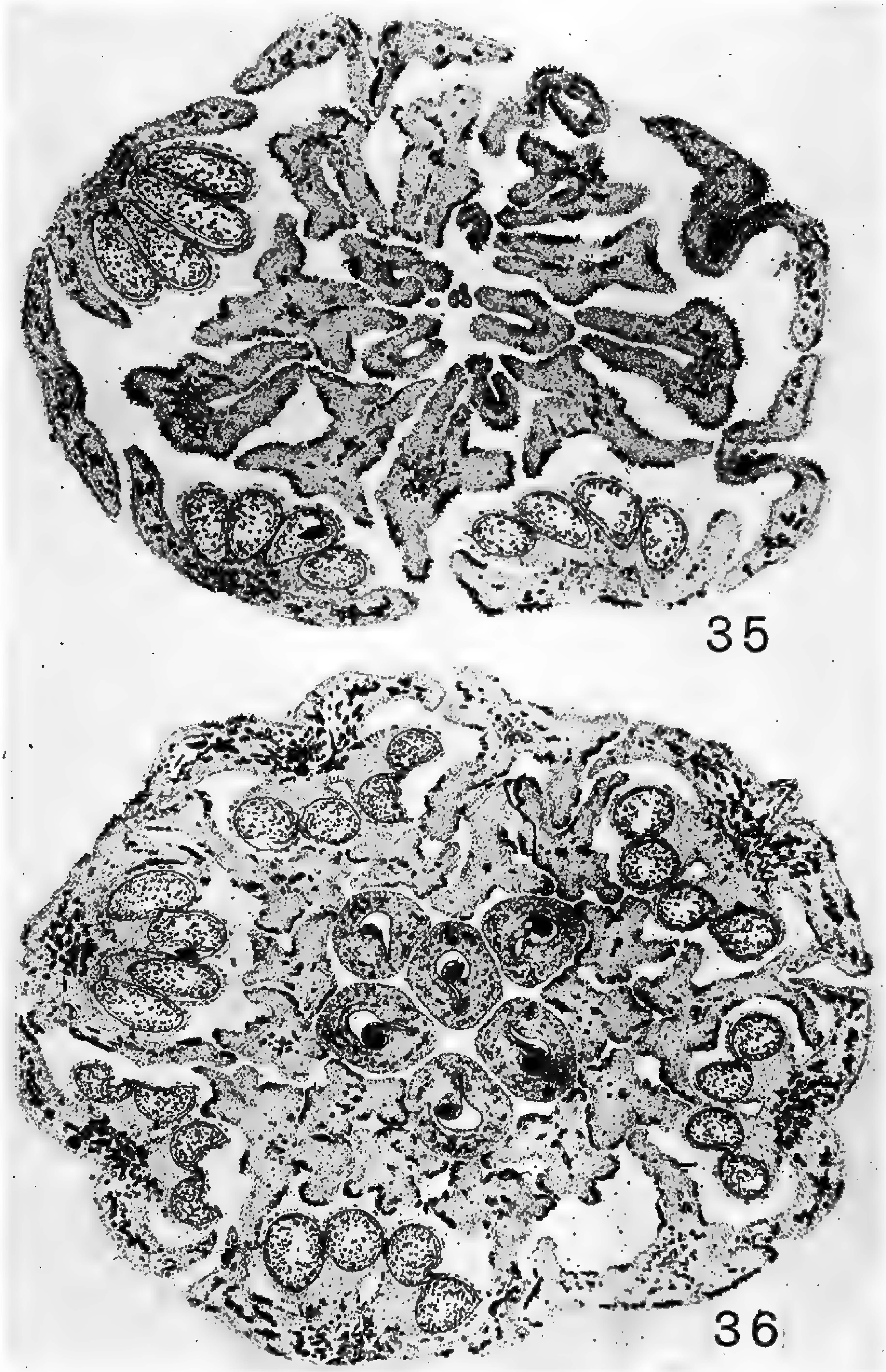

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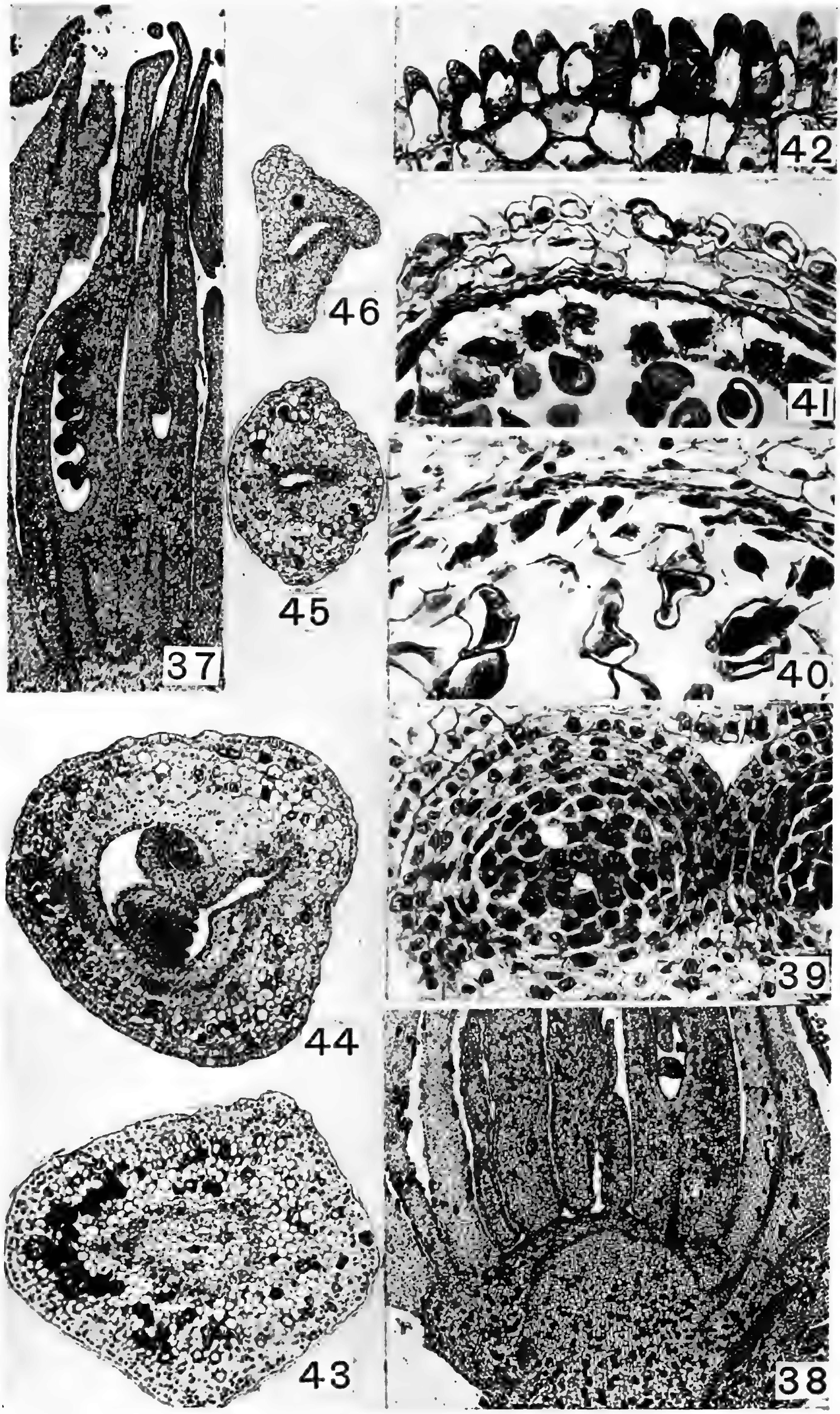

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A NEW AGAVE FROM ARIZONA

SUSAN DELANO MCKELVEY

With two plates

ON MAY 15, 1934, while visiting the Kaibab Plateau on the northern side of the Grand Canyon of the Colorado, Coconino County, Arizona, the writer first saw the *Agave* here described. Two plants had been collected by the Park authorities at some previous date, but their leaf-rosettes and long fruiting stalks were still intact. It was not possible to make the descent into the gorge, but a few scattered plants were discernible some distance below the rim. Flowers were promised at a later date but were never forthcoming, unfortunately.

The two plants are shown in the included photograph (McKelvey 152–12); although one was considerably smaller than the other it was undoubtedly the same species. The dimensions are from the larger plant.

Agave kaibabensis, spec. nov.

A *A. utahense* differt habitu solitario, non caespitoso; foliis basi rosulatim confertis, longioribus, latioribus; inflorescentiis elongatis (4.4–7.5 m. longis), basi ramiferis.

Leaf-rosette 1.4 m. in breadth, 0.7 m. in height, nearly hemispherical, with ascending and spreading straight leaves which attained 0.4 m. in length (base included). Leaf-blade concavo-convex for the entire length, usually tapered from the point of union with the base to the apex, sometimes constricted above this union, then gradually and slightly broadened to a point near the middle, thence tapered to an acuminate apex, smooth on both surfaces; terminal spine 1–1.3 cm. in length, channeled on the upper surface and decurrent along the margins of the blade for 10–15 cm.; prickles along the leaf-margins irregularly spaced at intervals of 0.7–2 cm., small, 1.6–3.2 mm. in length, curving either backward or forward following the blade-margins. Leaf-base about 15 cm. in breadth at the point of union with the stem, gradually narrowed to the point of union with the blade where about 6.5 cm. in breadth, about 10 cm. in median length. Inflorescence 4.4 m. in length over all; scape 1.4 m., inflorescence proper ca. 3 m.; the last, while spicate in general appearance, was narrowly ovoid-cylindrical, branched for the entire length, the branchlets longer and more complexly branched below than above; branchlets near the base 10–12 cm. in length, twice forked; those above gradually reduced in length and finally at the top of the inflorescence proper simple. Capsules produced in great numbers, 2.5–3 cm. in length, nearly ovoid with an acute apex and short-stipitate base, with slightly glossy, red-brown epidermis; pedicels attaining 0.7 cm. in length, enlarged at the point of union with the capsule, terete; seeds extremely abundant, small, black;

bracts near the base of the scape 18–20 cm. in length, only slightly reduced in length below the inflorescence proper, at insertion 2.5–3.8 cm. in breadth, tapered from this point to the apex, the upper portion more or less concave, the lower portion flat, with a short, very sharp, channelled red spine, tenaciously attached to the scape, eventually reflexed.

ARIZONA: Coconino County, Kaibab Plateau on the north side of the Grand Canyon of the Colorado River, *McKelvey 4381* (Arnold Arboretum, TYPE), *4381A* (Arnold Arboretum), May 15, 1934.

At first glance the plants were thought to be *Agave utahensis* Engelm., in colossal form — that species is common in northwestern Arizona and is said to occur plentifully in the Grand Canyon although the writer has not happened to see it growing there. But examination disclosed marked differences in the individual leaf, the leaf-rosette, to some extent in the inflorescence, and, important, in the habit of the plant.

When examined the leaves of the new species were dry and their margins were considerably incurled but must once have been much flatter; in form and size and in the straight, spreading habit they came close to what is found in the so-called century plant or mescal — with paniculate inflorescence — and the rosette in size and near-hemispherical form also. The leaves of *Agave utahensis* and of those of its allies with prickles along the leaf-margins (and producing spicate or subspicate inflorescences) show a marked tendency to bend inward towards the center of the head, producing a spherical or near-spherical rosette. This tendency to spreading or to curving inward is not altered with the death of the plant; if anything it becomes more pronounced with drying in each instance. The leaves are also much smaller, shorter, and narrower.

Agave utahensis shows a tendency towards a panicled inflorescence. This has been noted by the writer more than once and has been recorded in the literature. Miss Mulford (Agaves of the United States, 77, 1896) states that that species ". . . so frequently approaches the paniculate character, that it might be placed in the Euagave section with almost as much propriety as in that of the Littaea." In the case of the new species the branching is more complex and not confined to the lower portion of the inflorescence proper as is usual in the better known plant.

In habit the two would seem to differ radically. The two plants of *Agave kaibabensis* which were examined showed no tendency to produce offsets, while those seen from afar in the gorge were obviously solitary rather than of clump-habit. *Agave utahensis* is caespitose, in all instances, often producing large and involved clumps.

Park officials said that near the base of the gorge flower-stalks attained 7.5 m. in over-all length; while easy to overestimate, yet, from the large specimen seen, a greater size does not seem improbable. It is not unique to find a plant growing on the walls of the gorge but not appearing above the rim — it has been observed in one species of *Yucca* certainly. It was said that the Piute Indians called the plant "Oose" (this spelling open to correction); the local name was "Yant," the stalk of the inflorescence called a "Yant-stick" and used to prod cattle.

Unsuccessful attempts were made to locate the plant in adjacent regions, and while, from information obtained, it may occur near the lower portion of Kanab Creek where this empties into the Colorado, it is possible that the name "Yant" may be applied as well to *Agave utahensis*.

It is believed that photographs of *Agave kaibabensis* have appeared on three occasions: Once in an unsigned article in *Garden and Forest* (8: 384, *fig. 53.* 1895) as *Agave utahensis;* but the solitary rosette is far more suggestive in every respect of the plant under discussion. The short scape of the photograph would be abnormal for either species, — it may have been cut for inclusion, but one cannot be sure from the reproduction. The article notes the leaves as ". . . twelve or fourteen inches long and from two to three inches broad. . . ." and ". . . the slender spike . . . as three feet long, and often raised on a stem seven or eight feet high." This plant grew on ". . . the bluffs and cliffs which rise from the slopes of the Grand Cañon . . ." (while not entirely clear this seems to indicate the Canyon walls); it is not stated whether on the north or the south side of the river.

Next, two photographs appeared in Mr. Harold E. Anthony's interesting article published in *Natural History* (40: 719, 1937), describing the exploration of Shiva Temple, a near-island in the Canyon connected by a saddle with the north rim. The first photograph, showing only a rosette — one which might well belong in the Euagave section — is captioned: "The Mescal of Shiva is a variety of century plant with stiff, thorn-tipped foliage. The young plants grow in a compact clump." The word "clump" as used here probably refers to the dense rosette — it shows no tendency to suckering. The second photograph is captioned: "When mature the mescal, or 'yant,' sends up a tall flower stalk twelve feet or more. The Pueblo Indians used the starchy center of this stalk for food, baking it in earthen pots." The rosette is not visible in this picture, but one sees a tall inflorescence with scape longer than the flowering portion and with the inflorescence proper considerably broader below than above, although the general effect is spike-like.

The third picture of this plant has recently (1945) appeared in *This is the Place: Utah,* by Maurine Whipple. The caption is *The Grand Canyon of the Colorado,* the plate on page 204.

The name *Agave kaibabensis* indicates the plant's habitat as now known. The smaller plant of the picture is *McKelvey 4381A*. The plant, as noted, came originally from some distance below the rim on the north wall of the Canyon. The date of actual collection is not known; it must have been in the tourist season of 1933; the writer made her specimens on May 15, 1934. Her photographs 152–11, 12, and 153–1, 2 are of these plants; reproduced here is 153–2 (Pl. I).

Included, to show the different appearance of its rosettes and leaves, is a photograph (McKelvey 82–1) of *Agave utahensis* (Pl. II); the specimen (*McKelvey 1655*) was collected March 31, 1929, some 13 miles east of Peach Springs, Mohave County, Arizona, in the extreme northwestern corner of Yavapai County. Over much of this region the plant is plentiful, reaching certainly as far southwest as Valentine, Mohave County.

The tendency of the leaves to bend inward towards the center of the head and so form a near-spherical rosette, and the caespitose habit of the plant are apparent. The six-inch rule indicates the small size of leaf and leaf-cluster. Miss Mulford (l. c.) described the leaves of *Agave utahensis* as ". . .linear-lanceolate . . . 12 to 17 cm. long, 2–2.5 cm. wide, or larger . . ." and its inflorescence thus, ". . . scape 15 to 24 dm. high . . . upper 3 to 6 dm. floriferous; panicle narrow . . ."

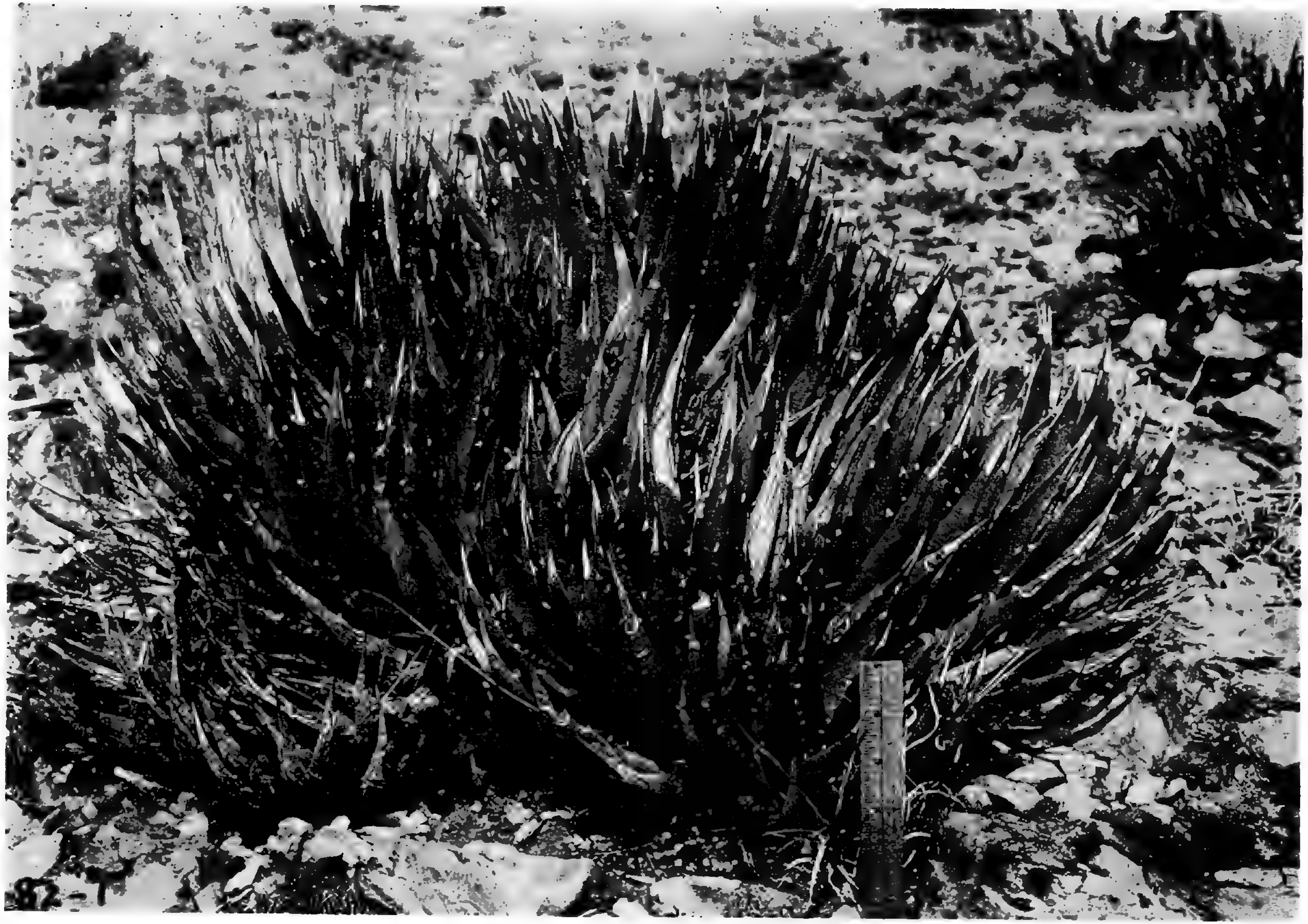
EXPLANATION OF PLATES

PLATE I. *Agave kaibabensis* McKelvey, showing the near-hemispherical rosette of leaves and the long-branched inflorescence. Collected on the Kaibab Plateau, on the north side of the Grand Canyon of the Colorado River, Coconino County, Arizona.

PLATE II. *Agave utahensis* Engelm., showing caespitose habit. Collected about thirteen miles east of Peach Springs, Mohave County, Arizona.

ARNOLD ARBORETUM,
HARVARD UNIVERSITY.

Agave kaibabensis McKelvey



Agave utahensis Engelmann

A NEW GENUS OF THE ARALIACEAE

HUI-LIN LI

ON THE ISLAND OF TAIWAN (FORMOSA), there is an anomalous species of the family Araliaceae known as *Oreopanax formosana* Hayata. *Oreopanax* is otherwise an exclusively tropical American genus. Upon careful study of the ample number of specimens preserved in Formosan herbaria, I have come to the conclusion that a different genus is represented. Not being able to refer it to any existing genus, I propose a new genus under the name *Sinopanax,* in recognition of its geographical location.

The specimens cited below are those preserved in the Herbarium of the National Taiwan University except *Wilson 9734,* which is deposited in the herbarium of the Arnold Arboretum.

Sinopanax, gen. nov.

Arbuscula vel frutex, ramis cinereo-stellato-tomentosis vel adpresse pilosis inermibus. Folia ampla simpla longe petiolata, petiolis basi dilatatis, stipulis parum prominulis ad basin petiolorum connatis, laminis late orbicularibus obsolete 3–5-lobatis vel grosse irregulariter dentatis, subtus stellato-tomentoso et piloso dense obtectis. Inflorescentia ampla corymboso-paniculata terminalia laxa erecta aperta, ramis alternis angulo obtuso divaricatis. Florum capitula sublobata, capitulis florum pedunculatis remote instructis, bracteolae florum sub singulo flore 3-nae, 1 subtendente majore, 2 lateralibus minoribus oppositis. Calyx margine minute dentatus, basi exarticulatus. Petala 5, aestivatione valvata, caducissima. Stamina 5, filamentis brevissimis; discus explanatus. Ovarium 2-loculare, loculis 1-ovulatis, stylis 2 brevibus liberis erectis, stigmatibus terminalibus. Fructus late globosi, abortu 1-spermi drupacei, stylis persistentibus valde recurvis. Semina ovoideo subtriquetra, albuminibus ruminatis.

TYPE SPECIES: *Oreopanax formosana* Hayata.

One species, Taiwan (Formosa), China.

Sinopanax formosana (Hayata), comb. nov.

Oreopanax formosana Hayata, Fl. Mont. Form. 108, *pl. 14.* 1908, Icon. Pl. Form. **2:** 61. 1912, Gen. Ind. Fl. Form. 33. 1916; Kanehira, Form. Trees 280. 1917, rev. ed. 524, *f. 484.* 1936; Nakai in Jour. Arnold Arb. **5:** 19. 1924; Masamune, Short Fl. Form. 155. 1936.

CHINA: Taiwan: Kao-hsiung, Chi-shan, *Suzuki-Tokio 20930;* Akohuzi, *E. Matuda 1404;* Karenko, Nankotaizan, *Suzuki-Tokio, N. Fukuyama, & H. Shimida 17547;* Hannoki, Heito, *S. Suzuki 11127;* Arisan, Usyuoko, *S. Suzuki s. n.;* Ako, Mt. Buwi, *S. Sasaki s. n.;* Arisan, *E. H. Wilson 9734* (Arnold Arboretum).

A small tree or shrub, in dry sunny places, on landslides or in open forests at high altitudes of over 2000 meters. Endemic.

For *Oreopanax formosana,* Hayata originally cited five collections: *N. Konishi 34A; G. Nakahara s. n.; T. Kawakami & U. Mori 1709,* *1871,* and *1914.* Among these, three are represented by duplicates in the Herbarium of the Forestry Institute of Taiwan and carry the herbarium numbers as follows: *Kawakami & Mori 18506, Mori 18505,* and *Konishi 18511.* These have also been seen.

Oreopanax is an araliaceous genus of the tropics of the western hemisphere. Two species have been credited to eastern Asia, the only records of the genus outside America. One of them, *Oreopanax chinense* Dunn (Jour. Linn. Soc. Bot. 35: 500. 1906) is a species with digitately compound leaves, described from southern Yunnan. It belongs to the group of species of *Schefflera* with capitate flowers and is now known as *Schefflera chinensis* (Dunn) Li (Sargentia 2: 17. 1942). Another species, *Oreopanax formosana* Hayata, a species with simple irregularly and shallowly lobed leaves and described from Formosa, seems to represent a distinct genus. The occurrence of *O. formosana* Hayata in Formosa has often been referred to as a very anomalous case of distribution in the flora of the island, the species being the only representative of the otherwise exclusively tropical American genus. This view thus needs revision.

This Formosan species, here designated as representing the type of a distinct genus, *Sinopanax,* resembles *Oreopanax* in the simple leaves, sessile and capitate flowers, ruminate endosperm, and the presence of three bracts under each flower. However, there are some fundamental differences between the two. The ovary of *Oreopanax* is generally 5-celled, and the flowers are polygamo-dioecious or more rarely polygamo-monoecious. In this Formosan plant the ovary is 2-celled and the flowers are hermaphroditic. There are two styles, and these are so extremely short that the stigmas can actually be called sessile. In *Oreopanax* the style is rather long and bears a flat stigma.

This new genus of Formosa seems to be related to, but evidently not congeneric with *Schefflera.* The species of *Schefflera* have hermaphroditic flowers. Occasionally simple palmately lobed leaves and capitate flowers characterize some of its species. *Schefflera,* however, differs from the Formosan plant in having a 5–7-celled ovary and uniform or very rarely slightly ruminated endosperm. The relationship of this Formosan genus is probably closer to *Brassaiopsis* than to *Schefflera.* In *Brassaiopsis* the ovary is 2-celled, the leaves are either palmately lobed or digitately compound, and the endosperm is either ruminate or uniform. But in *Brassaiopsis* the flowers are polygamous and not capitate, and the two styles, either long or short, are distinctly united. *Sinopanax* is also distinct from both *Schefflera* and *Brassaiopsis* in the presence of three small bracts, one larger than the other two, under each flower.

It thus seems that this Formosan plant is not acceptable to *Oreopanax, Schefflera,* or *Brassaiopsis.* Nor can it be assigned, to the knowledge of the writer, to any other tropical Asiatic genus of the family. In order to ascertain its phylogenetic and geographic significance, it is thought best to designate a separate genus for its accommodation.

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THE GENUS ILEX IN CHINA *

SHIU-YING HU

With nine text-figures

INTRODUCTION

IN THE SPRING OF 1943, with Prof. W. F. Chu, Head of the Department of Forestry, College of Agriculture, University of Nanking, and a class of Agricultural students of Chuan-kang College of Agriculture and Engineering, I made a collecting trip to the charcoal manufacturing area at the White-water River, Pun-hsien, Szechuan, China. In the dense mixed forest I found an attractive dioecious evergreen shrub with large dark green lanceolate leaves, shiny cherry-red fruit, and chocolate-colored small flowers. The beautiful combination of colors, the complete representation of staminate and pistillate flowers and fruit, the rarity of the plant in the forests of West China, together created in me a strong interest in the plant. In my ignorance of the Aquifoliaceae I mistook it for an *Ilex* presumably a new species. Hence, I collected many sets of the plant, treasuring it highly and holding it for the time when I could identify it.

In the summer of 1944 I was asked to represent the Chengtu Chapter of the Science Society of China at its twenty-third annual meeting in Pai-pei, Chungking, China. I took this opportunity to be my precious chance to identify the specimens that had been accumulating in the herbarium of the West China Union University, the institute where I was working. Those specimens which I considered unusual I carried along, hoping that I might identify them in the well-equipped herbaria of the Biological Laboratories of the Science Society of China and that of the Academia Sinica, two neighboring refugee institutions then at Pai-pei.

After the meeting I stayed on to work at the Biological Laboratories, and starting with the White-water River shrub I worked through the Aquifoliaceae, but was doomed to disappointment. First, there was nothing that would match my specimen, and secondly, the Aquifoliaceae in that herbarium were in a discouraging condition. About half of the mounted sheets were not named. With three months of vacation ahead of me, and at the suggestion and with the encouragement of Prof. S. S. Chien, Acting Director of the Biological Laboratories, and others on the staff, I made a start in the clarification of the Chinese Aquifoliaceae. At that time I could not foresee the trouble that lay before me.

Life during those three months will provide me always with precious memories. I boarded in a mediaeval-type bungalow and worked on the

* A thesis submitted to the Graduate School of Radcliffe College in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

top floor of a poorly built and unshaded building under the blistering summer sun in one of the two hottest areas of China. In this environment I embarked on the study of the Chinese Aquifoliaceae. Though living in the age when atomic energy had been utilized by man, my equipment was no better than that used by Linnaeus. All that I had, besides the specimens and literature, were a hand-made tripod-lens, a ruler, two self-fashioned dissecting needles, and at night a rapeseed-oil lamp lit by three pieces of pith from *Juncus effusus*. My study gradually became so intensified that I found myself working fourteen or sixteen hours daily. Perspiration and the blood of crushed mosquitoes punctuated my three hundred pages of manuscript.

On my way back to Chengtu I stopped at the National Central University in Shih-pai, Chungking, then a refugee institution, and asked for the aquifoliaceous material in the herbaria of the Department of Biology of the College of Science and the Department of Forestry of the College of Agriculture. In Chengtu I worked on the material of the Herbarium of the University of Nanking (which had been transported to this place during the war), and the Herbarium of the Department of Biology, College of Science, National Szechuan University.

In the autumn of 1946 I came to the Arnold Arboretum to study taxonomy with Professor E. D. Merrill. One day I asked him about a topic for my thesis. After a good smile he said, "Well, since you have delved into the problem of *Ilex,* you might as well go more deeply and come out of it gallantly." Hearing this, a false joy of holding a secret fell upon me, for I then thought that I might use my old manuscript, emend it, make some additions, and use it as a thesis. At that time I still considered species to be definite entities and so readily separable one from another.

I started with the material in the Arnold Arboretum and the Gray Herbarium. Dr. A. C. Smith, then Curator of the herbarium of the Arnold Arboretum, borrowed the Chinese Aquifoliaceae from the U. S. National Herbarium of the Smithsonian Institution for me. Prof. Merrill, on a recent trip to Europe, procured either as a loan or a gift, isotypes, photos, and fragments of types from the herbaria at Kew, the British Museum, and the Rijksherbarium at Leiden. Later he obtained isotypes and other authentic specimens from the herbarium of the Muséum National d'Histoire Naturelle, Paris, France, the National Taiwan University of China, and the Botanical Institute of the University of Tokyo, Japan. Through Professor Johnston I received photographs and the loan of types from Cambridge University and from the British Museum and later the Asiatic types of *Ilex* from the New York Botanical Garden. In September, 1948, Professor Merrill made it possible for me to take a trip to the last mentioned institution so that I might examine the Chinese Aquifoliaceae in the herbarium, and as a result of this trip I borrowed about 400 sheets of *Ilex* for critical study. As I examined more and more material, my confidence in the classification of the Chinese Aquifoliaceae waned. First, the study weakened my concept as to the nature of species. So much variation appeared within a species, and such a gradual change from one species to another was exhibited, that I found it very difficult to determine definite specific limitations. I found that my original manuscript prepared in China was far too premature and that even Loesener's classical monograph on the Aquifoliaceae was, in part, based on characters far too superficial.

Besides those whom I have mentioned in the foregoing paragraphs and all the curators of the herbaria that have facilitated my studies, I would like to take this opportunity to express my special thanks to Professor E. D. Merrill who assigned me the problem, who has watched all my efforts, and has enjoyed with me the completion of the work; to Professor I. M. Johnston, the present sponsor of my thesis, for helpful criticisms and suggestions; to Dr. C. E. Kobuski, Curator of the herbarium of the Arnold Arboretum, for his patience in answering all my questions and, in turn, questioning me wisely, and for the pains he took in going over my manuscript; to Professor Karl Sax, Director of the Arnold Arboretum, for all the facilities he has provided in this study; and to Dr. Lily M. Perry, Professor A. Rehder, and the whole staff of the Arnold Arboretum for their willingness and readiness to give any help that a stranger in this New Land might need. A large part of this work has been done under the Julia George fellowship granted to me by Radcliffe College. To the administrators of that college, especially to Dean Bernice Brown Cronkhite, I wish to extend my deep appreciation.

In the paper I have used the terms East China, Central China, West China, Southwest China, and South China rather loosely. These names were taken in the common sense, as they are used in general literature and the spoken language. There is no definite geographical area assigned to each. In order to give my reader a picture as to the locality to which each name approximately refers, I find it necessary to define them. If one takes Ichang as a center, a circle with a radius of 400 miles will cover approximately the area between Lat. E. 105–115° and Long. N. 127–133°. This I term Central China. East of this area is East China and west of this area is West China. North of Central and East China is North China. South of Central and East China is South China. North of West China is Northwest China and south of West China is Southwest China. Northeast China in general usage refers to Manchuria.

HISTORY

In Linnaeus' Species Plantarum (1753), one Asiatic species was described, *Ilex asiatica* from "India." Because of the very short description, and because no type was preserved, its status cannot be determined. Linnaeus knew no Chinese species of the genus.

The first botanist to publish a species of Chinese Aquifoliaceae was John Sims. In 1819 he described the staminate plant of *Ilex chinensis* from a living plant introduced into England. Fourteen years later Hooker and Arnott (1833) described *Ilex pubescens* and *Prinos asprella* (*Ilex asprella* [Hook. & Arn.] Champ.) from South China, and in 1850, seventeen years later, Lindley and Paxton described two plants introduced by Fortune into England and named them *Ilex cornuta* and *Ilex microcarpa* (= *Ilex rotunda* Thunb. var. *microcarpa* [Lindl. & Paxt.] S. Y. Hu). About the same time (1852), Bentham, working on the flora of Hongkong, described *Ilex cinerea, Ilex graciliflora, Ilex memecylifolia,* and *Ilex viridis* from that island. These species were treated again (1861) in his Flora Hongkongensis. Maximowicz (1881) in his monographic work on *Ilex* treated twenty-two eastern Asiatic species, many of which occur in China. Forbes & Hemsley (1886), in their Index Florae Sinensis, enumerated nineteen species, one of which, *Ilex ficoidea,* was new.

Loesener in 1900, in Diels' Die Flora von Central-China, discussing the Aquifoliaceae of the area concerned, listed seventeen species and varieties that occurred there. Three of the specific epithets used, as well as five names of lower rank, were *nomina nuda.* In his monumental Monographia Aquifoliacearum published the following year he treated forty-eight species and eighteen varieties native to China. Ten of these species and fourteen of the varieties were described as new. In the supplement to that monograph (1908) he added notes on nine Chinese species and four varieties. He also described nine other new varieties or forms from China. In 1911, in Sargent's Plantae Wilsonianae, he added records for twenty species and described three from West China as new.

H. Léveillé (1911–1915) created much trouble for later botanists with an interest in Chinese plants. In his work on *Ilex* he was especially confusing. He described *Ilex chinensis* Sims at various times as a new species of *Celastrus,* of *Symplocos,* of *Embelia,* and of *Callicarpa.* Likewise he mistook *Ilex suaveolens* (H. Lévl.) Loes. for a new species of *Celastrus, Ilex metabaptista* Loes. for a new species of *Maesa* and of *Embelia* and *Ilex macrocarpa* Oliv. for a new species of *Diospyros* and of *Celastrus.*

Rehder, in his Ligneous Plants of Northern China (1926), recorded *Ilex pernyi* Franch. from Central and West China and *Ilex yunnanensis* Franch. from West China. An important contribution to the study of *Ilex* was his identification, in 1933, of three species and four varieties improperly classified by H. Léveillé.

Among the papers I have reviewed in the past six years, there is only one which is devoted solely to the *Ilex* of China, and this includes only a portion of the country. This paper was published by Comber in 1933. In it he published five species and seven varieties or forms from Southwest China. He also added new records to nineteen species and five varieties. Handel-Mazzetti in the same year treated nineteen species and eight varieties of *Ilex* in his Symbolae Sinicae. One of these species and four of the varieties were new.

In 1937, Chen, in his voluminous Illustrated Manual of Chinese Trees and Shrubs, gave detailed descriptions of eleven species of *Ilex.* Seven of them were illustrated, with most of the drawings reproduced from sources not given. But the information concerning each species was quite original and useful.

MORPHOLOGICAL CHARACTERS AND THEIR BEARING ON CLASSIFICATION

The genus *Ilex* is the only representative of the family Aquifoliaceae in China. The morphological characters discussed below accordingly refer to the genus *Ilex* only.

I. **Habit:** The Chinese members of the genus *Ilex* are either evergreen or deciduous trees or shrubs. The largest of them are trees of the coastal forests. Plants of *Ilex rotunda* Thunb. often attain a height of twenty meters, with a smooth gray trunk of half a meter in diameter. The smallest species are the shrubs of the Yunnan alpine region. Plants of *Ilex intricata* Hook. f. and *Ilex perryana* S. Y. Hu are creeping, with upright branchlets only 20–70 cm. high. Unless the contrast is very great and is reinforced by good supplementary characters, the differences in habit have not been considered of much importance in this paper. This is because our knowledge of the habit of the plant depends largely on the reports given by the collectors of specimens in the herbarium. These reports are not always dependable and are often entirely lacking. One collector may call a plant a large shrub while another may call it a small tree, depending upon the collectors' judgment, experience and knowledge of the plants. Moreover, in China the vegetation has been so disturbed that a plant with a tree habit may have been so repeatedly cut by fuel gatherers that it has assumed a shrubby habit.

II. **Branchlets:** *Ilex* species are generally slow-growing plants. A small twig usually represents two or more years of growth. In general, the amount of the annual growth of a twig is 5–15 cm. The current year's growth is usually angular. Older growths are terete or subterete.

1. Dimension: Though environmental conditions often produce variations in the diameter of the branchlets of a species, in general the dimension attained by the branchlets is correlated with the various series into which the genus is divided. The Prinifoliae have slender, much ridged current year's growth which never exceeds 2 mm. in diameter and with the terminal buds absent or very poorly developed. On the other hand, the Lauroilex have stout branchlets 3–4 mm. in diameter with well-developed terminal buds.

2. Elongated and Abbreviated Shoots: The presence or absence of the abbreviated shoots is of subgeneric interest in *Ilex*. There are no abbreviated shoots in the evergreen species. On the other hand, the deciduous species largely possess this feature. The abbreviated shoots are 0.5–5 cm. long, densely covered by persistent bud-scales and scars of former inflorescences or leaves. It appears that there is a correlation between the presence of abbreviated shoots and the lenticels on the current year's growth of the elongated shoots, for both of them are characteristic of most members of the subgenus Prinos.

3. Lenticels: The lenticels of the evergreen species of *Ilex* are usually absent on the first, second, or even the third year's growth. They are

small, inconspicuous, circular, or sometimes coalescent. Those of the deciduous species are usually conspicuous even on the current year's growth. They are elliptic, white, and elevated on the second year's growth.

4. TERMINAL BUDS: The members of the genus *Ilex* exhibit a very interesting variety of terminal buds. Some of them, like *Ilex atrata* W. W. Sm., have large ovoid buds up to 1 or 2 cm. long with thick coriaceous densely ciliate scales. Others, like *Ilex kobuskiana* S. Y. Hu and *Ilex salicina* Hand.-Mzt., have narrowly conic acute buds with such loose scales that the buds look naked. There are still others, like the Prinifoliae and the Hanceanae, that seldom have any terminal buds. In general, the presence or absence of the terminal buds, their shape and size, are often of serial significance. For example, the Prinifoliae possess no terminal buds, the Hanceanae have poorly developed ones, the Sideroxyloides have thin buds with loose scales, and the Hookerianae have very well developed terminal buds.

5. INDUMENTUM AND EXCRESCENT GROWTH: Most species of *Ilex* have smooth, glabrous, or pubescent branchlets; the hairs are always simple and straight. In general the hairs are very minute and sparse. This I call puberulous. When the hairs are long enough to be seen by the naked eye, they are, with the exception of a few species like *Ilex pubescens* Hook. & Arn. and *Ilex aculeolata* Nakai, ferruginous in color. Since the variation in the density of the hairs in a species is often very gradual, unless it is aided by other characters pubescence has been considered of minor importance in this work.

There are three species of *Ilex* occurring on the high mountains of southwestern China and eastern Himalaya, *Ilex delavayi* Franch., *Ilex intricata* Hook. f., and *Ilex nothofagifolia* Ward, that have rugose or warty branchlets. In general, these branchlets appear ochraceous and corky. This excrescent growth is denser on the current year's growth. It varies from merely pliciform ridges in *Ilex delavayi* to so dense a covering of distinct warts in *Ilex nothofagifolia* that the current year's growth appears like a thin pipe-cleaner. Such excrescent growths form a very convenient means of distinguishing species.

III. Leaves: The size, shape, margin, and texture of the leaves of *Ilex* have always been used as major features in the classification of its species. Needless to say, the use of these characters has been over-emphasized by many authors. It is one of the reasons why so much confusion exists in Loesener's monograph. For example, because of their agreement in the number of the pyrenes, the nature of the endocarp, the inflorescences, the type of the flowers, and the glandularly punctate leaves, *Ilex crenata* Thunb. and *Ilex viridis* Champ. ex Benth. are very closely related species. Yet because of differences in the size of the leaves and their relative thickness, Loesener placed the former species in the Paltoria and the latter in the Aquifolium.

1. DURATION: The duration of the leaves, whether evergreen or deciduous, varies in association with other characters and is useful in sub-

generic, sectional, or serial diagnosis. All the members of the subgenus Prinos have deciduous leaves. In the warm temperate regions like the Chengtu Plain, the leaves of those deciduous species appear with the flowers in mid-April. For six or seven months they persist on the tree and fall in October or November. In the warmer regions, like Canton, the leaves of the deciduous species appear a month earlier.

The leaves of Lioprinus rarely remain on the second year's growth. They are like many broad-leaved evergreen trees of the Lauraceae in that the older leaves fall soon after the terminal buds unfold in the spring. Leaves of the various species of the Dipyrenae are the longest-lived ones in *Ilex*. Many of them retain leaves on the third or even the fourth year's growth.

2. Texture: The Chinese species of *Ilex* exhibit considerable variation in the texture of the leaves. In the section Aquifolium are found leaves of the thick-coriaceous type. Many of them, like the leaves of *Ilex latifolia* Thunb., have shiny glabrous surfaces. Some of them, like *Ilex elmeriana* S. Y. Hu, have such thick leaves that the lateral nerves are obscured. A very few of them, like *Ilex perryana* S. Y. Hu and *Ilex intricata* Hook. f., due to greatly impressed veinlets, have rugose upper surfaces.

The chartaceous leaves of the series Hookerianae present another variation. Most of these leaves are opaque, with evident lateral nerves. Distinctive are the membranaceous leaves of the subgenus Prinos. Most of these leaves are large, with prominent veins. In *Ilex tsoii* Merr. & Chun the veinlets are so prominent that the leaf-surfaces are marked with distinct minute areolae.

Though the texture of leaves is usually greatly influenced by environmental factors, it can be a useful character in defining subgenera and sections. For example, the subgenus Prinos is characterized by membranaceous or chartaceous leaves, the Denticulatae by coriaceous leaves, and the Lauroilex by large, entire, thick-coriaceous leaves.

3. Size and Shape: The largest leaves of the genus are found in *Ilex dolichopoda* Merr. & Chun, and the smallest in *Ilex intricata* Hook. f. This variation is from 20 cm. in length in the former to 1 cm. in the latter. Extreme cases, however, are few. In the majority of the species the leaves vary normally from 2 to 8 cm. in length. In shape they vary from suborbicular, as found in *Ilex nothofagifolia* Ward, to linear-lanceolate, as found in *Ilex fargesii* Franch., obovate or obcordate as in *Ilex tutcheri* Merr., or ovate as in *Ilex macrocarpa* Oliv. *Ilex cornuta* Lindl. & Paxt. is unique in having subquadrangular leaves. The evergreen species usually possess leaves elliptic or oblong-elliptic in outline, while in the deciduous species the leaves are ovate or ovate-elliptic.

Environmental conditions and the age of the plant are factors which influence very much the variation in size and shape of the leaves. A vigorous offshoot of a shrub may have leaves 2–3 times as large as the normal leaves. Furthermore, the leaf shape is often affected by the position of the leaves on the branchlets. Often, upwards from the base of the branchlet, the leaves gradually change in width; thus one finds ovate leaves near the base and elliptic or even lanceolate leaves toward the apex of a branchlet.

Only when there is a sharp contrast in other characters between two species may the size and shape of the leaves be used as distinguishing characters. For example, *Ilex dolichopoda* Merr. & Chun and *Ilex kobuskiana* S. Y. Hu both have punctate leaves. The former has leaves 18–25 cm. long and the latter leaves 4.5–9 cm. long. This difference, reinforced by differences in the length of the fruiting pedicels, clearly distinguishes the two species. Mere size of the leaves alone cannot be used as a specific character.

4. APEX AND BASE: In the leaf apices of the Chinese *Ilex* species, nearly all the common variations are found. The apex may be: (1) long-caudate and acute; (2) caudate and obtuse; (3) acuminate and serrate; (4) short-acuminate and retuse; (5) obtuse and retuse; (6) obcordate; and finally the extreme (7) tricuspidate and spinose. The last-mentioned apex, although extreme, is probably the best known and the one most associated with the genus by the general public.

Both the apex and the base of the leaves of a species vary with the size and shape of the blade and with the position of the leaves on a branchlet. The leaves on the lower portion of a twig may be ovate with rounded bases and acute apices, while those of the apical portion of the same twig may be elliptic with obtuse bases and acuminate apices. This is the case in *Ilex tsoii* Merr. & Chun and *Ilex macrocarpa* Oliv. For this reason, the shape of the apex and the base cannot be used alone even for varietal differentiation. Nevertheless, when associated with other characters, they are the most obvious characters to employ in the differentiation of species, or even in characterizing series. For example, *Ilex venulosa* Hook. f. is differentiated from *Ilex omeiensis* Hu & Tang by its caudate apex and its cymose inflorescences. Likewise, the series Longecaudatae is characterized by the small fruit, entire leaves, and caudate or acuminate leaf apices.

5. MARGIN: Over half of all the species of Chinese *Ilex* possess leaves with serrate or crenate margins. The teeth may be fine and aristate as in *Ilex pubescens* (Hook. & Arn.) Champ. ex Benth. and *Ilex serrata* Thunb. var. *sieboldi* (Miq.) Rehd., coarse and remote as in *Ilex intermedia* Loes. var. *fangii* (Rehd.) S. Y. Hu, or crenulate and inconspicuous as in *Ilex ficoidea* Hemsl. About thirty-seven per cent of the species have entire leaves. The remaining nine per cent have spinose leaves. Again, the margin of the leaves in a species may vary with the age of the plant. In species such as *Ilex cornuta* Lindl. & Paxt., *Ilex corallina* Franch., and *Ilex dipyrena* Wall., in developing from the juvenile stage to maturity the margin of the leaf changes from spinose to subentire or entire. For this reason the margin alone should not be used even for varietal differentiation. However, when the margin is used as an auxiliary character, it is a very convenient and obvious means for distinguishing species. It is often used as a supplementary character to separate sections or series. For example, over ninety-five per cent of the species in the section Pseudoaquifolium have entire leaves. The Lauroilex species all have entire leaves and the Prinoides species all have chartaceous or membranaceous, serrate or crenate leaves.

6. Venation: All the Chinese *Ilex* have pinnate, netted veins. The midribs are usually impressed above and elevated beneath. Midribs elevated above are often used as supplementary characters for distinguishing species. The lateral nerves of *Ilex* vary from two, three, or four pairs in *Ilex intricata* Hook. f. to ten to twenty pairs in *Ilex polyneura* (Hand.-Mzt.) S. Y. Hu. An appreciable difference in the number of the lateral nerves is always a convenient quantitative means for separating closely related species, for example, *Ilex micrococca* Maxim. is distinguished from *Ilex polyneura* by having only six to eight pairs of lateral nerves. About forty-seven per cent of the Chinese species of *Ilex* have obscure lateral nerves and veinlets, at least on the upper surfaces. In the case of herbarium specimens, venation is often affected by the method of preparation of the plants. In Prinoides all species have distinct veinlets, while most of the species in Lioprinos have obscure veinlets. In the Hookerianae all the species have veinlets impressed on the upper surface. *Ilex tsoii* Merr. & Chun of the section Prinoides can be readily distinguished even in a sterile condition because of the very distinct veinlets.

7. Petioles: Most species of the *Ilex* have canaliculate petioles. Few of them have plane ones. The presence or absence of grooves on the upper surface of the petioles is often useful in separating species. For example, specimens of *Ilex sterrophylla* Merr. & Chun from Hainan have been identified as representing *Ilex pedunculosa* Miq. But without reference to the indumentum or pyrene characters, the former can readily be distinguished from the latter by its plane petioles.

The length of the petiole varies from 2–4 mm. in *Ilex cinerea* Champ. to 15–25 mm. in *Ilex sterrophylla* Merr. & Chun. The differences in the ratio between the leaves and the petioles are more striking. In *Ilex cinerea* the petioles are one thirty-sixth to one-nineteenth the length of the lamina, and in *Ilex sterrophylla* one-fourth to one-half. This proportional difference is another quantitative measure often used in separating species.

8. Stipules: Van Steenis in 1948 (in Bull. Bot. Gard. Buitenz. III. 17: 389) called attention to the fact "that in British botany there is much controversy as to the occurrence of stipules in Aquifoliaceae." He cited authors like Hooker, f., Brandis, and Christie. Even as late as 1926, Hutchinson says, "Stipules absent."

The Chinese representatives of the Aquifoliaceae are assentially stipulate, and in ninety per cent of the species, the stipules are present and persistent even after the leaves fall. In the other ten per cent the stipules are obscure or lacking by abortion. In general the stipules are minute, callose, deltoid, less than one millimeter long. The largest stipules of the Chinese *Ilex* are found in *Ilex serrata* Thunb. var. *sieboldi* (Miq.) Rehd. In this species they are 2 mm. long, pilose, and caducous.

The presence or absence of stipules is of serial significance. It is of great interest to know that all the species that are devoid of stipules are in the series Chinenses. Thus the presence or absence of stipules can be used as a supplementary character for differentiating this series from its closely related ones.

The size of the stipules of closely related species is rather definite. Examples can be found in *Ilex polyneura* (Hand.-Mzt.) S. Y. Hu and *Ilex micrococca* Maxim. In the former species the stipules are 1–1.5 mm. long, and in the latter only 0.2–0.3 mm. In such a case the stipules can be used as a good supplementary character in distinguishing species.

IV. **Inflorescences:** The fundamental organization of the inflorescences in the genus *Ilex* is a trichotomous axillary cyme as illustrated by *Ilex chinensis* Sims and *Ilex ferruginea* Hand.-Mzt. Through reduction or multiplication of such cymes, and as a result of the evolution of the shoot system, directed towards a division of labor, various types (as illustrated in figures 3 and 4) of inflorescences may be evolved. The types of the inflorescences and their position on the branchlets are of important consideration in this work.

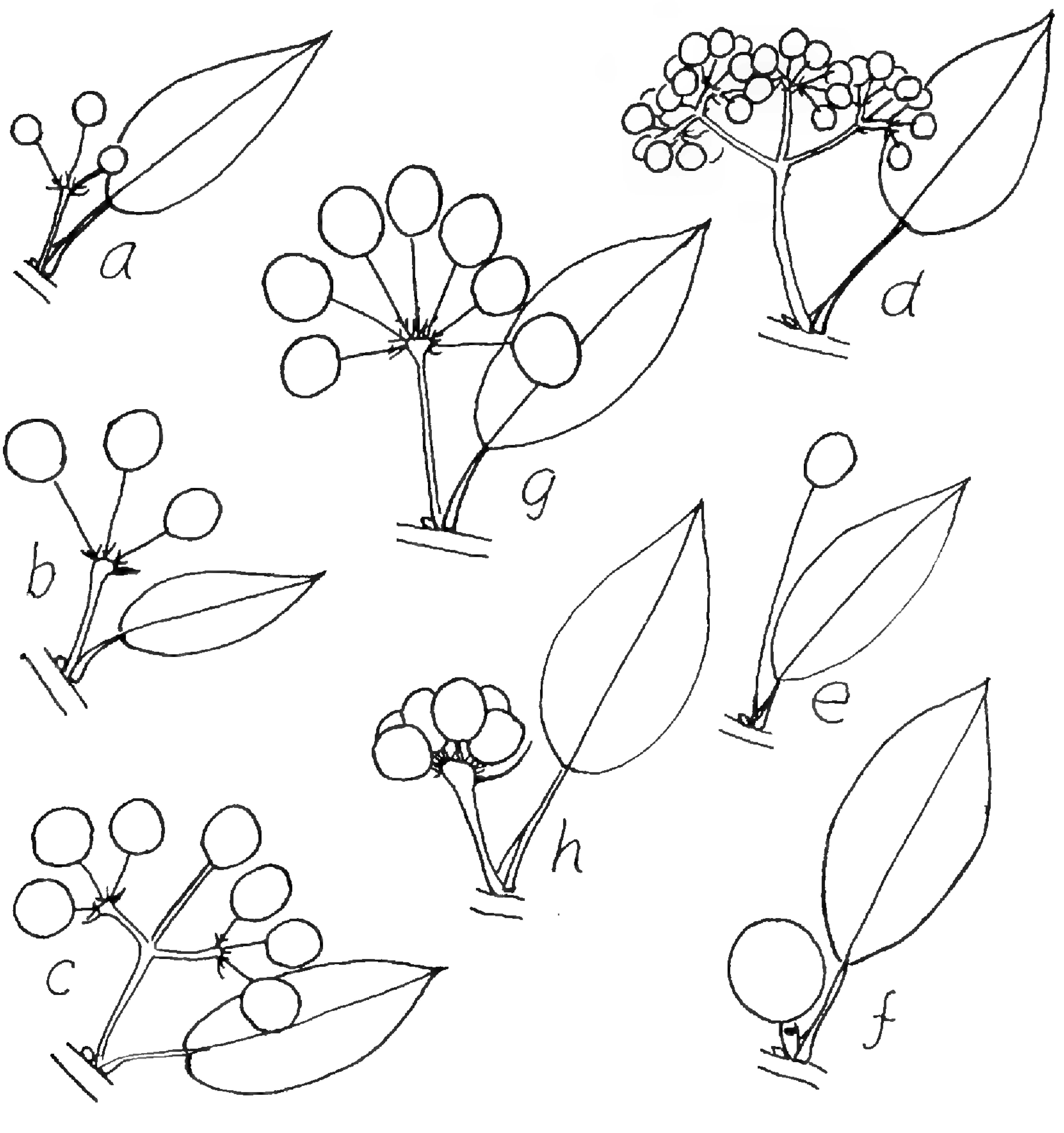

FIG. 1. TYPES OF THE SOLITARY INFLORESCENCE IN ILEX: *a* & *b*. simple cymes; *c*. dichotomous compound cyme; *d*. trichotomous compound cyme; *e*. long-pedicellate solitary flower; *f*. short-pedicellate solitary flower; *g*. pseudo-umbel; *h*. head-like inflorescence.

1. Types of the Inflorescence: The Chinese *Ilex* exhibit a very interesting set of inflorescences. According to their positions on the branchlets I discuss them under the following two heads.

a. *Solitary type:* The solitary type of inflorescence occurs only on the current year's growth. They are nearly all axillary to a leaf and are often associated with an adaxial dormant vegetative bud. The simplest kind of such solitary inflorescences consists of a cyme with three flowers. Its peduncle is about 5–10 mm. long, and the pedicels of the individual flowers are usually shorter than the peduncle. Examples are the pistillate inflorescences of *Ilex ferruginea* Hand.-Mzt. (fig. 1, b) and the staminate flower of *Ilex macrocarpa* Oliv. (fig. 1, a).

From the simple cyme evolution can proceed by the multiplication of branches. This is shown in the dichotomous compound cyme with evident secondary axes, like those of the pistillate flowers of *Ilex maclurei* Merr. (fig. 1, c), or a trichotomous compound cyme with rather long secondary axes and evident tertiary axes, like those found in *Ilex micrococca* Maxim. (fig. 1, d).

By reduction in the number of flowers in the simple cyme there may be evolved a solitary flower with a long pedicel and two median or supermedian prophylla (scales on the pedicel), as, for example, the pistillate flower of *Ilex yunnanensis* Franch. (fig. 1, e). Reduction of both the number of flowers and the length of the pedicel of a simple cyme may occur. Then there is evolved a subsessile solitary fruit borne on a pedicel 2–3 mm. long, at the middle of which are the scars of two abortive flowers. The pistillate flowers of *Ilex lancilimba* Merr. (fig. 1, f) are an example.

By the reduction of the secondary axes of a compound dichotomous cyme there can be evolved a pseudo-umbel that has a peduncle 10–20 mm. long, and many bracteoles at the bases of the pedicels. Examples occur in the staminate or the pistillate inflorescences of *Ilex umbellulata* (Wall.) Loes. (fig. 1, g). If such reduction also occurs in the pedicels, then a subcapitate inflorescence like that of *Ilex tugitakayamensis* Sasaki (fig. 1, h) may be evolved.

b. *Fasciculate types:* The fasciculate types of inflorescence occur only on the second year's growth or on older growth. They are axillary to old leaves and never have a dormant axillary bud at their base. The commonest kind consists of a sessile fascicle with a basal collar formed of several persistent cartilaginous or leathery bud-scales, and a short axis with or without an abortive terminal bud. A membranaceous scale subtends each of the 1–3-flowered individual branches. The staminate inflorescences of *Ilex ficoidea* Hemsl. (fig. 2, a) are examples of this type.

Through multiplication by the branching of the individual branches, a fascicle with trichotomous compound cymes or with pseudo-umbels, as in the Lauroilex (fig. 2, b & c), may be evolved. By an increase in the number of flowers on the branches and the elongation of the central axis, a pseudopaniculate inflorescence such as the staminate inflorescence of *Ilex latifolia* Thunb. (fig. 2, d) may result. By a reduction in the number of flowers on the branches, a loose fascicle or pseudoraceme of uniflorous cymes may develop. The pedicels each bear one or two submedian prophylla. This is the condition in the flowers of *Ilex intermedia* Loes. (fig. 2, e). By the shortening of both the axis and the pedicels, a compact fascicle of uniflowered pedicels, each bearing one or two basal prophylla, may develop, as in the pistillate inflorescences of *Ilex corallina* Franch. (fig. 2, f). Reduction in the number of individual flowers in the fascicle produces paired fruits as in *Ilex hanceana* Maxim. and *Ilex perryana* S. Y. Hu (fig. 2, g). A further reduction of the number of the flowers gives the solitary-flowered condition, as found in *Ilex chingiana* Hu & Tang

FIG. 2. TYPES OF THE FASCICULATE INFLORESCENCE IN ILEX: *a.* fascicle with 1–3-flowered individual branches; *b.* fasciculate compound cymes; *c.* fasciculate pseudo-umbels; *d.* pseudopanicle; *e.* loose fascicle with uniflorous individual branches; *f.* compact fascicle with uniflorous individual branches; *g.* paired fruits; *h.* solitary fruit of a much reduced fascicle.

(fig. 2, h). In this the scar or scars at the base of the fruiting pedicel indicate the positions of the aborted flowers.

2. Structure of the Inflorescences:

a. *Bud-scales:* The fasciculate type of inflorescence is evolved from an axillary bud. The bud-scales of these inflorescences are often persistent. They are cartilaginous or coriaceous. Sometimes it is hard to differentiate bud-scales from the bracts, for the change in texture is gradual.

b. *Bracts:* The scales that subtend the individual branches of a fascicle are called bracts in this paper. Those that subtend the secondary or tertiary branches are called bracteoles. Most bracts have stipule-like basal appendages. The size and shape of these appendages are sometimes of serial importance; for example, all the Repandae have bracts with long, slender, ciliate appendages.

c. *Prophylla:* The scales on the pedicels, which do not subtend flowers are called prophylla. Their insertion may be basal, superbasal, median, or supermedian on the pedicels. The insertion of the prophylla is often used as an auxiliary character for distinguishing species; for example, besides the size of the fruit and the texture of the leaves, *Ilex tephrophylla* (Loes.) S. Y. Hu is differentiated from *Ilex corallina* Franch. by its minute prophylla, which cover less than half of the fruiting pedicel, while, in contrast, the prophylla of *Ilex corallina* reach the calyx.

d. *Peduncles:* The stalks of all the branched solitary types of inflorescence and those of the multiflorous individual branches of the fasciculate types are called peduncles in this work. The peduncles of the solitary inflorescences possess no bracts at their bases. Those of the fasciculate inflorescences all have basal bracts. The length of the peduncle of a species is a variable character. In a few cases it has been used as an auxiliary means for distinguishing species. For example, *Ilex rotunda* Thunb. is differentiated from *Ilex umbellulata* (Wall.) Loes. by its shorter peduncles (9–13 mm. long), and *Ilex sterrophylla* Merr. & Chun is differentiated from its closely related species, *Ilex editicostata* Hu & Tang, by its peduncles of a length of 2–3 cm.

e. *Pedicels:* The stalks of either the solitary individual flowers or of the ultimate branches of compound inflorescences are called pedicels in this paper. The longest pedicels, those of *Ilex pedunculosa* Miq., are 4–4.5 cm. long. But this length is extremely rare. In general the pedicels of *Ilex* are 2–15 mm. long. Most of them possess one or two prophylla at the base (basal), at the middle (median), or above the middle (supermedian).

The length of the pedicels of *Ilex* is a rather stable character. It is an obvious quantitative character for distinguishing species. Thus *Ilex asprella* (Hook. & Arn.) Champ. is differentiated from all the other Prinos species by its long slender pedicels. Even between closely related species like *Ilex macropoda* Miq. and *Ilex tsoii* Merr. & Chun the length of the fruiting pedicels is a dependable character for separating them.

f. *Central Axis:* All the fasciculate types of inflorescence have central axes. These may be very short, even almost completely suppressed, as in *Ilex corallina* Franch. or *Ilex intricata* Hook. f. Or they may be quite long, so long, in fact, that the inflorescences appear pseudoracemose, as in *Ilex intermedia* Loes., or pseudopaniculate, as in *Ilex latifolia* Thunb. The length of the central axes of different inflorescences on a single branchlet may vary considerably, and thus it is not a good character to use for distinguishing species. As an auxiliary character it is sometimes useful in separating a variety from a species; for example, *Ilex confertiflora* Merr. var. *kwangsiensis* S. Y. Hu is differentiated from the typical species by its large leaves and its central axis of a length of 22 mm.

g. *Secondary and Tertiary Axes:* The compound cymes, both solitary and fasciculate, all possess secondary or sometimes tertiary axes. The presence or absence of the secondary axis and its relative length are convenient distinguishing characters. For example, *Ilex maclurei* Merr. is distinguished from the rest of the Chinese *Ilex* species by having a secondary axis in the infructescence. Besides having more numerous lateral nerves, *Ilex polyneura* (Hand.-Mzt.) S. Y. Hu is also distinguished from its very close relative, *Ilex micrococca* Maxim., by the fact that its secondary axis is shorter than the fruiting pedicel.

3. SEXUAL DIMORPHISM: All the Chinese species of *Ilex* are dioecious. The inflorescences of almost all the species are sexually differentiated. In over ninety per cent of the species the staminate inflorescences are more prolific, and the flowers are more showy. This abundant flowering is attained by the branching of the solitary inflorescence or the fascicle, or through the specialization of the shoot systems (one species), or through both.

Nearly all of the more prolific staminate inflorescences result from increased branching. In *Ilex serrata* Thunb. var. *sieboldi* (Miq.) Loes. the inflorescence is solitary. The pistillate flowers are usually solitary or rarely a much reduced 2- or 3-flowered cyme with a peduncle 1–1.5 mm. long. The staminate ones are cymose, with nine to twenty-one flowers and peduncles 3 mm. long. In *Ilex chinensis* Sims the pistillate cymes are usually 3- to 7-flowered, with the peduncles usually shorter than the leaf-petioles, and the staminate cymes usually have twenty-one or more flowers, with the peduncles always exceeding the leaf-petioles in length. In all the species of the section Aquifolium the pistillate fascicles have one-flowered individual branches, while those of the staminate fascicles are 3- to 5-flowered. Many of these staminate fascicles, such as those of *Ilex latifolia* Thunb., are so prolific that they appear pseudopaniculate.

About nine per cent of the more prolific staminate inflorescences are due to both branching and specialization of the shoot system. In *Ilex microcarpa* Oliv., for example, the pistillate flowers are solitary axillary, and the staminate flowers are one- or three-flowered, cymose, and often fasciculate. Such a condition is also common in *Ilex yunnanensis* Franch., *Ilex crenata* Thunb., and their related species.

Ilex asprella (Hook. & Arn.) Champ. is the only species that has solitary pistillate flowers and fasciculate staminate flowers with the individual branches uniflorous.

The inflorescences of the Chinese species of *Ilex* are as a whole inconspicuous. The great reduction of the number of flowers in the pistillate inflorescences makes them less conspicuous than the staminate ones, and hence the female plants are less attractive to collectors, especially inexperienced ones. Many of the Chinese *Ilex* are unrepresented in the herbarium by flowering specimens and specimens with pistillate flowers are especially uncommon.

Because of this sexual dimorphism in the inflorescences, an unduly large number of new species have been proposed by workers who either lacked sufficient material or who did not appreciate the significance of sexual dimorphism. This has added greatly to the synonymy of certain species.

V. **Flowers:** The flowers of *Ilex* are all small and inconspicuous. When fully opened, the majority of them are 5–6 mm. in diameter. The largest, the staminate flowers of *Ilex latifolia* Thunb., are only 9 mm. in diameter. The flowers of *Ilex micrococca* Maxim. measure only 3–4 mm. in diameter.

The color of the flowers of *Ilex* is never brilliant. In the total number of species of which we have floral records, about eighty-four per cent are greenish yellow or white and about thirteen per cent are pink, lavender, or red. The flowers of *Ilex intricata* Hook. f. are chocolate-colored. In *Ilex lancilimba* Merr. the pistillate flowers are pink-purple and the staminate flowers greenish white. The color of the flowers of *Ilex yunnanensis* Franch. has been reported as greenish yellow, cream-white, or red. It is most likely that the color of the flowers of this species varies with the age of the flowers and also with the habitats of the plants. The color of the flowers of *Ilex* appears to have some correlation with other characters of the various groups. All the members of the subgenus Prinos have white flowers. A majority of the pink, lavender, or red-flowered species are in the section Lioprinus. All the Aquifolium with the exception of *Ilex intricata* Hook. f. have greenish yellow or cream-white flowers. But due to the small size and the lack of attractive color of the flowers, they have been overlooked in the field, and thus flowering specimens are often poorly represented in herbaria. For this reason, in this paper the color of the flowers has not been taken into consideration in distinguishing species.

Of the total species of which we have floral records, thirteen per cent have been reported as fragrant. Personally I have observed bees and small wasps visiting the white and fragrant flowers of *Ilex macrocarpa* Oliv. in the woods of West China.

There are no field records concerning the length of the flowering period of a species. Experience tells us that for a period of two weeks one can collect good flowering specimens from a tree of *Ilex macrocarpa* Oliv. growing to a height of ten meters.

The height of the flowering season, as one would expect, is in April, with approximately one-third of the species producing flowers at this time. May and June come next, with March and July following in that order. A very few species may be found flowering in January and December.

The floral characters which are valuable in the classification of the species are summarized here.

1. CALYX: In *Ilex* the calyx is always persistent. At anthesis it is usually patelliform, but after the fruiting stage it becomes explanate. It is small, measuring 2–4 mm. in diameter. The dimension of the persistent calyx is of serial significance. In all members of the series Sideroxyloides the calyx is large for the genus, its diameter measuring over half that of the fruits. All representatives of the Repandae have a small quadrangular calyx 2 mm. in diameter.

The indumentum of the calyx-lobes is a rather variable character. In the species *Ilex triflora* Blume, for instance, the calyx may be either sparsely or densely pubescent. Hence this characteristic has been little featured in the classification of the species. On the other hand, the presence or absence of cilia on the margin of the calyx-lobes is quite constant. It has occasionally been employed as a supplementary character in distinguishing species or varieties.

2. COROLLA: The shape and size of the corolla of the staminate flowers of all the species are fairly constant. The corolla is always rotate, with the petals slightly united at the base. The free parts of the petals are oblong, 2–3, rarely up to 4 mm. long. The apical half of the petals of the Repandae is ciliate.

In the pistillate flowers, the corolla is rotate, with the base of the petals considerably more united in the Paltoria or only slightly so in the Lioprinus and the Venulosae, or suberect, with the base of the petals either slightly united or choripetalous in Aquifolium and in Pseudoaquifolium. The differences in the shape of the corolla and the degree of union of the petals seem to have serial or sectional significance. But the inadequate representation of the pistillate flowers in the herbaria has restricted the use of these characters in classification.

3. STAMENS AND STAMINODES: At full anthesis the stamens of *Ilex* may be longer than the petals, as in the Repandae, equaling the petals, as in *Ilex wenchowensis* S. Y. Hu, or shorter than the petals, as in *Ilex crenata* Thunb. The anthers are usually oblong-ovoid, 0.75–1 mm. long. As the length of the filament and the shape of the anthers change with the age of the flower, these characters have not been used in distinguishing species.

The abortive stamens of the pistillate flowers are called staminodes in this paper. They are always shorter than the petals. Their anthers are either sagittate, cordate, or ovate. They are glabrous except in *Ilex memecylifolia* Champ. The hairy staminodes of this species have been used as a supplementary character for distinguishing it from its close relatives.

4. OVARY AND RUDIMENTARY OVARY: The ovary of the flower of all

the species of *Ilex* is syncarpous, with two up to thirteen carpels. At anthesis it is usually ovoid, 1–2 mm. in diameter, devoid of style, but with a discoid and lobed stigma, as in *Ilex serrata* Thunb. var. *sieboldi* (Miq.) Loes. (fig. 3, a), or with a slightly elevated and pointed mammiform stigma, as in *Ilex kwangtungensis* Merr. (fig. 3, b). In *Ilex tsoii* Merr. & Chun the ovary is subglobose with a capitate stigma (fig. 3, c). In *Ilex fragilis* Hook, f. the ovary is pulvinate, with an evident style and a capitate or narrow-cristate stigma (fig. 3, d). In *Ilex macrocarpa* Oliv. the ovary is ovoid, with an evident style and a columnar stigma (fig. 3, e).

The shape of the stigma (especially after the fruit attains maturity) and the presence of a style are very constant characters in some species of *Ilex.* Therefore they are of fundamental importance in the delineation of species and even of sections. The columnar stigma is characteristic of *Ilex macrocarpa* Oliv., *Ilex chapaensis* Merr., and many members of the series Sideroxyloides. A majority of the species of the series Denticulatae have plane or slightly impressed navel-like stigmas.

In general the ovary is glabrous. In *Ilex pubilimba* Merr. and *Ilex wangiana* S. Y. Hu the ovary and the fruit are sparsely pubescent. These characters set the two species off from their close relatives.

The abortive ovary of the staminate flowers is called the rudimentary ovary in this work. It may be subglobose with obtuse or slightly impressed center, or pulvinate with a rostellate and cleft apex as in *Ilex micrococca* Maxim. (fig. 3, g). The presence or absence of the rostellum on the rudimentary ovary is of serial or sectional significance. For example, all the Micrococca and the Umbelliformes species have rostellate rudimentary ovaries. A branchlet of *Ilex chapaensis* Merr. with staminate flower can be distinguished from one of *Ilex macrocarpa* Oliv. only by the rostellum on the ovary. The rudimentary ovary is always glabrous except in *Ilex brachyphylla* (Hand.-Mzt.) S. Y. Hu (fig. 3, f).

VI. **Fruit:** Over ninety-five per cent of the Chinese *Ilex* species possess red fruit. This fruit reaches maturity in autumn and persists on the tree for a long time, often until the plant flowers again the following spring. Trees or shrubs with scarlet fruit, whether accompanied by leaves or not, are striking sights in any landscape. They attract the collectors' attention. Even the black-fruited *Ilex* is not altogether devoid of means for attracting attention. Some species, like *Ilex asprella* (Hook. & Arn.) Champ. have their fruit projected from the branchlets on extremely long pedicels (fig. 3, i), and others, like *Ilex macrocarpa* Oliv., have extraordinarily large fruit (fig. 3, h). Since the fruit of over ninety-eight per cent of our species of *Ilex* is known, it is of fundamental importance in the classification of the genus. Thus any character that one can draw from the fruit, be it the size, the color, the pedicel, the persistent calyx, the style (when present), or the stigma, is of some aid in distinguishing the species.

1. Size: Nearly all of the fruit of the Chinese *Ilex* is less than 8 mm. in diameter (usually 4–7 mm.). The larger fruits are usually limited to

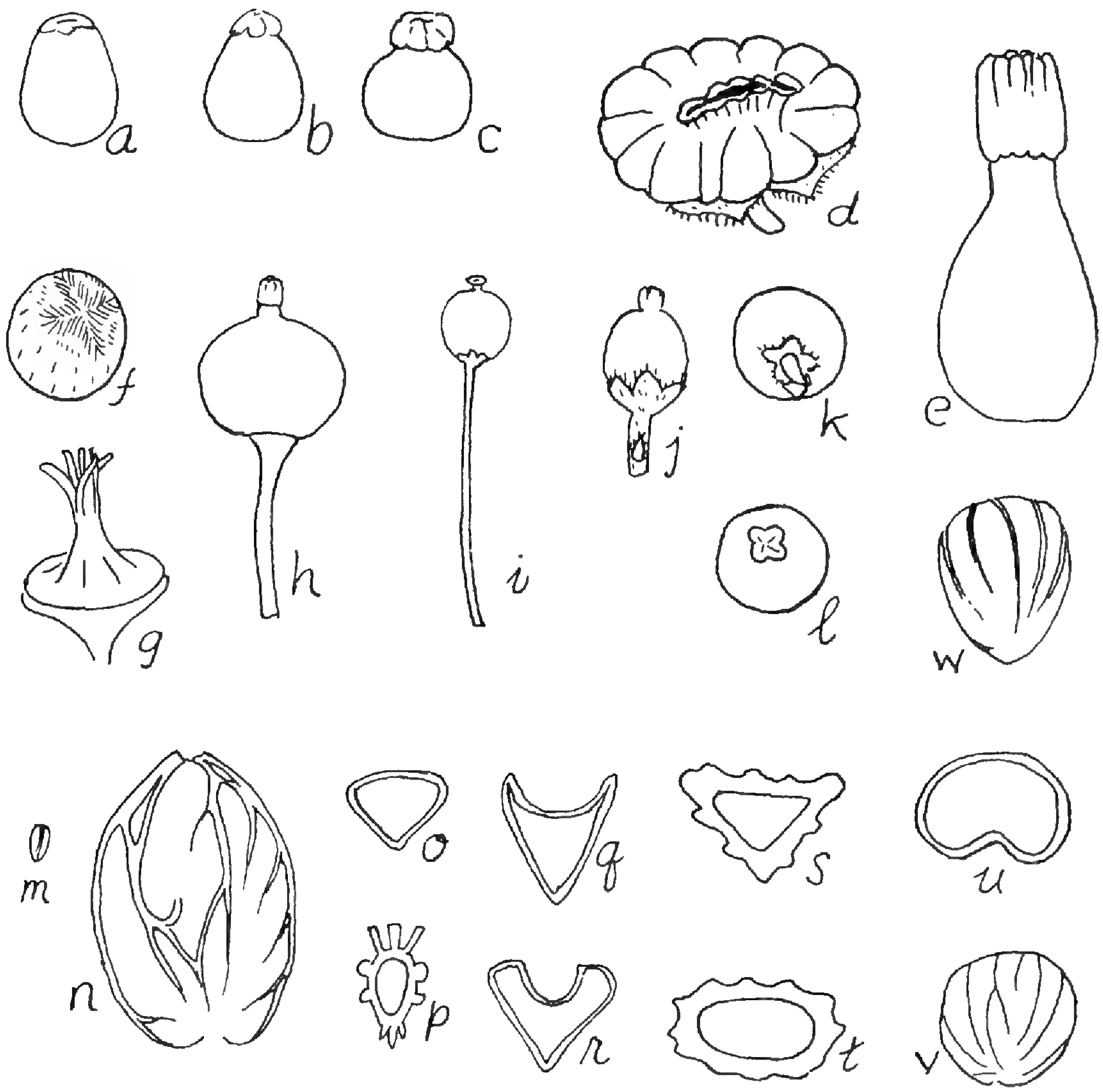

FIG. 3. *a-e.* STIGMA: *a.* discoid stigma of ovary of *I. serrata; b.* mammiform stigma of *I. kwangtungensis; c.* capitate stigma of *I. tsoii; d.* cristate stigma of *I. fragilis; e.* columnar stigma of *I. macrocarpa. f & g.* RUDIMENTARY OVARY: *f.* globose and pubescent rudimentary ovary of *I. brachyphylla,* × 12; *g.* rostellate rudimentary ovary of *Ilex micrococca,* × 10. *h-l.* FRUIT: *h.* a large fruit of *I. macrocarpa* with columnar stigma, × 1; *i.* a long-pedicellate fruit of *I. asprella* with capitate stigma, × 1; *j.* large persistent calyx of fruit of *I. metabaptista,* × 2; *k.* small calyx of fruit of *I. ficoidea* showing the pedicel and prophylla, × 2; *l.* the same showing the discoid stigma. *m & n.* SIZE OF PYRENES: *m.* a small smooth pyrene of *I. wardii,* × 2; *n.* a large rugose pyrene of *I. chingiana,* × 2. *o-u.* OUTLINE OF THE CROSS-SECTIONS OF PYRENES, all × 3: *o.* triangular, smooth with thin endocarp, *I. pedunculosa; p.* 3-ridged and 2-canaliculate pyrene, *I. macrocarpa; q & r.* U-SHAPED PYRENES WITH SMOOTH THIN ENDOCARP; *s.* triangular thick-walled stony pyrene of *I. subficoidea; t.* elliptic thick-walled woody pyrene of *I. dipyrena; u.* suborbicular smooth pyrene of *I. perryana. v & w.* PALMATELY STRIATE PYRENES: *v.* striate, esulcate pyrene of *I. perryana* with slightly impressed striae; *w.* striate and sulcate pyrene of *I. ficoidea.*

the section Prinoides and to the series Aquifolioides and Denticulatae of the section Aquifolium.

2. FRUITING PEDICEL: The length of the fruiting pedicels varies from 1–2 mm. long in *Ilex ficoidea* Hemsl., *Ilex corallina* Franch., and many others in the series Dipyrenae or Repandae to 40–45 mm. long in *Ilex pedunculosa* Miq. This difference in the length of the fruiting pedicels has been used as a supplementary character in distinguishing species and varieties.

3. PERSISTENT CALYX: The size of the persistent calyx of the fruit of *Ilex* is constant in the series and sometimes in the sections. The series Sideroxyloides is characterized by the large persistent calyx, which is over half the diameter of the fruit (fig. 3, j). On the other hand, the series Aquifolioides and the Repandae are characterized by their quadrangular persistent calyces (fig. 3, k).

4. STIGMA: The stigma of the mature fruit is quite a constant character, useful as a supplementary character for distinguishing species. Some of the stigmas, like those of the Denticulatae, are plane or somewhat navel-like, some, as those of *Ilex ficoidea* Hemsl., discoid (fig. 3, l), some, like those of *Ilex pubescens* Hook. & Arn., capitate, and some are cristate, as in *Ilex fragilis* Hook. f. (fig. 3, d).

All members of the genus have fleshy fruit, with chartaceous exocarp, fleshy and juicy mesocarp, and distinct coriaceous woody or stony endocarps, each enclosing a seed. In classification there seems to be no proper term to apply to this type of fruit. DeCandolle (Prodr. 2: 13. 1825) called it a berry, "bacca." Hooker (Gen. Pl. 1: 357. 1862) referred to it as a drupe, "drupa," as did Loesener. But the fruit of *Ilex* is neither a berry nor a drupe, for a berry does not possess a hard endocarp, and a drupe has only a single stone, since it is derived from a single carpellate ovary. The hard parts in a berry are the seeds. The hard portion of the fruit of *Ilex* is the endocarp with the vascular bundles clinging to it or loosely attached to it. The fruit of the genus might be termed a drupe-like berry or a berry-like drupe. To make things simple and definite, however, I would like to propose the term bacco-drupe and define it as a fruit derived from a syncarpous ovary with chartaceous exocarp, fleshy mesocarp, and separated coriaceous, woody or stony endocarps (pyrenes), each enclosing a single seed. It is characteristic of all *Ilex* species except *Ilex insignis* Hook. f. of India.

VII. Pyrenes: The seed of *Ilex,* enclosed by the endocarp, is called a pyrene in this work. The pyrenes of all the Chinese *Ilex* are in one whorl embedded in the soft mesocarp. Their abaxial surface is much broader than the keel-like adaxial surface. The abaxial surface of a pyrene is called the dorsal surface in this paper.

Like the fruit, the pyrenes are commonly available in the herbaria and are important in the classification of the genus.

1. NUMBER: About seventy per cent of the Chinese *Ilex* species have four pyrenes. The remaining species possess a varying number, from one

to thirteen. The number in those species producing four pyrenes is constant. The number in those species which have more or less than four pyrenes is generally variable; for example, a branchlet of *Ilex fragilis* Hook. f. var. *kingii* Loes. has many fruits with six to eight pyrenes and some with nine to thirteen. A single branchlet of *Ilex dipyrena* Wall. bears many fruits with two pyrenes and some with one, three, or four. The large percentage of the four-pyrene species and the variability in the number of the more or less than four-pyrened species both indicate that four-merous may have been the fundamental condition of the flower parts, including the ovary, of *Ilex,* and that the other numbers are derivatives.

The pyrene number has no subgeneric significance. Both the subgenera Prinos and Euilex have four-pyrened species. Species with five or more pyrenes are common to both subgenera. Nevertheless, the species that have less than four pyrenes are all confined to the series Dipyrenes of the Euilex.

The number of the pyrenes has provided a valuable supplementary character for separating the sections; for example, all of the species of the Aquifolium have four pyrenes with woody or stony endocarps, and those of the Pseudoaquifolium, on the other hand, have more than four pyrenes, with coriaceous or sublignescent endocarps.

2. SIZE AND SHAPE: The smallest pyrenes are found in *Ilex wardii* Merr. and are ca. 1.5 mm. long (fig. 3, m). The largest are found in *Ilex chingiana* Hu & Tang and measure approximately 15 mm. long (fig. 3, n). The pyrenes in other species of the genus fall between these extremes.

With a few exceptions, the cross-section of a pyrene of *Ilex* is triangular in outline. In *Ilex pedunculosa* Miq. (fig. 3, o) the dorsal surface is smooth and convex. In *Ilex macrocarpa* Oliv. (fig. 3, p) the dorsal surface is 3-ridged and 2-canaliculate. In *Ilex lancilimba* Merr. (fig. 3, q) the dorsal surface is widely U-shaped. In *Ilex kwangtungensis* Merr. (fig. 3, r) the dorsal surface is narrowly U-shaped. In *Ilex subficoidea* S. Y. Hu (fig. 3, s) the dorsal surface is rugose and uneven. Other variations in the outline of the cross-section of the pyrene are found in *Ilex dipyrena* Wall. (fig. 3, t) where it is oblong-elliptic, and in *Ilex perryana* S. Y. Hu (fig. 3, u) where it appears suborbicular.

Viewed from the dorsal surface, the pyrenes show varied shapes, namely oblong, oblong-elliptic, elliptic, or rarely suborbicular or obovate. The ends may be pointed or obtuse, rarely retuse.

The shape of the pyrenes is sometimes of significance in the delimiting of the series. The Umbelliformes have narrow elliptic pyrenes with pointed ends, while the Repandae have oblong pyrenes, usually with obtuse ends.

3. TEXTURE AND SCULPTURE: The texture of the pyrene of *Ilex* varies from coriaceous as found in *Ilex crenata* Thunb. through sublignescent as found in *Ilex rotunda* Thunb., to woody as found in *Ilex pernyi* Franch., and finally to stony as found in *Ilex latifolia* Thunb.

The sculpture of the pyrenes of *Ilex* exhibits a very interesting set of variations. This character is very valuable in distinguishing species. The descriptive terms used in this work concerning the surface of the pyrene need some definition: (1) estriate and esulcate pyrenes are those that are smooth, coriaceous, free from any vascular bundles of the pericarp, as in *Ilex yunnanensis* Franch.; (2) striate and esulcate pyrenes are those that are smooth, coriaceous, but with vascular bundles loosely attached to the surface, as in *Ilex longecaudata* Comber; (3), striate, esulcate pyrenes with impressed striae are those that are smooth, coriaceous, but with the vascular bundles slightly sunk into the endocarp, as in *Ilex crenata* Thunb.; (4) striate esulcate pyrenes with elevated striae are those that are coriaceous and with the vascular bundles clinging to the surface of the pyrenes, as in *Ilex metabaptista* Loes.; (5) striate and sulcate pyrenes are those that are sublignescent and with three elevated vascular bundles evenly and longitudinally fused with the dorsal surface of the endocarp, as in *Ilex rotunda* Thunb.; (6) palmately striate and sulcate pyrenes are those that are woody, with the vascular bundles on the surface of the palmate ridges of the endocarp, as found in *Ilex ficoidea* Hemsl. (fig. 3, w); (7) rugose, pitted, or wrinkled pyrenes are those that are stony, with irregularly branched and anastomosing vascular bundles which extend over the protuberances, as in *Ilex subficoidea* S. Y. Hu and *Ilex chingiana* Hu & Tang (fig. 3, n); (8) unicanaliculate pyrenes are those that are sublignescent or coriaceous and have a U-shaped cross-section (fig. 3, q & r), as in *Ilex lancilimba* Merr. or *Ilex chinensis* Sims; and (9) the three-ridged and two-canaliculate pyrenes are those that are stony, with the endocarp so modified that the dorsal surface has two deep canals (fig. 3, p), as in *Ilex macrocarpa* Oliv.

These various types of pyrenes are of sectional or serial significance. In the subgenus Prinos, the Pseudoprinos have smooth striate and esulcate pyrenes with impressed striae. The Micrococca have unicanaliculate pyrenes, the Prinoides have striate and sulcate or three-ridged and two-canaliculate pyrenes. In the subgenus Euilex, the Chinenses have unicanaliculate pyrenes, the Umbelliformes have three-striate and two-sulcate pyrenes; the Paltoria have smooth, striate esulcate, or estriate and esulcate pyrenes, and the Aquifolium have palmately striate and sulcate or rugose and pitted pyrenes.

GEOGRAPHIC DISTRIBUTION

The geographic distribution of the Chinese Aquifoliaceae reaches its northern limit in the provinces of the Yangtze River basin; thence it extends southward into Indo-China and India. Except for a form of *Ilex crenata* Thunb., a native of Japan, introduced and cultivated in a park of Tsing-tao, Shantung, and a few specimens of *Ilex pernyi* Franch., from Tsing-ling, a mountain range on the border of Szechuan, Kansu, and Shensi, no *Ilex* has ever been recorded from either North or Northwest China. Latitude 33° N. seems to be the northern limit for a natural distribution of the Chinese Aquifoliaceae. From this latitude southward the number of species occurring in each province is as follows: southern

Kiangsu, 3; southern Honan, 1; southern border of Shensi and Kansu, 1 each; Chekiang, 23; Anhwei, 12; Kiangsi, 17; Hupei, 17; Hunan, 12; Kweichow, 24; Szechuan, 18; Sikang, 9; Yunnan, 38; Kwangsi, 38; Kwangtung, 26; Fukien, 13; Taiwan, 18; Hainan, 21; and Hongkong, 10. Though some of the species are widely distributed, covering from six to twelve provinces, and a few of them extend even to Japan and Korea in the north, to Himalaya or North India in the west, and one of them to Java in the south, the majority of them, especially those species in the sections of Aquifolium, Lauroilex, and Pseudoaquifolium, are localized to less than five provinces. Some of them, like *Ilex cinerea* Champ. are endemic even to a small coastal island like Hongkong.

Judging by the large number of species and the many intermediate forms found there, it seems that South China and Southwest China, or, to be more specific, the border region of Kwangtung, Kwangsi, Yunnan, and Indo-China, is the center of the distribution of the Asiatic *Ilex*. From there various species disperse radiately to form the Sino-Japanese, the Sino-Himalayan, and the Sino-Indo-Malaysian elements of the genus. This assumption is supported by much evidence. In the series Umbelliformes, *Ilex rotunda* Thunb. is the most northern of the Sino-Japanese elements; those occur in East China and Japan. It is an entire-leaved glabrous species with striate sulcate narrow-elliptic pyrenes. *Ilex excelsa* (Wall.) Hook. f. is the most southern of the Sino-Himalayan elements; those occur in Southwest China and North India. It is also an entire-leaved species, but with puberulous inflorescences and striate-esulcate smaller but broader pyrenes. *Ilex rotunda* var *microcarpa* (Lindl. & Paxt.) Hu is an intermediate form that occurs in South China and northern Indo-China, and is characterized by its puberulous inflorescences, small broad-elliptic striate and slightly sulcate pyrenes. Among these three the changes in the indumentum, the size and shape of the pyrenes, and the sculpture of the endocarp are so gradual that it is sometimes difficult to tell to which species a specimen collected from the geographically intermediate provinces like Kwangsi belongs. Similar behavior occurs in the series Stigmatophorae, involving the Sino-Japanese element *Ilex crenata* Thunb., the Sino-Indo-Malaysian element *Ilex triflora* Blume, and the intermediate species *Ilex viridis* Champ. of South China; in the series Cassinoides, involving the Sino-Himalayan element *Ilex yunnanensis* Franch. and the Sino-Japanese element *Ilex sugeroki* Maxim.; and in the section Aquifolium, involving the Sino-Japanese element *Ilex latifolia* Thunb., the Sino-Himalayan element *Ilex denticulata* Wall. ex Wight., and the Chinese species *Ilex intermedia* Loes.

The altitudinal range of the Chinese *Ilex* extends from sea-level in the coastal provinces to a height of 3400 m. in the mountains of Yunnan. In general, as the habitat changes from low to high altitudes, the habit of the plants changes from trees to shrubs. In the subalpine Yunnan flora, three prostrate or creeping species of *Ilex* have been reported. Such creeping forms have otherwise been recorded only from Yezo of northern Japan and Sakhalin and the Himalaya.

The Chinese *Ilex* seems to illustrate a very interesting tie between the flora of Hainan and that of Indo-China, which, from a geographic and hydrographic standpoint, is to be expected. Examples of this are found in *Ilex pubilimba* Merr., *Ilex cochinchinensis* (Lour.) Loes., *Ilex kobuskiana* S. Y. Hu, and *Ilex hainanensis* Merr. & Chun. The flora of Taiwan (Formosa) also has close relationship with that on the mainland, especially that of Chekiang, Fukien, and, for certain high-altitude species, also Yunnan. Numerous examples in *Ilex* representative of this can be cited, notably *Ilex pubescens* Hook. & Arn., *Ilex formosana* Maxim., *Ilex yunnanensis* Franch., and *Ilex boiritsensis* Hayata.

Another interesting fact is that the Chinese Aquifoliaceae indicate a certain affinity between the floras of eastern Asia and eastern North America. The fruiting branches of *Ilex tsoii* Merr. & Chun from East, Central, and South China, resemble so closely those of *Ilex montana* Torr. & Gray of eastern North America that only a specialist could distinguish them. The same is true of *Ilex aculeolata* Nakai of China and *Ilex decidua* Walt. of eastern North America; *Ilex asprella* (Hook. & Arn.) Champ. of South China, Taiwan, and Luzon, and *Ilex longipes* Chapm. of eastern North America; *Ilex yunnanensis* Franch. of China and *Ilex glabra* (Linn.) Gray; and *Ilex serrata* Thunb. var. *sieboldi* (Miq.) Rehd. of China and Japan and *Ilex verticillata* (Linn.) Gray of eastern North America. In general, however, there is a vast difference between the Chinese and the American *Ilex*. In China more than ninety per cent of the species are evergreen, with comparatively few deciduous species, while in eastern North America most of the species are deciduous.

The great concentration of *Ilex* in China is shown by statistics giving the number of species found in Malaysia, as well as in adjoining countries of Asia. Pitard in 1912 (Lecomte, Fl. Gén. Indo-Chine 1: 850–862) admitted seventeen species for Indo-China, but by 1948 Tardieu-Blot (Lecomte, Fl. Gén. Indo-Chine Suppl. 1: 759–781) increased the number to thirty-seven. In the same general area Craib in 1926 (Fl. Siam. Enum. 1: 277–278) recognized but five species from Siam. The number occurring in Burma is approximately fifteen. Hooker f. in 1875 (Fl. Brit. Ind. 1: 598–606) admitted twenty-four species for the area he covered (India proper, Ceylon, Burma, and the Malay Peninsula), but this number has now been increased for the area by perhaps fifteen or twenty species. Ridley in 1922 admitted seventeen species for the Malay Peninsula alone (Fl. Malay. Penin. 1: 437–442). For the Philippines, Merrill in 1922 (Enum. Philip. Fl. Pl. 1: 476–480) recognized twenty-one species, but undoubtedly some reductions remain to be made. In the Malay Archipelago, outside of the Philippines, the area extending from Sumatra and Borneo to New Guinea, about forty-five species have been described. Possibly a critical consideration of the Malaysian species will somewhat reduce this number, although from a cursory examination of available material from the Archipelago it seems apparent that a number of Malaysian species have as yet not been described; eventually the total may be increased rather than diminished.

Because of the characteristic local endemism of a high percentage of the Old World species of *Ilex* and the paucity of species of relatively wide distribution (and this applies to most of the species in the large genera of flowering plants for the entire Indo-Malaysian region), no general discussion of geographic distribution of the Malaysian species seems to be called for in this study of the Chinese forms. However, for all the species of British India, as I understand specific limits, only about seven extend to Southwest China, chiefly Yunnan Province; of the fifteen Burmese species, ten occur in China; of the thirty-seven Indo-Chinese species about twenty (many of them are new synonyms) extend to China. This relatively high percentage of species not confined to a single geographic area is understandable since northern Indo-China borders on southern China, and the boundary between the two countries is merely one of a political nature.

Again considering those areas more distant from China proper, of the five Siamese species two occur in Southwest China; only three of the seventeen Malay Peninsula species extend to China; only two of the twenty-one Philippine species have this range; and of the larger number of species (approximately forty-five) characteristic of the Malay Archipelago proper and New Guinea, only one is known to extend to China.

As Taiwan (Formosa) is now politically again a part of China, I have to the best of my ability considered the species of that island. A critical comparison of our somewhat inadequate Formosan collections with the vast amount of material available to me from China proper has led me to reduce a certain number of the proposed Formosan species to synonymy. As the island lies on the continental shelf, and as it was in geologic times immediately preceding the present undoubtedly a part of the continent, it is to be expected that the percentage of endemism for the Formosan flora would be reduced on the basis of critical comparisons as material became available for study. I have, in all, reduced eight of the proposed Formosan species to synonymy. It is expected that the same results will attain in other genera when it is possible to make critical comparisons of a considerable number of the described Formosan species with Chinese material. I note in passing that both low- and high-altitude species are involved among those Formosan species which I have reduced to earlier described continental species and varieties.

In this paper I have not considered the species of the Liukiu Islands and Japan except in those cases where species originally described from those areas have later been found on the continent. In the second edition of their Flora of Japan (1931) Makino and Nemoto treated forty-nine species of *Ilex* from Sakhalin, Japan, Liukiu, and Taiwan. In the Supplement Nemoto (1936) added nine more species to the flora of Japan. The lack of comprehensive collections from the area involved for purposes of comparison renders it unsafe for anyone to pass judgment on the validity of this or that species, except on the basis of a critical study of the types.

In citing the specimens the following abbreviations have been used: A = Arnold Arboretum, Harvard University; B = British Museum of

Natural History, London, England; CB = Cambridge Botanic Museum, Cambridge, England; CCC = Canton Christian College, Canton, China, now Lingnan University; G = Gray Herbarium, Harvard University; K = Royal Botanic Gardens, Kew, England; LU = Lingnan University, Canton, China; NY = New York Botanical Garden, New York, N. Y.; P = Muséum National d'Histoire Naturelle, Paris, France; SS = Biological Laboratories, Science Society of China, Nanking, China; Sz = College of Science, National Szechuan University, Chengtu, China; TU = National Taiwan University, Taipei, China; UN = University of Nanking, Nanking, China; US = United States National Herbarium, Washington, D. C.; UT = University of Tokyo, Japan.

TAXONOMY

Ilex Linn. Sp. Pl. 125. 1753, Gen. Pl. ed. 5, 1754; DC. Prodr. **2**: 13. 1825; Benth. & Hook. f., Gen. Pl. 1: 356. 1862; Maxim. in Mém. Acad. Sci. St. Pétersb. VII, **29**(3): 14–53, *pl. 1.* 1881; Kronfeld in Engler & Prantl, Nat. Pflanzenfam. III, **5**: 183. 1896; Loes. in Engler & Prantl, Nat. Pflanzenfam. Nachtr. 217. 1897, in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. **78**: 8–500, *pl. 1–15* (Monog. Aquif. 1:) 1901, **89**: 20–312 (Monog. Aquif. 2:) 1908, in Sarg. Pl. Wils. 1: 67–82. 1911, in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **20**: 36. 1942; Comber in Notes Bot. Gard. Edinb. **18**: 37–62. 1933.

Flower small, inconspicuous, regular, heteromerous, unisexual by abortion. Staminate flowers: calyx patelliform, 4–6-lobed; corolla rotate, with petals 4–8, slightly connate at the base; stamens usually as long as the petals, epipetalous; anthers oblong-ovate with rounded base; rudimentary ovary subglobose or frequently pulvinate, with a cleft beak, glabrous or puberulous. Pistillate flowers: 1–18-(usually 4–8)-merous; calyx persistent, 4–8-lobed. Petals connate at the base and spreading or distinct and suberect; staminodes epipetalous, small, half or two-thirds the length of the petals, the sterile anthers sagittate or cordate; ovary ovoid, 1–10- usually 4–8-loculate, glabrous or rarely pubescent; style rarely developed, stigma discoid, capitate or columnar. Fruit a bacco-drupe, usually globose, with a membranous or chartaceous exocarp, a fleshy mesocarp, and distinct coriaceous, woody or stony endocarps. Pyrenes (endocarps) 1–18, usually 4–6, smooth, striate, striate-sulcate or rugose and pitted, 1-seeded.

Dioecious trees or shrubs. Leaves alternate, rarely opposite, deciduous or evergreen, the margin entire, serrate or spinose, the stipules minute, callose, usually persistent. Inflorescences cymose, simple or much branched, solitary and axillary on the current year's growth or fasciculate and axillary on the second year's growth. Flowers white, pink, or red. Mature fruit red or black.

Over four hundred species distributed in the tropic, subtropic, and warm temperate zones of both hemispheres. One hundred and twelve species, belonging in two subgenera, Prinos and Euilex, occur in China. The two subgenera are well-marked groups and probably represent diverging evolutionary lines within the genus. Which is the more primitive can be determined only after the genus has had a thorough anatomical and cytological study. I have placed Prinos before Euilex and so have departed from general practice. For publication of my paper this has been most practical. It does not imply necessarily that I believe Prinos to be the more primitive subgenus.

Key to the Subgenera

A. Deciduous trees or shrubs with membranaceous, chartaceous or rarely subcoriaceous leaves; branchlets usually with both elongated and abbreviated shoots; lenticels usually conspicuous on the current year's growth.......................................A. Subgenus *Prinos*.

AA. Evergreen trees or shrubs with thick-coriaceous, coriaceous, or rarely chartaceous leaves; branchlets without abbreviated shoots; lenticels usually absent on the current year's growth.........B. Subgenus *Euilex*.

A. Subgenus PRINOS (Linn.) Loesener

Ilex subgen. **Prinos** (Linn.) Loes. Vorst. Monog. Aquif.-Diss. 25, 26. 1890 "Prinus," in Verh. Bot. Ver. Brand. **33**: 25, 26. 1891 "Prinus," in Engl. & Prantl, Nat. Pflanzenfam. Nachtr. 221. 1897, et in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. **78**: 465 (Monog. Aquif. 1: 465). 1901 "Prinus"; Rehd., Man. Cult. Trees & Shrubs, ed. 2, 551. 1940, Bibl. Cult. Trees & Shrubs 402. 1949.

Prinos Linn. Sp. Pl. 330. 1753, Gen. Pl. ed. 5, 153. 1754.

Shrubs or trees usually with both elongated and abbreviated shoots, the lenticels usually conspicuous on the current year's growth; leaves deciduous, membranaceous or chartaceous, rarely subcoriaceous, the margin serrate or crenulate, rarely subentire, the pistillate inflorescence solitary.

Key to the Sections

A. Mature fruit red; the pyrenes smooth with coriaceous, rarely woody, endocarp.

B. Branchlets with definite abbreviated shoots; fruit strongly depressed-globose with a capitate or cristate stigma, the style evident; pyrenes 6–13, longitudinally striate, the striae slightly impressed, the endocarp woody............................Sect. I. *Pseudoprinos*.

BB. Branchlets without abbreviated shoots; fruit globose, with a discoid stigma, the style lacking; pyrenes 4–8, smooth, not striate, the endocarp coriaceous.

C. Pistillate flowers in trichotomous cymes or pseudo-umbels; the inflorescence with 10 or more flowers..Sect. II. *Micrococca*.

CC. Pistillate flowers solitary or in 2- or 3-flowered cymose or pseudofasciculate inflorescences.........Sect. III. *Euprinos*.

AA. Mature fruit black; the pyrenes rugose, striate, sulcate or canaliculate; the endocarp stony...........................Sect. IV. *Prinoides*.

SECTION I. PSEUDOPRINOS, SECT. NOV.

Frutices vel arbores parvae; ramulis elongatis abbreviatisque, lenticellis conspicuis; foliis membranaceis vel chartaceis, serratis; inflorescentiis paucifasciculatis vel solitariis; floribus 6–16-meris; ovario stylifero, stigmate capitato vel cristato; fructibus valde depresso-globosis; pyrenis 6–13, laevibus, striatis, endocarpio sublignescente.

One species in China.

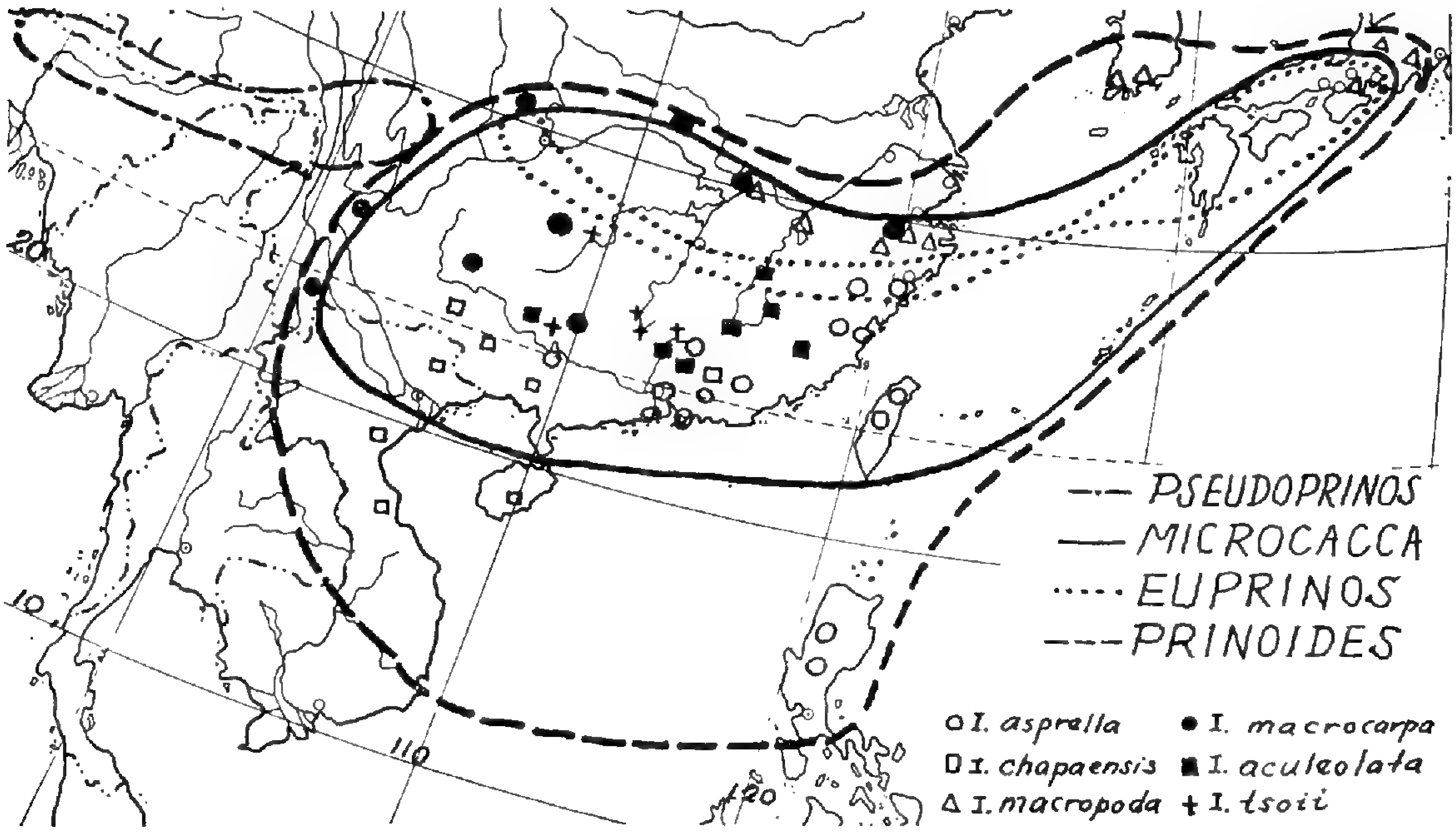

FIG. 4. Geographic distribution of the Eastern Asiatic representatives of the four sections of the subgenus *Prinos* with the species of the section Prinoides shown in detail.

1. **Ilex fragilis** Hook. f. forma **kingii** Loes. in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. 78: 493 (Monog. Aquif. 1: 493). 1901, in Sarg. Pl. Wils. 1: 82. 1911.

Ilex burmanica Merr. in Brittonia **4**: 102. 1941. *Syn. nov.*
Ilex opienensis S. Y. Hu in Ic. Omei. **2**: *pl. 173.* 1946. *Syn. nov.*

A deciduous shrub or small tree up to 5 m. high with both elongated and abbreviated branchlets, membranaceous or chartaceous ovate serrate leaves with pubescence beneath, very short pedicellate fruits with 6–13 small smooth striate woody pyrenes.

Branchlets castaneous or nigrescent; elongate shoots 7–15 cm. long or even longer, angular, smooth, shiny, rarely minutely puberulous in grooves below the terminal buds, otherwise glabrous, the lenticels conspicuous, elliptic, white, the terminal buds conic, with glabrous, strongly ciliate scales; abbreviated shoots 10–15 mm. long, very rugose with persistent bud-scales and leaf-scars; leaves 15–35 mm. apart on the elongated shoots, 1 or 2, rarely 3, crowded at the tip of the abbreviated shoots; stipules minute, broadly deltoid, persistent; petioles 6–12 mm. long, one-ninth to one-eighth as long as the lamina, glabrous, narrowly canaliculate above, the distal end narrowly winged by the decurrent leaf-base; lamina chartaceous or membranous, olivaceous, opaque on both surfaces, hirsute along the veins on both surfaces, rarely glabrescent, ovate or ovate-elliptic, 5.5–14 cm. long, 2–5.5 cm. wide, rounded or obtuse at the base, acute or acuminate at the apex, the acumen 3–20 mm. long, serrate, the very tip cuspidate; the margin serrate, the teeth apiculate and nigrescent; midrib slightly impressed or plane, puberulent or glabrescent above, elevated and hirsute beneath, rarely glabrescent, the lateral nerves 8 or 9 pairs, slightly hirsute, rarely glabrescent beneath, the reticulations of the veinlets obscure above, evident beneath. Staminate inflorescence: fasciculate or solitary and axillary to scales or basal leaves of the elongate shoots, the individual branches of the fascicles uniflorous; pedicels 4–6 mm. long, glabrous; flowers 6–8-merous; the calyx patelliform, glabrous, 3 mm. across, deeply 6–8-lobed, the size and shape of lobes of the same flower varying greatly, 1 mm. long, ciliate, acute, rarely obtuse; corolla rotate, 6 mm. across, the petals oblong, 2 mm. long, very minutely ciliate, one-sixth connate at the base; stamens one-half the length of the petals, the anthers ovoid-oblong, 1 mm. long; rudimentary ovary pulvinate, depressed in the center. Pistillate inflorescence: solitary, axillary to the scales or rarely to the leaves; the pedicels 2–3 mm. long, up to 5 mm. long after fruiting, glabrous; flowers 6–16-merous; calyx patelliform, 4 mm. across, deeply 6–8-lobed, the lobes acute, 1 mm. long, ciliate; corolla subrotate, the petals oblong, 2 mm. long, one-eighth connate at the base; staminodes one-third as long as the petals, the sterile anthers cordate; ovary pulvinate, the style evident, up to 1.5 mm. long, glabrous or puberulous, the stigma capitate or comb-shaped. Fruit depressed-globose or discoid, 4 mm. long, 5–6 mm. in diameter, the persistent calyx explanate, the stigma discoid, capitate or cristate. Pyrenes 6–13, broadly elliptic or subglobose in outline, the ends obtuse, 2–2.5 mm. long, 1.5 mm. wide, smooth, longitudinally striate, the striae slightly impressed, the endocarp woody.

CHINA: Szechuan: Opien-hsien: *W. C. Cheng 6129* (SS); *Y. S. Liu 2233* (A); *C. W. Yao 2739* (SS), *2803* (SS), *4320* (SS), *4327* (SS); *T. S. Chao 148* (SS), *615* (SS), *734* (SS); Mt. Omei(?), *H. C. Chow 12307* (A), *12321* (A); Wa-wu-shan, *E. H. Wilson 892* (A), *334* (A); *C. W. Yao 2306* (SS), *3766* (SS), *3842* (SS); Lung-an, *E. H. Wilson 4580* (A). Sikang (Southeastern Tibet): Tsarong, *G. Forrest 20298* (A), *21808* (A); *J. F. Rock 10208* (A, US), *22015* (A, US), *22482* (A); Ta-chien-lu, *E. H. Wilson 892A* (A). Yunnan: *E. E. Maire 44* (A); Wei-hsie, *J. F. Rock 17058* (A, NY, US), *17168* (A, NY); Liang-shan, *H. T. Tsai 51233* (A); Yi-liang-hsien, *H. T. Tsai 52128* (A); Ping-pien-hsien, *H. T. Tsai 62568* (A), *62680* (A); Salwin-Kiukiang Divide, *G. Forrest 20298* (US), *21808* (US); *T. T. Yu 19237* (A), *19289* (A), *20306* (A); Tarulaka, *T. T. Yu 20920* (A).

UPPER BURMA: Adung Valley, *F. K. Ward 9559* (TYPE of *Ilex burmanica*, A), *9583* (A).

INDIA: Sikkim, *J. D. Hooker* (fragment, A).

Ilex fragilis forma *kingii* is endemic to Eastern Himalaya. It is common on the high mountain of Sikkim, Upper Burma, and the Szechuan-Yunnan border. There it grows as a shrub or small tree in thickets or woods at altitudes of 1500–3000 m. The flowers appear in June, and the fruit turns red in October.

Both of Kingdon Ward's Specimens from Upper Burma are staminate flowering shoots. The leaves are still young and not fully expanded, hence they are smaller than those found on the fruiting specimens.

The membranaceous or chartaceous leaves, the variable number of carpels on one shoot, and the styliferous ovaries of *Ilex fragilis* indicate a close relationship with *Ilex macrocarpa* Oliv. The latter, however, has larger (over 10 mm. in diameter) fruits with ridged and canaliculate pyrenes. Nevertheless, the staminate branches of the two species are sometimes hard to distinguish. The short fruiting pedicels of *Ilex fragilis* suggest close relationship with *Ilex tsaii* Merr. & Chun, but the latter has deeply ridged stony pyrenes. When Loesener published the form *kingii* he doubted that this pubescent plant could be a juvenile form of *Ilex fragilis*. I have a fragment from Hooker's cotype (*Hooker & Thomson*, Khasia) in fruit. Its leaves are completely glabrous. At the same time I have *Wilson 892A* before me. The fruits of this specimen are mature, also. The lower surfaces of the leaves are pilose. I do not believe that the presence and absence of hairs in this case is correlated with age.

Section II. MICROCOCCA (Loes.), stat. nov.

Ilex subgen. *Byronia* (Endl.) Loes. series B. *Micrococca* Loes. in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. 78: 91 (Monog. Aquif. 1: 91). 1901.

Large trees with conspicuous lenticels on the current year's growth, membranaceous or chartaceous serrate leaves, solitary trichotomous compound cymes or pseudo-umbels, small globose fruit, and 6–8 smooth longitudinally canaliculate pyrenes with coriaceous endocarp.

Two species in China.

Key to the Species

A. Inflorescence a compound trichotomous cyme with the secondary axis longer than the fruiting pedicels; leaves with 6–8 pairs of lateral nerves, the petioles plane above. (East and Southeast China) .... 2. *I. micrococca*.

AA. Inflorescence a pseudo-umbel, the secondary axis usually lacking, when present shorter than the fruiting pedicels; leaves with 10–20 pairs of lateral nerves, the petioles canaliculate above. (West and South China) .... 3. *I. polyneura*.

2. **Ilex micrococca** Maxim. in Mém. Acad. Sci. St. Pétersb. VII, **29**: 39, *pl. 1, fig. 6.* 1881; Loes. in Nov. Act. Acad. Leop.-Carol. Nat. Cur. 78: 91 (Monog. Aquif. 1: 91). 1901; Chung in Mem. Sci. Soc. China 1: 141. 1924; Anon. in Notes Bot. Gard. Edinb. **17**: 115.

1926, 156, 268, 303, 365, 403. 1930; Merr. & Chun in Sunyats. 1: 68. 1930; Comber in Notes Bot. Gard. Edinb. 18: 55. 1933; Masamune Fl. Kainant. [Hainan] 174. 1943; Tardieu-Blot in Fl. Gén Indo-Chine Suppl. 1: 765. 1948.

Ilex micrococca var. *longifolia* Hayata Icon. Pl. Form. 3: 55, *pl. 9.* 1913; Kanehira, Formosan Trees 377, *fig. 334.* 1936. *Syn. nov.*

Tree up to 20 m. high with conspicuous lenticels on the current year's growth, the inflorescences cymose, trichotomous, solitary, with the secondary axis longer than the pedicels, the fruit globose, the pyrenes smooth with coriaceous endocarp.

Branchlets stout, very glabrous, second year's growth 1.5–5 mm. thick, cinereous-brunnescent, longitudinally plicate and rather rugose with conspicuous large circular or oblong, often coalescent white lenticels and slightly elevated obovate leaf-scars often united with the peduncle-scars immediately above them; current year's growth 2–4 mm. thick, shiny castaneous, with conspicuous white lenticels. Leaves occurring only on the current year's growth, 1–3 cm. apart; stipules minute, broadly deltoid, 0.2 mm. long, 0.3 mm. wide at the base; petioles slender, 1.5–3.2 cm. long, one-quarter to one-third the length of the lamina, plane above, plicate-rugose beneath, glabrous; lamina membranous or chartaceous, glabrous, olivaceous or brunnescent, dull above, paler beneath, ovate or ovate-elliptic, 7–13 cm. long, 3–5 cm. wide, rounded or obtuse and often oblique at the base, acuminate at the apex, the acumen 5–20 mm. long; margin subentire or sharply aristate-serrate; midrib plane and toward the base slightly sulcate above, prominent and elevated beneath, the lateral nerves 5–8 pairs, the tertiary veins prominent, the reticulations evident on both surfaces. Inflorescence cymose, solitary, or current year's growth only, axillary, twice or thrice trichotomous; bracts and bracteoles on the secondary axis lacking, the bract on the tertiary axis broad deltoid, minute, 0.4 mm. long, 0.5 mm. wide, acute, the bracts subtending the individual flowers very minute and warty; peduncle glabrous, longer than the secondary axis, 9–12 mm. long, plicate and in fruiting branches rugose; pedicels very short, 2–3 mm. long, shorter than the secondary axis, glabrous; prophylla 1 or 2, minute, warty, basal. Staminate flowers: 5- or 6-merous; calyx patelliform, 2 mm. across, shallowy 5- or 6-lobed, the lobes obtuse, glabrous, eciliate or sparsely ciliate; corolla rotate, the petals oblong, 1.25 mm. long, one-third connate at the base; stamens equaling the petals in length, the anthers ovoid-oblong, 0.5 mm. long; rudimentary ovary subglobose, rostellate with a 0.5 mm. beak parted to the base. Pistillate flowers: 6–8-merous, very small, calyx patelliform, 2 mm. across, deeply 6-lobed, the lobes obtuse, ciliate; corolla rotate, 3 mm. in diameter, the petals oblong, 1 mm. long, one-fourth connate at the base; staminodes one-half as long as the petals, the sterile anthers sagittate; ovary conic-ovoid, 1 mm. in diameter, slightly constricted below the discoid stigma. Fruits globose, 3 mm. in diameter, the persistent calyx explanate, orbicular in outline, ciliate, the stigma thick-discoid, convex, distinctly

6–8-lobed. Pyrenes 6–8, minute, elliptic in outline, 2 mm. long, 1 mm. wide, the ends obtuse, the dorsal surface slightly roughened, longitudinally unicanaliculate, the sides smooth, the endocarp coriaceous.

CHINA: Chekiang: Sia-chu, *R. C. Ching 1691* (LU, US), *1753* (US); Tai-sun, *R. C. Ching 2181* (A, US). Kiangsi: Lu-shan, *W. Y. Chun 4291* (A). Kwangtung: *S. S. Sin 9513* (LU, NY); Sin-fung, *Y. W. Taam 682* (A), *866* (A); Yu-yuen, *S. P. Ko 52688* (A); Lo-chang, *C. L. Tso 20773* (NY). Hainan: Fan-yah, *N. K. Chun & C. L. Tso 44097* (A, NY, US). Taiwan: Lake Jitugetutan, *Y. Kudo* in 1929 (A); Taihoku, *Nakamura 4055* (TU), *E. H. Wilson 10784* (A); without precise locality, *S. Susuki* in 1925 (TU).

JAPAN: Hondo: *Y. Okada 73* (A), *3913* (A).

Ilex micrococca was first described from material collected in Japan and is common in the coastal provinces of east and south China and the islands of Hainan and Taiwan, occurring also in Indo-China. It is a big tree up to 20 m. high. The white flowers appear in May, and by October its red fruit has fully matured.

2a. **Ilex micrococca** forma **pilosa**, f. nov.

Ilex pseudogodajam Franch. in Jour. de Bot. **12:** 256. 1898.

Ilex micrococca sensu S. Y. Hu in Ic. Pl. Omei. **2:** *pl. 155.* 1940, in part.

Arbor; pedicellis, calycibus et etiam foliis subtus pilosis.

CHINA: Hupei (Hupeh): Enshih, *H. C. Chow 1840* (A); Chang-yang, *E. H. Wilson 664* (A, B). Kweichow: Fan-ching-shan, *Steward, Chiao & Cheo 713* (A, NY, US). Szechuan: Tchen-kéou-tin, *R. P. Farges* (P); Nan-chuan, *W. P. Fang 5656* (A); Mt. Omei, *T. S. Liu 1285* (A); *T. C. Lee 4605* (Sz); *W. P. Fang 15144* (Sz), *15548* (Sz), *15734* (Sz), *15576* (Sz), *19116* (Sz), *19164* (Sz); *S. N. Hsu 691* (Sz); *E. H. Wilson 3317* (K). Yunnan: An-ngy-tsin, *Ducloux 2775* (P); Sze-mao, *A. Henry 11974A* (NY); Meng-tze, *A. Henry 13702* (NY); *Y. Liu & C. W. Wang 85752* (A); Che-li, *C. W. Wang 78193* (TYPE, A); *Y. Liu & C. W. Wang 82895* (A); Ping-pien, *H. T. Tsai 60843* (A); *Delavay 6827* (A). Kwangtung: Lok-chong, *L. C. Tso 20724* (NY), *20810* (NY). Kwangsi: N. Lu-chen, *R. C. Ching 5900* (A, US), *6220* (NY); N. Hin-yen, *R. C. Ching 6915* (LU); Chen-pien, *S. P. Ko 55887* (A); On-Tak, *S. P. Ko 55788* (A); Lin-yuin, *Steward & Cheo 328* (A, NY), *316* (A, NY); Shang-sze, *W. T. Tsang 22069* (A), *22145* (A), *24149* (A); Ping-nan, *C. Wang 39316* (A), *39923* (A).

INDO-CHINA: Tonkin: *W. T. Tsang 27284* (A), *29274* (A).

This variety differs from typical *Ilex micrococca* in having pubescent pedicels, calyces, and sometimes the branchlets and the lower surface of the leaves.

3. **Ilex polyneura** (Hand.-Mzt.), comb. nov.

Ilex micrococca Maxim. var. *polyneura* Hand.-Mzt. Symb. Sin. **7:** 654. 1933.

Tree up to 20 m. high (ex Yu), with conspicuous lenticels on current year's growth, chartaceous leaves, pseudo-umbelliform inflorescences, small globose fruits, each with 6 or 7 pyrenes, the endocarp coriaceous, smooth and unicanaliculate along the longitudinal median dorsal line.

Branchlets stout, very glabrous; second year's growth 3.5–4.5 mm. thick, cinereous-brunnescent, longitudinally plicate, the lenticels conspicuous, white, orbicular or oblong, the leaf-scars semi-orbicular, slightly elevated, closely associated with the oblong peduncle-scars; current year's growth glabrous, shiny, castaneous, 2–4 mm. thick, with conspicuous elliptic lenticels. Leaves occurring only on current year's growth, 5–15 mm. apart, the stipules scaly, rather large for the genus, 1.5 mm. long, 1 mm. wide; petioles one-fourth to one-third the length of the lamina, 1.5–2.8 cm. long, cylindric, deeply and narrowly canaliculate above, puberulent in the groove; lamina chartaceous or thin-coriaceous, glabrous above, minutely puberulent beneath, especially on the lateral nerves, olivaceous-brunnescent, oblong-elliptic, rarely ovate-elliptic, 8–15 cm. long, 3.5–6.5 cm. wide; rounded or obtuse, rarely oblique at the base, acuminate at the apex, the acumen 5–15 mm. long; margin finely and sharply serrate; midrib slightly impressed above, elevated beneath, the lateral nerves 11–20 pairs, plane above, elevated beneath, the tertiary nerves clear, the reticulation of the veinlets evident on both surfaces. Inflorescences pseudo-umbelliform, solitary, on the current year's growth, axillary, secondary axis usually not evident, but if developed, then shorter than the pedicels; peduncular bracts none, bracteoles subtending the individual flowers prophylla-like, basal, minute, broadly deltoid, brunnescent; peduncles slightly compressed, gradually enlarged at the distal end, 6–9 mm. long, puberulous; flowers 6- or 7-merous. Staminate flowers: pedicels 2–3 mm. long, puberulous, with 2 minute basal prophylla; calyx patelliform, 2 mm. across, deeply 6–7-lobed, the lobes deltoid, erose, eciliate; corolla rotate, 4 mm. across, the petals ovate, 2 mm. long, one-fourth connate at the base; stamens equaling or slightly shorter than the petals, the anthers oblong, 1 mm. long; rudimentary ovary pyramidal, 1 mm. long, the apex rostellate, the beak cleft. Pistillate flowers: pedicels 3 mm. long, after fruiting 4–5 mm. long, with minute acute basal prophylla; calyx 2 mm. across, deeply 6- or 7-lobed, the lobes deltoid, acute, erose, eciliate, rarely minutely and sparsely ciliate; corolla rotate, 4 mm. across, the petals oblong, 1.5 mm. long, one-fifth connate at the base; staminodes very short, one-half as long as the petals, the sterile anthers sagittate; ovary ovoid, 2 mm. in diameter, the stigma discoid. Fruit globose, 4 mm. in diameter, the persistent calyx 3 mm. across, the stigma discoid, convex. Pyrenes 7, small, elliptic in outline, 2–2.5 mm. long, 1 mm. wide on the back and narrowly unicanaliculate along the longitudinal median line, the endocarp coriaceous.

CHINA: Sikang: Ya-an, *C. Y. Chiao 1254* (A). Yunnan: *Handel-Mazzetti 8407* (A, US); Djiou-djiang, *Handel-Mazzetti 9349* (A); Mengtze, *A. Henry 10329A* (B); Sze-mao, *A. Henry 11953* (A); Tsing-pian, *H. T. Tsai 52526* (A); without precise locality, *G. Forrest 8003* (A), *8651* (A), *16058* (A); Tsarong, *G. Forrest 20823* (A, US), *21663* (A, US), *22824* (A), *26627* (A, US); Shang-pa, *H. T. Tsai 54374* (A), *54810* (A), *58736* (A), *59041* (A); Ping-pien, *H. T. Tsai 60434* (A); Kung-shan, *C. W. Wang 66885* (A), *66913* (A); Fo-hai, *C. W. Wang 77392* (A); Shun-ning, *T. T. Yu 16010* (A), *16197* (A); Ai-wa, *T. T. Yu 22879* (A); Salwin Valley, *T. T. Yu 22918* (TYPE, A).

The description of the staminate flowers is drawn from *Handel-Mazzetti 9349*, and that of the pistillate flowers from *T. T. Yu 16010*.

This species has a limited range of distribution. It is found only in the mountainous area of western Yunnan and Sikang at altitudes of from 1500 to 2600 m. It flowers in May, and by December the fruits are mature. No leaves have been observed on twigs of the second year's growth. This may mean that the species is deciduous, or at least that the old leaves drop before the new ones develop.

In the color of the branchlets, the presence of white lenticels on the current year's growth, and the chartaceous leaves, *Ilex polyneura* resembles *Ilex micrococca* Maxim. These two species differ chiefly in their venation, petioles, and inflorescences. In *Ilex micrococca* the lateral nerves are 6–8 pairs, the petioles plane above, and the inflorescence twice or thrice trichotomous with prominent secondary axes which are always longer than the pedicels. In *Ilex polyneura* the lateral nerves vary from 11 to 20 pairs, the petioles are deeply and narrowly sulcate above, and the inflorescences are pseudo-umbelliform, but when secondary axes evolve, they are always shorter than the pedicels. The last character is constant. The differences impress me as sufficiently strong to warrant giving specific status to Handel-Mazzetti's variety.

3a. **Ilex polyneura** var. **glabra**, var. nov.

Arbor; ramulis glabris, castaneis, lenticellis conspicuis; foliis chartaceis vel membranaceis, 7–15 cm. longis, 3–7 cm. latis; inflorescentiis pseudo-umbelliformis, glabris; fructibus globosis.

CHINA: Yunnan: Mengtze, *A. Henry 10329* (A, US), *10629C* (A); Sze-mao, *A. Henry 11953A* (A), *11953B* (A, US), *11953C* (A, NY), *11953D* (A); without precise locality, *G. Forrest 11886* (A), *17981* (A), *18758* (A); Ta-li, *J. F. Rock 6888* (A, NY); Tang-yueh, *J. F. Rock 2709* (A, US); Shang-pa-hsien, *H. T. Tsai 54500* (A), *54626* (A), *54701* (A), *58988* (A); Tsang-yuan, *C. W. Wang 71396* (A); Chen-kang, *T. T. Yu 17241* (A); Mien-ning, *T. T. Yu 17879* (A); Champutong, *J. F. Rock 10156* (A, NY, US), *11666* (A, US), *22061* (TYPE, A; NY); *T. T. Yu 19166* (A); Tsarong, *G. Forrest 19904* (A), *26652* (A, NY, US), *27417* (A).

This variety differs from typical *Ilex polyneura* in having glabrous leaves and inflorescences. It has been reported only from Yunnan, especially from the south and southwestern sections of that province. There it grows as a common tree. The greenish yellow flowers appear in June, and the fruit becomes scarlet in October.

SECTION III. EUPRINOS LOESENER

Ilex subgen. **Prinos** Loes. sect. **Euprinos** Loes. in Engler & Prantl, Nat. Pflanzenfam. Nachtr. 221. 1897, in Nov. Act. Acad. Caes. Leop.-

Carol. Nat. Cur. **78**: 465 (Monog. Aquifol. **1**: 465). 1901 "Euprinus"; Rehd. Man. Cult. Trees Shrubs 551. 1940 "Euprinus," et Bibl. Cult. Trees Shrubs 402. 1949.

Ageria Adanson, Fam. Nat. Pl. **2**: 166. 1763, pro parte.

Prinos Sect. *Ageria* (Adans.) DC. Prodr. **2**: 17. 1825.

Ilex sect. *Prinos* (L.) Gray, Man. Bot. N. U. S. ed. 2, 264. 1856; Maxim. in Mém. Acad. Sci. St. Pétersb. VII, **29**(3): 30. 1881.

Shrubs with membranaceous or chartaceous leaves, solitary or subfasciculate red fruits, and 4–6 smooth pyrenes with coriaceous endocarp.

One species in China.

4. **Ilex serrata** Thunb. var. **sieboldi** (Miq.) Rehd. in Bailey Cycl. Am. Hort. [2]: 798. 1900; Loes. in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. **78**: 468 (Monog. Aquif. **1**: 468). 1901 "Sieboldii"; Makino, Ill. Fl. Nip. 368, *fig. 1102*. 1940.

Ilex sieboldi Miq. in Versl. Med. Kon. Akad. Wet. II, **2**: 84. 1868 [1866] (Repr. 19. 1866), et in Ann. Mus. Bot. Lugd.-Bat. **3**: 104. 1867; Franch. & Sav. Enum. Pl. Jap. **1**: 77. 1873; Maxim. in Mém. Acad. Sci. St. Pétersb. VII, **29**: 30, 48. 1881; Nakagawa in Bot. Mag. (Tokyo) **13**: 108. 1899.

Ilex subtilis Miq. in Versl. Med. Kon. Akad. Wet. II, **2**: 84. 1868 [1866] (Repr. 19. 1866), et in Ann. Mus. Bot. Lugd.-Bat. **3**: 107. 1867; Franch. & Sav. Enum. Pl. Jap. **1**: 78. 1875.

Ilex serrata var. *subtilis* (Miq.) Yatabe in Bot. Mag. (Tokyo) **62**: 158. 1892; Loes. op. cit. 469 (1901); Koidz. Fl. Symb. Orient.-As. 8. 1930. *Syn. nov.*

A very pubescent deciduous shrub 1–2.5 m. high with hirsute branchlets, conspicuous lenticels, elliptic densely and argutely serrate leaves, solitary cymose inflorescences borne behind an axillary bud on the current year's growth, short-pedicellate fruit, and 4–6 smooth pyrenes.

Branchlets subterete, cinereous, hirsute; third year's growth 3–4 mm. in diameter, longitudinally rimulose, the lenticels numerous, circular, leaf-scars semi-orbicular, not elevated; second year's growth 3–3.5 mm. in diameter, puberulous, the lenticels conspicuous; the current year's growth 1.5–2.5 mm. in diameter, hirsute, longitudinally plicate-canaliculate, the lenticels conspicuous, the terminal buds ovoid, with puberulous and crisply ciliate scales. Leaves occurring only on current year's growth, expanding a little before or during anthesis, 8–14, rarely 20 mm. apart; the stipules linear, 2 mm. long, pilose, caducous; petioles 6–8 mm. long, one-tenth to one-sixth the length of the lamina, plicate-rugose and hirsute, deeply canaliculate above; lamina membranaceous, griseous-olivaceous, sometimes brunneous, hirsute on both surfaces, elliptic, rarely ovate or obovate-elliptic, 2–8.5 cm. long, 1–4 cm. wide (usually 5 cm. long, 2 cm. wide), acute or rarely obtuse at the base, shortly acuminate or rarely acute at the apex, the acumen 3–5 mm. long, the very tip mucronate; margin densely and argutely serrate; midrib elevated on both surfaces, hirsute, the lateral nerves 6–8 pairs, obscure above, prominent beneath, hirsute on both surfaces, the reticulation of the veinlets prominent beneath, hirsute. Inflorescences essentially cymose, solitary, on current year's growth, always behind an axillary bud, hirsute, very rarely subfasciculate in the pistillate. Staminate inflorescences: cymes twice or thrice dichotomous or trichotomous, 9–21-flowered; peduncles 3 mm. long, the secondary axis 1.5 mm. long, the pedicels 2–2.5 mm. long, with scale-like minute deltoid basal prophylla; flowers 4- or 5-merous; calyx patelliform, 1.5–2 mm. across, deeply 4- or 5-lobed, the lobes deltoid, obtuse or rounded, hirsute and ciliate; corolla rotate, 4.5 mm. across, the petals oblong, erose, eciliate, one-tenth connate at the base; stamens slightly shorter than the petals, the anthers oblong, 1.25 mm. long; rudimentary ovary narrowly conic, 0.75 mm. long, acute at the apex, glabrous. Pistillate inflorescences: cymes with 1–3 flowers, the peduncles 0–1.5 mm. long, the pedicels 2–3 mm. long; flowers 4–6-merous; calyx as in the staminate flowers; corolla rotate, 4.5 mm. in diameter, the petals ovate, erose, one-eighth connate at the base; staminodes one-half as long as the petals, the sterile anthers sagittate, obtuse at the apex; ovary ovoid, 1.5 mm. in diameter, glabrous, the stigma discoid. Fruit globose, 5 mm. in diameter, solitary or 2 or 3 in a simple cyme, pedicels less in length than the diameter of the fruit, 2–2.5 mm. long, hirsute, the prophylla sub-basal, persistent, explanate, suborbicular in outline, 5- or 6-lobed, the lobes round, hirsute and ciliate, the stigma discoid, 5- or 6-lobed. Pyrenes 4 or 5, rarely 6, broadly elliptic in outline, 2–2.3 mm. long, 1–1.25 mm. wide, smooth, estriate-esulcate, the endocarp coriaceous.

CHINA: Chekiang: Ching-yuen, *R. C. Ching 2324* (A). Hunan: Changsa, *Y. Lin* in 1947 (A), in 1948 (A). Szechuan: Kia-ting, *E. H. Wilson 3519* (A).

JAPAN: *P. H. Dorsett & W. J. Morse 1450* (A); *U. Faurie 88* (A), *6119* (A); *J. G. Jack* in 1905 (G); *Maximowicz* in 1862 (NY); *N. Mochizuki* in 1904 (G); *Siebold* (TYPE of *Ilex serrata* var. *subtilis*, fragment, A); *K. Shiota 6663* (A); *E. H. Wilson 7043* (A), *7555* (G); *K. Watanabe* in 1892 (G).

CULTIVATED: Europe: Germany, Botanical Garden Darmstadt, *J. A. Purpus* (A). America: United States, Arnold Arboretum 892, 5385 (A).

Ilex serrata var. *sieboldi* is common in Japan. It differs from typical *Ilex serrata* Thunb. in having hirsute leaf-surfaces. Specimens which match perfectly the Japanese specimens have been collected at several places in China.

I am treating *Ilex sieboldi* Miq. as only a variety of *Ilex serrata* Thunb. It appear to differ from the Thunbergian species only in having hirsute leaf-surfaces. After examining all the available Asiatic material of *Ilex serrata,* I belive that to be essentially a pubescent species. None of the specimens has completely glabrous branchlets as stated by Thunberg, "Rami teretes, laeves, glabri." In fact, many of them have pubescent midribs, and all of them have puberulent pedicels. Nowhere in his description did Thunberg mention the presence of hairs on the branchlets, leaves, or inflorescences. Since I have not seen Thunberg's original specimen, I have followed his description and treated the Japanese plant with sparsely puberulous branchlets, glabrous or glabrescent petioles and lamina as typical *Ilex serrata.*

Miquel based his description of *Ilex subtilis* on a juvenile branch with unfolding buds in which the leaves were not fully expanded. A fragment of the type is in the Arnold Arboretum. It is certainly a juvenile form of *Ilex serrata* var. *sieboldi.*

Ilex serrata Thunb. and *Ilex verticillata* Gray, the latter a North American species of deciduous holly, are alike in their crisply hirsute indumentum, their membranaceous or thinly chartaceous argutely serrate leaves, their solitary, rarely 2- or 3-flowered infructescences, their ciliate calyx and their smooth coriaceous pyrenes. The latter species differs in having 6–9-merous flowers. The texture of the leaves, the shortly pedicellate infructescences, and the indumentum of *Ilex serrata* var. *sieboldi* also simulate *Ilex pubescens* Hook. & Arn. of China, but the latter has fasciculate inflorescences on the old growth, a styliferous ovary, and striate and sulcate woody pyrenes.

Section IV. PRINOIDES (DC.) Gray

Ilex subgen. **Prinos** Loes. sect. **Prinoides** (DC.) Gray, Man. Bot. N. U. S., ed. 2, 264. 1856; Loes. in Engl. & Prantl, Nat. Pflanzenfam. Nachtr. 221. 1897, et in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. 78: 476 (Monog. Aquif. **1**: 476). 1901; Rehd. Man. Cult. Trees Shrubs ed. 2, 552. 1940, et Bibl. Cult. Trees Shrubs 403. 1949.

Prinos sect. *Prinoides* DC. Prodr. **2**: 16. 1825.

Deciduous trees or shrubs with chartaceous, membranaceous or subcoriaceous leaves, black mature fruit, 4–9 rugose, striate, sulcate, or 2-canaliculate pyrenes with stony endocarp.

Key to the Species

A. Pyrenes 3-ridged and deeply canaliculate on the dorsal surfaces; fruit with capitate or columnar stigma, the style evident.
- B. Leaves small, (3–)4–5(–7) cm. long; fruit 5–6 mm. in diameter; pedicels slender, 5 or 6 times as long as the diameter of the fruit; stigma capitate. (East and South China and the near-by islands) .... 5. *I. asprella.*
- BB. Leaves large (5–)7–10(–15) cm. long; fruit 12–14 mm. in diameter; pedicels never as much as 3 times as long as the diameter of the fruit; stigma columnar.
  - C. Rudimentary ovary pulvinate, with slightly depressed center; pyrenes 7–9, laterally much compressed, the dorsal surface 1–2 mm. wide; style glabrous. (West, southwest, central, and east China) .... 6. *I. macrocarpa.*
  - CC. Rudimentary ovary conic with a rostellate apex; pyrenes 6 or 7, the dorsal surface 4 mm. wide; style puberulous. (South China and Indo-China) .... 7. *I. chapaensis.*

AA. Pyrenes striate and sulcate, the striae of the dorsal surface often reticulate; fruit with discoid (sometimes capitate in *I. tsoii*) stigma, the style lacking.

B. Leaves obovate, (2–)3–4(–5) cm. long, cuneate at the base; pyrenes 4 .... 8. *I. aculeolata.*

BB. Leaves ovate or ovate-elliptic, (4–)6–8(–10) cm. long with rounded base; pyrenes 5 or 6.

C. Fruiting pedicels 6–7 mm. long; pyrenes 5; calyx 2.5 mm. across; leaves with obscure reticulations on the upper surface. (East and Central China and Japan) .... 9. *I. macropoda.*

CC. Fruiting pedicels 2–3 mm. long; pyrenes 6; calyx 4 mm. across; leaves with sharply defined areoles on both surfaces. (East, central, and south China) .... 10. *I. tsoii.*

5. **Ilex asprella** (Hook. & Arn.) Champ. ex Benth. in Hook. Jour. Bot. Kew Gard. Misc. **4**: 329. 1852; Benth. Fl. Hongkong 65. 1861; Maxim. in Mém. Acad. Sci. St. Pétersb. VII, **29**: 49. 1881; Forbes & Hemsl. in Jour. Linn. Soc. Bot. **23**: 115. 1886; Henry in Transact. As. Soc. Jap. **24** (Suppl.): 26. 1896; Loes. in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. **78**: 477 (Monog. Aquif. **1**: 477). 1901; Dunn & Tutcher in Kew Bull. Misc. Inf. Add. Ser. **10**: 60. 1912; Merr. in Sunyats. **1**: 22. 1930.

Prinos asprellus Hook. & Arn. Bot. Beech. Voy. 176, *pl. 36, figs. 1, 2.* 1833; Walp. Rep. **1**: 541. 1842.

Ilex oxyphylla Miq. in Jour. Bot. Neerl. **1**: 124. 1861; Forbes & Hemsl. in Jour. Linn. Soc. Bot. **23**: 117. 1886.

Ilex gracilipes Merr. in Philip. Jour. Sci. Bot. **3**: 237. 1908, **5**: 358. 1910; Elm. Leafl. Philip. Bot. **5**: 1664. 1913.

Ilex merrillii Briq. in Ann. Conserv. Jard. Bot. Genève **20**: 421. 1919.

A deciduous shrub up to 3 m. high with slender elongate and short abbreviated branchlets, membranaceous ovate acuminate serrate leaves, long-pedicellate solitary fruits and 4–6 ridged and deeply sulcate bony pyrenes.

Branchlets glabrous, castaneous, the lenticels on older portions conspicuous and numerous; elongated shoots slender, the third year's growth 1.5–2 mm. in diameter, the lenticels lacking, the second year's growth 1 mm. in diameter, the current year's growth 0.7 mm. in diameter, all glabrous, the abbreviated shoots 3–15 mm. long, rugose with persistent bud-scales and scars, the terminal buds very narrowly conic, acute, glabrous. Leaves 5–10 mm. apart on elongated shoots or 1–4 crowded at the tips of abbreviated shoots; stipules callose, deltoid, acute, persistent; petioles 3–8 mm. long, one-ninth to one-sixth the length of the lamina, narrowly canaliculate and sparsely puberulent above, the rest glabrous; lamina membranaceous, olivaceous, opaque on both surfaces, minutely pubescent above (sometimes only on the veins), glabrous beneath, ovate or ovate-elliptic, 3–7 cm. long, 1.5–3 cm. wide, obtuse, rarely rounded, or acute at the base, acuminate at the apex, the acumen 3–12 mm. long, serrulate on the basal portion, the very tips acute or mucronate; margin serrate; midrib slightly impressed and hirsute above, elevated and glabrous beneath, the lateral nerves 6–8 pairs, evident and hirsute above, evident and glabrous beneath, the reticulation of the veinlets obscure. Staminate inflorescences: paucifasciculate with 2 or 3 flowers or solitary, axillary to the leaves or scales, when axillary to the leaves often behind an axillary bud; pedicels (3–) 5–6 (–9) mm. long; flowers 4- or 5-merous; calyx patelliform, 2.5–3 mm. across, glabrous, shallowly 4- or 5-lobed, the lobes unequal, broadly deltoid or rounded, erose and ciliate; corolla rotate, 6 mm. across, the petals 4 or 5, suborbicular, 2 mm. in diameter, rarely ciliate, one-fifth connate at the base; stamens 4 or 5, three-fourths as long as the petals, the anthers oblong, 1 mm. long; rudimentary ovary pulvinate, the middle shortly rostellate. Pistillate inflorescences: solitary, axillary to the leaves; pedicels 2–2.5 cm. long, after fruiting up to 3 cm. long, glabrous, with 2 minute basal prophylla; flowers 4–6-merous; calyx 3 mm. across, deeply 4–6-lobed, the lobes ciliate; corolla rotate, the petals suborbicular, 2 mm. in diameter, one-fourth connate at the base; staminodes one-half the length of the petals, the sterile anthers sagittate; ovary subglobose-ovoid, 1.5 mm. in diameter, the style evident, the stigma thickly discoid. Fruit globose, 5–6 mm. in diameter, longitudinally striate and sulcate, the persistent calyx explanate, 3 mm. across, suborbicular in outline, ciliate, the stigma capitate, the style evident. Pyrenes 4–6, obovate-elliptic in outline, the ends obtuse, 5 mm. long, 2 mm. wide, 3-striate, ridged, canaliculate, the sides almost smooth, striate, the ventral keel sharp, the endocarp stony.

CHINA: Chekiang: Sia-chu, *R. C. Ching 2210* (A, LU, US); Tai-shun, *Y. L. Keng 267* (A). Kiangsi: Woo-kung-shan, *H. H. Hu 758* (A); Tsu-chi-hsien, *H. H. Hu 1247* (A); Tsoong-jen, *Y. Tsiang 10218* (NY). Fukien: Central Fukien, *Dunn* (Herb. Hongk. no. *2463*) (A); Chang-chow, *H. H. Chung 1187* (A), *1214* (A, LU); Ing-hok, *H. H. Chung 2621* (A), *3227* (A), *7988* (A); Yeng-ping, *H. H. Chung 3354* (A); Ku-tien, *H. H. Chung 4030* (A); Ku-liang, *H. H. Chung 6776* (A, LU); Ku-dien, *H. H. Chung 7920* (A); Foochow, *H. H. Chung 8916* (A, LU, NY); *F. P. Metcalf 845* (LU), *3518* (A, LU); *Tang Siu-ging 13948* (LU), *15579* (LU), *15600* (LU). Kwangtung: Canton, *C. O. Levine* (CCC) *437* (US), *478* (A, US), *638* (A, US), *2102* (A); Mei-hsien, *J. L. Gressitt 1205* (A), *1324* (A); Tung-wan, *S. Y. Lau 20040* (LU, NY); Chung-shan, *Fung-hom 24* (LU *18449*) (NY); *W. T. Tsang* (LU *19242*) (NY); *Fung & McClure 19* (LU *19328*) (NY); Loh-fau-shan, *E. D. Merrill 10728* (A); Wai-yang, *T. M. Tsui 146* (A, NY, US); San-on, *T. M. Tsui 195* (US); Ying-tak, *T. M. Tsui 317* (A, NY, US); Ta-pu, *W. T. Tsang 21081* (A, NY); *21752* (A, NY); Ho-yuen, *W. T. Tsang 28707* (A); Sin-tong, Ko-chow, *Y. Tsiang 969* (A); Lo-fou-shan, *Y. Tsiang 1689* (A); Lui-chow, *Y. Tsiang 2208* (NY), *2558* (NY); Kwu-dzu, Tse-kung *C. L. Tso 41473* (NY); Sun-wui, *Tso & Tsiang 2019* (A). Kwangsi: Tang-hsien, *G. W. Groff* (CCC) *4135* (LU). Hongkong: Hongkong New Territory, *W. Y. Chun 6250* (A); without precise locality, *Faber 116* (A); Aberdeen, *Y. W. Taam 1988* (A); Bridge Valley, *Y. Tsiang 63* (A); Hwang-tso-kong, *Y. Tsiang 617* (A, NY); without precise locality, *C. Wright* (NY). Taiwan: *U. Faurie 125* (A); *T. Hayashi 21216* (A); *A. Henry 221* (A, NY), *254* (A), *572* (A, NY), *1334* (US); *T. Hosokawa 9893* (TU); *J. L. Gressitt 86* (A, NY); *E. Matuda 44* (A); *T. Nonaka & K. Mori* in 1932 (TU); *S. Sasaki 21569* (A); *H. Simada 335* (TU); *S. Suzuki* in 1931 (A); *T. Suzuki* in 1933 (TU); *T. Tanaka 76* (A, NY); *T. Tanaka & Y. Shimada* (Herb. no. *11009*) (NY, US), (Herb. no. *11094*) (A, NY, US); *E. H. Wilson 10065* (A, US), *10293* (A, US), *11186* (A).

Ilex asprella is a wide-spread deciduous species in the coastal provinces of warm temperate and subtropical China including Taiwan (Formosa) where it occurs at low altitudes. The white flowers appear in March, and the fruit turns black in October. It is common in Taiwan and extends to the Philippine Islands where it occurs at altitudes of from 1200 to 1900 meters. It is the only deciduous species of *Ilex* known from the Philippines and there it flowers also in March. I agree with Merrill in his reduction of *Ilex gracilipes* Merr. and *Ilex merrillii* Briq. as synonyms of the common Chinese species. Among the many Philippine collections I may cite *Clemens 51888; D. E. Elmer 9515A, 14297; E. C. Leano 22914; A. Loher 13020; Ramos & Edano 38079, 45061, 47271; J. K. Santos 7* and *31735;* all specimens seen in the Arnold Arboretum.

In its membranaceous leaves and its solitary staminate or pistillate flowers, each behind an axillary bud on elongated branchlets, *Ilex asprella* shows close relationship with *Ilex serrata* Thunb. The latter, however, has smooth pyrenes and small, shortly pedicellate fruits. The texture of the leaves and the sculpturing of the pyrenes of *Ilex asprella* show close relationship with *Ilex aculeolata* Nakai, but the latter has obovate leaves and very shortly pedicellate fruits.

5a. **Ilex asprella** var. **tapuensis,** var. nov.

Frutex; ramulis glabris; foliis membranaceis, ovato-ellipticis, 4–8 cm. longis, 1.7–3.4 cm. latis, basi obtusis vel rotundatis, apice acuminatis, acuminibus 3–15 mm. longis, mucronatis, costa supra impressa et puberula; inflorescentiis fructiferis solitariis, pedicellis 2 cm. longis, glabris; fructibus ellipsoideis, 9 mm. longis, 8 mm. diametro, calycibus persistentibus subexplanatis, 4 mm. diametro, ciliatis; stigmate crasse discoideo; pyrenis 6, 8 mm. longis, 3 mm. latis, dorso 3-striatis, 2-canaliculatis, lateralibus 1- vel 2-striatis et sulcatis, endocarpio lapideo.

CHINA: Kwangtung: Ta-pu, *W. T. Tsang 21245* (TYPE, A; K).

The only specimen we have seen was collected at Ta-pu, E. Kwangtung. There the plant grows as a shrub up to 3 m. high. The fruit is black at maturity.

This variety could be either a form of *Ilex macrocarpa* Oliv. var. *longipedunculata* S. Y. Hu with small leaves and fruit or a large-fruited variety of *Ilex asprella.* I prefer the latter position, since the fruit lacks the characteristic columnar stigma of *Ilex macrocarpa* Oliv.

6. **Ilex macrocarpa** Oliv. in Hook. Ic. Pl. 8: *pl. 1787.* 1888; Loes. ex Diels in Bot. Jahrb. 29: 436. 1900, in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. 78: 489 (Monog. Aquif. 1: 489). 1901; Pamp. in Nuov. Giorn. Bot. Ital. n. s. 17: 147. 1900; Dunn & Tutcher in

Kew Bull. Misc. Inf. Add. Ser. **10**: 60. 1912; Loes. in Sarg. Pl. Wils. **1**: 81. 1911; Pamp. in Nuov. Giorn. Bot. Ital. n. s. **17**: 417. 1910; Rehd. in Jour. Arnold Arb. **8**: 158. 1927, **14**: 242. 1933; Chun in Sunyats. **1**: 181. 1933; Hand.-Mzt. Symb. Sin. **7**: 659. 1933; Comber in Notes Bot. Gard. Edinb. **18**: 54. 1933; Tardieu-Blot in Fl. Gén. Indo-Chine Suppl. **1**: 780. 1948.

Ilex henryi Loes. in Nov. Act. Acad. Caes. Leop.-Carol. **78**: 491 (Monog. Aquif. **1**: 491). 1901. *Syn. nov.*

Ilex macrocarpa Oliv. var. *trichophylla* Loes. ll.cc. 491. 1901, 81. 1913. *Syn. nov.*

Ilex macrocarpa Oliv. var. *genuina* Loes. ll.cc.; Comber in Notes Bot. Gard. Edinb. **18**: 54. 1933. *Syn. nov.*

Ilex dubia (G. Don) Trel. var. *hupehensis* Loes. l.c. 488. 1901. *Syn. nov.*

Ilex montana Torr. & Gray var. *hupehensis* Fern. in Rhodora **41**: 428. 1933. *Syn. nov.*

Celastrus salicifolia H. Lévl. in Fedde, Rep. Spec. Nov. **13**: 263. 1914.

Diospyros Bodinieri H. Lévl. Fl. Kouy-Tchéou. 144. 1914.

Ilex macrocarpa Oliv. var. *brevipedunculata* S. Y. Hu in Ic. Pl. Omei. **2**: *pl. 171.* 1946. *Syn. nov.*

A deciduous tree with both elongated and abbreviated branchlets, ovate, ovate-elliptic, or rarely oblong-elliptic leaves, solitary or pseudofasciculate staminate inflorescences, solitary large fruits with 5–9 laterally compressed striate-sulcate pyrenes.

Branchlets brunneous; third and second years' growth 3 mm. in diameter, the lenticels orbicular, conspicuous; current year's growth glabrous, 2–3 mm. in diameter, the lenticels evident, the terminal buds subglobose-conic, glabrous; abbreviated shoots weakly developed, 3–10 mm. long. Leaves 10–30 mm. apart on elongated shoots, 1–3 crowded at the tips of the abbreviated shoots; stipules very minute, callose, often obscure; petioles 9–12 mm. long, one-tenth to one-seventh the length of the lamina, narrowly canaliculate and minutely puberulous above; lamina chartaceous, olivaceous, opaque on both surfaces, glabrous, glabrescent, or when young minutely and sparsely pubescent, ovate, ovate-elliptic or rarely oblong-elliptic, 5–15 cm. long, 3–7 cm. wide, rounded or obtuse at the base, shortly acuminate at the apex, the acumen 3–10 mm. long; margin serrate, midrib impressed and usually minutely puberulous above, elevated, glabrous, glabrescent or sparsely puberulous beneath, the reticulations of the veinlets prominent on both surfaces. Staminate inflorescences: pseudofasciculate on second year's growth of elongated shoots and on abbreviated shoots, or solitary, axillary to the basal scales or leaves of elongated shoots, 1- to 5-flowered, cymose; peduncles 2–4 mm. long, the pedicels 2–7 mm. long, both glabrous; flowers 5- or 6-merous; calyx patelliform, ca. 3 mm. across, shallowly 5- or 6-lobed, the lobes deltoid-ovate, obtuse or rounded, ciliate; corolla rotate, 7 mm. across, the petals obovate-oblong, 3 mm. long, ciliate, one-sixth connate at the base; stamens equaling the petals in length, the anthers ovate-oblong, 1 mm. long; rudimentary ovary pulvinate, the center slightly depressed, inconspicuously lobed. Pistillate inflorescences: solitary, axillary; pedicels 6–14 mm. long, glabrous, with 2 sub-basal prophylla; flowers 7–9-merous; calyx patelliform, 5 mm. across, shallowly 7–9-lobed, the lobes ovate-deltoid with obtuse or rounded apex, ciliate; corolla rotate, 10–12 mm. across, the petals 4–5 mm. long, one-fifth connate at the base; staminodes two-thirds as long as the petals, the sterile anthers sagittate, the apical end obtuse; ovary conical-ovoid, 2 mm. long, 3 mm. in diameter at the base, the style evident, 1–1.5 mm. long, the stigma columnar, 1.5 mm. long, glabrous. Fruit globose, 12–14 mm. in diameter, the persistent calyx explanate, 6 mm. in diameter, orbicular in outline, the stigma columnar, 2 mm. long. Pyrenes 7–9, laterally compressed, the ends obtuse, 9 mm. long, 2 mm. wide, on the dorsal surface longitudinally ridged and deeply canaliculate, reticulately striate and sulcate on the sides, the endocarp stony.

CHINA: Anhwei: Chu-hwa-shan, *R. C. Ching 2722* (A), *2732* (A), *2750* (A, LU). Hupei (Hupeh): *A. Henry 2891* (ISOTYPE, A), *3445* (G), *3451* (A, US), *4179* (A), *6214* (ISOTYPE of *Ilex dubia* var. *hupehensis*, US), *4633* (ISOTYPE, NY), *7382* (A), *7720* (US); Chang-yang-hsien, *E. H. Wilson 151* (A, US); without precise locality, *E. H. Wilson 250* (NY), *2695* (NY, US); Pa-tung-hsien, *E. H. Wilson 3089* (A, US). Hunan: *Handel-Mazzetti 575* (A). Kweichow: *J. Esquirol* in 1906 (TYPE of *Celastrus salicifolia*, photo & fragment, A), *6094* (A, P); *J. Chaffanjon* in 1898 (fragment of type of *Diospyros Bodinieri*, A); Ta-ting, *Y. Tsiang 8906* (NY). Szechuan: Chien-yang-hsien, *S. S. Chien 5249* (A, SS); without precise locality *E. Faber 27* (NY); Tchen-kéou-tin, *R. P. Farges 1397* (A, P); Mt. Omei, *C. Y. Chiao & S. C. Fan 82* (A), *115* (A); *S. S. Chien 5475* (Sz); *H. C. Chow 5842* (Sz), *5882* (Sz), *5883* (Sz), *5897* (Sz), *5962* (Sz), *7626* (A, Sz), *7811* (A, Sz), *8247* (A, Sz), *9728* (Sz), *11741* (A); *W. P. Fang 2342* (A), *2388* (A, NY, SS), *2398* (A), *3208* (A, NY), *7389* (US), *12236* (SS), *12576* (SS), *14163* (Sz), *14484* (Sz), *14825* (Sz), *16421* (Sz), *16473* (Sz), *16663* (Sz), *16976* (Sz), *17251* (Sz), *17281* (Sz), *17470* (Sz), *18757* (Sz), *18824* (Sz), *18895* (Sz); *T. C. Lee 3137* (Sz), *3328* (Sz); *Y. L. Liu 1024* (A); *C. L. Sun 1898* (Sz), *1989* (Sz), *2067* (Sz); *L. Y. Tai 411* (A); *K. Y. Yao 3320* (SS), *3255* (SS); *C. W. Yao 2723* (SS); *T. T. Yu 568* (A); Kwan-hsien, *S. S. Chien 5597* (Sz), *5761* (Sz); *W. P. Fang 1959* (A); *F. T. Wang 20797* (A); Chengtu, *S. S. Chien 5255* (Sz), *W. P. Fang 12228* (A, SS, US), *12236* (A, SS), *13385* (SS), *19286* (Sz); *C. Y. Wang 7293* (Sz); *E. H. Wilson 4795* (K); An-hsien, *F. T. Wang 22188* (A), *22208* (A); Lo-shan-hsien (Kia-ting), *H. C. Chow 9649* (A); *H. H. Chung 216* (A); *S. C. Sun & K. Chang 820* (A); *H. H. Tai 5* (A); *L. Y. Tai 825* (A), *1212* (A); *F. T. Wang 23553* (A); *T. T. Yu 218* (A); Opien-hsien, *S. N. Hsu 30* (SS); *E. H. Wilson 250* (A, US), *3088* (A), *4795* (A). Yunnan: *F. Ducloux 6657* (A, P); without precise locality, *E. E. Maire 1487* (K, US); Mi-le, *A. Henry 10308* (A, US); Yan-tai-hsien, *H. T. Tsai 50810* (A); Hsi-lung-tang, Chang-kiang, *Y. Tsiang & H. Wang 16243* (A), *16244* (A); *H. Wang 41495* (A); Kun-ming, *C. W. Wang 62807* (A), *62843* (A). Kwangtung: Tai-Yong, *J. L. Gressitt 1736* (A); Yao-shan, N. River, *S. S. Sun 9805* (NY); Sun-yi, *Y. Tsiang 2660* (NY). Kwangsi: Luchow, *R. C. Ching 5350* (NY).

CULTIVATED: I have seen specimens collected from the Arboretum of "Westonbirt, Glos," England.

Ilex macrocarpa was first described from material said to have been collected in Hupeh and Hongkong. In all the material we have studied there is no representative from Hongkong. Dunn & Tutcher in Kew Bull. Misc. Inf. Add. Ser. **10**: 60. 1912, and Tutcher in Rep. Bot. For. Dept. Hongk. Suppl. 20. 1916 may have copied Oliver's error. *Ilex macrocarpa* is essentially a tree of the warm temperate forests or woods and thickets of the Yangtze Provinces. There its white and fragrant flowers appear in April. The fruit turns black in November and is eaten by various birds, especially the common white-head bulbul. Possibly birds have aided in the dissemination of this widely distributed species.

Ilex macrocarpa is closely related to *Ilex chapaensis* Merr., but the latter has rostellate rudimentary ovaries, trigonous pyrenes, and thick-chartaceous leaves, often with shiny upper surfaces.

After examining many specimens from different parts of China, it is evident that *Ilex macrocarpa* is a very variable species. The indumentum of the leaves, for example, varies considerably. Usually the blade of the leaf is pubescent along the midrib on the upper surface, but in some plants the blade is entirely glabrous and in others pubescent on both upper and lower surfaces. The staminate inflorescences vary from solitary cymes on vigorously growing young shoots to pseudofasciculate on older shoots. The fruiting pedicels vary in length from those that are slightly shorter than the petioles to those that are subequal to or longer than the petioles. Both Oliver's illustration and his description, "pedunculis axillaribus petiolo subaequilongis," indicate that the specimens he examined had fruits with short pedicels. *Henry 2981*, an isotype, has leaves on which the midribs are puberulous on both surfaces and the fruiting pedicels are slightly longer than the petioles. Based on this evidence, among the host of variants we can define the typical form of *Ilex macrocarpa* as the plant with glabrous branchlets and inflorescences and fruits with pedicels subequaling or slightly exceeding the petioles. In so doing, both *Ilex henryi* Loes. and *Ilex macrocarpa* var. *brevipedunculata* S. Y. Hu are to be reduced to synonymy.

Loesener described *Ilex dubia* (G. Don) Trel. var. *hupehensis*, based on *A. Henry 6214*. This specimen is a fruiting branch of *Ilex macrocarpa*. Although the fruit is very young, its large size and its columnar stigma are very significant. I have dissected two fruits. Each has only 5 pyrenes. This low pyrene number is uncommon in typical *Ilex macrocarpa*. This particular plant may be a hybrid between *Ilex macrocarpa* and *Ilex macropoda* Miq., as both species are common in Hupei Province. Because of the large leaves and fruit and the columnar stigma of the plant I think it is proper to accept it as *Ilex macrocarpa*.

6a. **Ilex macrocarpa** var. **reevesae** (S. Y. Hu), comb. nov.

Ilex reevesae S. Y. Hu in Jour. W. China Bord. Res. Soc. **15**(B): 92. 1945, et in Ic. Pl. Omei. **2**: *pl. 172*. 1946. *Syn. nov.*

Branchlets minutely puberulent, leaves ovate, 3–10 cm. long, 2–5.5 cm. wide, pubescent on both surfaces; inflorescences pubescent; pyrenes laterally compressed.

CHINA: Szechuan: Chengtu, *S. S. Chien 5925* (A), *5926* (A, Sz); *W. P. Fang 12442* (Sz); *S. Y. Hu 535A* (WCUU), *535B* (WCUU).

The distribution of this variety is very localized. So far, it has been recorded only from Chengtu in the province of Szechuan. There its white and fragrant flowers appear in April. The fruit is black at maturity.

This variety is characterized by the pubescent branchlets, leaves, and inflorescences.

6b. **Ilex macrocarpa var. longipedunculata** S. Y. Hu in Ic. Pl. Omei. **2**: *pl. 171*. 1946.

Branchlets glabrous; leaves ovate, ovate-elliptic, pubescent at least along the midrib above; fruiting pedicels 14–33 mm. long, often more than twice as long as the petioles; pyrenes 7–9, laterally compressed, 3-ridged and deeply canaliculate, the endocarp bony.

CHINA: Kiangsu: I-shing, *Ching & Tso 594* (A). Chekiang: Shiao-fung-hsien, *H. H. Hu 559* (A); Chong-hwa-hsien, *Y. L. Keng 571* (A); Tien-mu-shan, *T. N. Liou 311* (NY); Yi-tsun, *F. N. Meyer 1523* (A, NY). Anhwei: Chiu-hwa-shan, *S. C. Sun 1398* (A). Hupei (Hupeh): *W. Y. Chun 3525* (A), *2526* (A); Pa-tung-hsien, *H. C. Chow 512* (A, NY), *665* (A, NY); Chien-shih-hsien, *H. C. Chow 1087* (A, NY); Li-chuan, *C. T. Hwa 97* (A); I-chang, *E. H. Wilson 151* (A, US), *2695* (A). Hunan: Lin-ling, *Handel-Mazzetti 423* (A). Kweichow: Tsun-yi-hsien, *Steward, Chiao & Cheo 108* (A, NY, US); Pi-chien, Tui-po, *Y. Tsiang 8982* (A, NY). Szechuan: *K. L. Chu 1918* (SS). Kwangsi: Kweilin, *W. T. Tsang 28137* (A, US), *28249* (A, US).

This variety is quite wide-spread. It appears that the shortest-pedicellate forms are found in the Upper Yangtze Provinces of Szechuan and Yunnan. The long-pedicellate forms are found in the Lower Yangtze Provinces of Kiangsi and Chekiang. A mixture of both the long- and short-pedicellate forms is found in the Central Provinces of Hupei, Hunan, and Kweichow.

This variety differs from typical *Ilex macrocarpa* in having long fruiting pedicels which are usually twice as long as the petioles.

7. **Ilex chapaensis** Merr. in Jour. Arnold Arb. **21**: 373. July 1940; Tardieu-Blot in Not. Syst. XII, **15**: 8. 1945, et in Fl. Gén. Indo-Chine Suppl. **1**: 773. 1948.

Ilex howii Merr. & Chun ex Tanaka & Odashima in Jour. Agr. Taiwan **10**: 372. 1938, nomen nudum; Merr. & Chun in Sunyats. **5**: 107. August 1940; Masamune, Fl. Kainant. (Hainan) 174. 1943. *Syn. nov.*

Ilex megistocarpa Merr. in Jour. Arnold Arb. **21**: 373. 1940; Tardieu-Blot. in Fl. Gén. Indo-Chine Suppl. **1**: 780. 1948. *Syn. nov.*

A deciduous tree up to 10 m. high with minutely and sparsely puberulent or glabrescent branchlets, chartaceous ovate-elliptic or oblong-elliptic crenate leaves, solitary inflorescences, large fruits with columnar stigmata and 6 oblong, ridged, and canaliculate pyrenes.

Branchlets castaneous, with numerous conspicuous lenticels; second year's growth 4 mm. in diameter, rugose with elevated orbicular lenticels, the leaf-scars crescent-shaped, not elevated; current year's growth 2–3 mm. in diameter, very sparsely and minutely puberulent or glabrescent, slightly angular, the lenticels conspicuous; abbreviated shoots few, undeveloped, 2–3 mm. long. Leaves 10–15 mm. (rarely up to 20 mm.) apart on elongated shoots, 1 or 2 at the very tip of the abbreviated shoots; stipules deltoid, callose, persistent; petioles slender, 15–30 mm. long, one-fifth to one-third the length of the lamina, glabrous, narrowly and deeply canaliculate, the distal end slighty winged by the decurrent leaf-base; lamina chartaceous or thin-coriaceous, brunneous-olivaceous, opaque or very slightly shiny and puberulous along the midrib and veins above, glabrous beneath, rarely puberulous on both surfaces in juvenile forms, ovate-elliptic or oblong-elliptic, 5–11 cm. long, 2.5–5 cm. wide, acute, obtuse, rarely rounded at the base, acuminate or very rarely (on abbreviated shoots) obtuse or rounded at the apex; margin finely crenulate-serrulate; midrib narrowly impressed and puberulous above, glabrous and elevated beneath, the lateral nerves 8 or 9 pairs, plane or slightly impressed, often puberulous above, elevated and glabrous beneath, the reticulation of the veinlets obscure on both surfaces. Staminate inflorescences: pseudo-fasciculate, occurring at the base of the current year's growth or along the sides of the second or third year's growth, the individual branches 1–5-flowered; the pedicels of the uniflorous branches 3 mm. long with 2 basal prophylla; the peduncles of the multiflorous branches 1–2 mm. long, the pedicels 2–4 mm. long, both puberulous; flowers 6–8-merous; calyx patelliform, 4 mm. across, glabrous or minutely pubescent, shallowly 6–8-lobed, the lobes rounded, sparsely ciliate; corolla rotate, ca. 10 mm. across, the petals obovate-oblong, 4–5 mm. long, ciliate, one-eighth connate at the base; stamens equaling the petals in length, the anthers ovate-oblong, 2 mm. long; rudimentary ovary conic, the apex rostellate and parted. Pistillate flowers: solitary, axillary to the inner scales of the terminal buds of the abbreviated shoots, rarely in the leaf-axils; pedicels 6–10 mm. long, minutely puberulous, with 2 sub-basal prophylla; flowers 6- or 7-merous; calyx patelliform, 4 mm. across, the lobes ciliate; corolla suberect, 8 mm. in diameter, the petals 4 mm. long; staminodes two-thirds as long as the petals, the sterile anthers sagittate; ovary ovoid, 2 mm. long, the style evident, puberulous, the stigma columnar, 2 mm. long, conspicuously lobed. Fruit subglobose-pomiform, 14 mm. in diameter, the persistent calyx explanate, 5 mm. in diameter, orbicular in outline, ciliate, the stigma columnar, 2–3 mm. long. Pyrenes 6 or 7, oblong in outline, the ends obtuse, 13 mm. long, the dorsal side 4 mm. wide, very deeply canaliculate and 3-ridged, the sides 1- or 2-striate and sulcate, the endocarp bony.

CHINA: Kwangtung: Wung-yuen, *S. K. Lau 2795* (A); Fang-cheng, *W. T. Tsang 26549* (A), *26715* (A), *26814* (A); Ko-chow, *Y. Tsiang 2344* (NY); Sun-yi, *Y. Tsiang 2718* (A), *21166* (NY). Kwangsi: S. Nan-ning, Seh-feng-dar-shan, *R. C. Ching 2766* (NY), *7966* (LU); W. Po-seh, *R. C. Ching 7408* (NY). Hainan: Po-ting, *F. C. How 73677* (TYPE of *Ilex howii*, A); Ting-on, *S. K. Lau 28122* (A).

INDO-CHINA: Tourane, *J. & M. S. Clemens 3389* (A), *4025* (A); Tonkin, Chapa, *A. Petelot 2303* (TYPE of *Ilex megistocarpa*, A), *4596* (NY), *5945* (TYPE, A; ISOTYPE, NY); Hacoi, *W. T. Tsang 27280* (A); Tien-yen, *W. T. Tsang 30609* (A).

Ilex chapaensis is endemic to the subtropical or tropical forests of Hainan and the Kwangtung-Kwangsi-Indo-China border and is a shrub or small tree up to 10 m. high. Its white flowers appear in April, and the fruit turns black in November.

The large fruit and dorsally 3-ridged and canaliculate pyrenes of *Ilex chapaensis* indicate very close relationship with *Ilex macrocarpa* Oliv. The latter, however, has a glabrous style, the pyrenes are laterally compressed with the dorsal surface 1–2 mm. wide, and the pulvinate rudimentary ovary is depressed at the middle.

8. **Ilex aculeolata** Nakai in Bot. Mag. (Tokyo) **44**: 12. 1930.

Ilex rhamnifolia Merr. in Sunyats. **1**: 201. 1934; H. H. Hu & Tang in Bull. Fan. Mem. Inst. Biol. Bot. **9**: 254. 1940. *Syn. nov.*

Ilex dubia (G. Don) Britton, Stern & Pogg. var. *hupehensis* sensu Hand.-Mzt. Symb. Sin. **7**: 658. 1933, non Loes.

A deciduous shrub up to 2 m. high with both elongated and abbreviated branchlets, obovate leaves, cuneate and acuminate bases, solitary inflorescences, 4- or 5-merous flowers, pea-sized fruits and 4 deeply wrinkled, striate and sulcate stony pyrenes.

Branchlets brunneous, the lenticels on the third and fourth years' growth numerous and conspicuous; elongated shoots 3–7 cm. long, slender, pubescent, the hairs short with thick bases, sometimes branched, the terminal buds conic, sparsely pubescent; abbreviated shoots 3–5 mm. long, rugose with persistent bud-scales and leaf-scars. Leaves 5–20 mm. apart on elongate shoots, 1–3 crowded at the tips of abbreviated shoots; stipules narrowly deltoid, persistent; petioles 10–12 mm. long, one-eighth to one-third the length of the lamina, narrowly and shallowly impressed and puberulous above, glabrescent or aculeolate along the side or all over; lamina membranaceous or thinly chartaceous, dark olivaceous above, paler beneath, opaque on both surfaces, pubescent along the midrib and lateral nerves on both surfaces, glabrescent or sparsely pubescent on both surfaces, obovate, 2–5 cm. long, 1–3 cm. wide; cuneate and acuminate at the base; acute or very shortly acuminate or rarely obtuse at the apex, the acumen 2–3 mm. long; margin coarsely and argutely serrate; midrib plane or slightly impressed above, elevated beneath, pubescent on both surfaces, the lateral nerves 3 or 4 pairs, evident on both surfaces, the reticulation of the veinlets obscure. Inflorescences solitary, axillary to scales or leaves on both elongated and abbreviated shoots; flowers 4- or 5-merous. Staminate inflorescence: 1–3-flowered, the peduncles 0.5–2 mm. long, the pedicels 1.5–3 mm. long, glabrous, with 2 basal, deltoid, acute, and ciliate prophylla; calyx patelliform, 2.5 mm. across, deeply 4-lobed, the lobes suborbicular-deltoid, ciliate; corolla rotate, 7 mm. across, the petals suborbicular-ovate, 3 mm. in diameter, erose, rarely sparsely ciliate, one-third connate at the base; stamens 4 or 5, two-thirds as long as the petals, the anthers oblong, 1.5–2 mm. long; rudimentary ovary ovoid, shortly rostellate and lobed. Pistillate inflorescences: uniflorous, the pedicels 3–4 mm. long with 2 ciliate basal prophylla; calyx and corolla as in the staminate flowers; staminodes two-thirds the length of the petals, the sterile anthers sagittate; ovary ovoid, 1.5 mm. in diameter, the stigma thickly discoid, 4-lobed.

Fruit globose, 7 mm. in diameter, the persistent calyx explanate, ciliate, subquadrangular in outline, the stigma discoid, 4-lobed. Pyrenes 4, elliptic in outline, the ends pointed, 6 mm. long, 2.5 mm. wide on the dorsal surface, deeply wrinkled, striate and sulcate, the striae branched and often reticulate, the endocarp bony.

CHINA: Kiangsi: Nan-chang, *H. H. Chung 26* (A), *27* (A); *J. N. Hsiung 550* (A); Yung-shing-hsien, *H. H. Hu 776* (A); Sung-wu, *J. L. Gressitt 156* (A); Kien-nan, *S. K. Lau 3993* (A, US), *4797* (A); Ling-chuan, *Y. Tsiang 9852* (NY), *9871* (NY); Houng-yang-shan, *Y. Tsang 10563* (NY); Ping-hsiang, *T. H. Wang* (ex Handel-Mazzetti Pl. Sin. 167) (A). Hunan: Chang-ning-hsien, *C. S. Fan & Y. Y. Li 152* (A); Sin-ning-hsien, *C. S. Fan & Y. Y. Li 439* (A); Tschangscha, *Handel-Mazzetti 2247 = 11344* (A); Da-o-ping, *Handel-Mazzetti 2710 = 11725*, (TYPE, A); Yun-schan, *T. H. Wang* (ex Handel-Mazzetti Pl. Sin. 70) (A); Yi-chang, *W. T. Tsang 23688* (A, US). Fukien: Yen-ping, *H. H. Chung 3266* (A). Kwangtung: Lung-t'au Mountain, *To & Tsang* (LU *12197*) (US), (LU *12751*) (A); Loh-chong, *C. L. Tso 21606* (TYPE of *Ilex rhamnifolia*, A); *W. T. Tsang 20929* (A, NY); Jen-hwa, *W. T. Tsang 26326* (A); Yang-shan, *T. M. Tsui 489* (A, NY, US), *649* (A, NY, US). Kwangsi: Lu-chen, *R. C. Ching 5615* (NY, LU), *6082* (NY); Yung-hsien, *Steward & Cheo 736* (A), *1070* (A, NY).

Ilex aculeolata is native to the Chinese Great Lake Provinces, Hunan and Kiangsi, and thence south to northern Kwangtung and Kwangsi. It grows in thickets or woods at an altitude of 250–600 m. The white and fragrant flowers appear in April. Its fruits become black in late September.

The membranous leaves, solitary fruits, deeply striate and sulcate pyrenes of *Ilex aculeolata* indicate close relationship between this species and *Ilex asprella* (Hook. & Arn.) Champ. ex Benth., but the latter has ovate leaves and very long (2.5–3.5 cm.) fruiting pedicels. Some specimens of this species collected from northern Kwangtung have been mistaken for *Ilex pubescens* Hook. & Arn. There is much similarity in the indumentum, leaf-form and margin, and pyrenes of these two species, but *Ilex pubescens* can easily be distinguished, since it is evergreen and has fasciculate flowers and fruits in the axil of the leaves, while *Ilex aculeolata* has solitary flowers or fruits mixed with leaves on abbreviated shoots.

8a. **Ilex aculeolata** var. **kiangsiensis**, var. nov.

Arbor parva; ramulis abbreviatis, 3–15 mm. longis, rugosis; foliis obovatis, 4–9 cm. longis, 1.5–3 cm. latis, apice acutis, breviter acuminatis vel raro obtusis, basi cuneatis et acuminatis; fructibus solitariis, axillaribus, ellipsoideis, 15 mm. longis, 7–9 mm. diametro, striato-sulcatis; stigmate capitato vel discoideo; pyrenis 5, 9–10 mm. longis, 2.5-3 mm. latis, dorso canaliculatis, lateralibus striato-sulcatis.

CHINA: Kiangsi: Kien-nan, *S. K. Lau 4086* (TYPE, A).

This variety is localized in southern Kiangsi. So far it has been collected only from near the Kwangsi-Kwangtung border. It grows as a small tree up to 5 m. in height.

This variety differs from typical *Ilex aculeolata* in having larger (15 mm. long) fruit and leaves.

9. **Ilex macropoda** Miq. in Ann. Mus. Bot. Lugd.-Bat. **3:** 105. 1867; Franch. & Sav. Enum. Pl. Jap. **1:** 77. 1873; Maxim. in Mém. Acad. Sci. St. Pétersb. VII, **29:** 30, 51, *pl. 1, fig. 8.* 1881; Hara in Bot. Mag. (Tokyo) **50:** 187. 1936.

Ilex costata Bl. ex Miq. Cat. Mus. Bot. Lugd.-Bat. 167. 1870, nomen nudum; Maxim. l.c. 51. 1881.

Ilex dubia (G. Don) Trel. var. *macropoda* (Miq.) Loes. in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. **78:** 487 (Monog. Aquif. **1:** 487). 1901. *Syn. nov.*

Ilex dubia (G. Don) Trel. var. *hupehensis* Loes. l.c. 488. 1901, in part. *Syn. nov.*

Ilex dubia (G. Don) Britton, Stern & Pogg. var. *pseudomacropoda* Loes. in Sarg. Pl. Wils. **1:** 82. 1911; Rehd. in Jour. Arnold Arb. **8:** 158. 1927; Chien in Contr. Biol. Lab. Sci. Soc. China **3**(1): 58. 1927.

Ilex montana Torr. & Gray var. *macropoda* (Miq.) Fern. in Rhodora **41:** 428. 1939. *Syn. nov.*

A deciduous tree up to 13 m. high with elongated and abbreviated branchlets, conspicuous lenticels, chartaceous ovate or broad-elliptic and serrate leaves, fasciculate staminate and solitary pistillate inflorescences, globose drupes with discoid stigma, and 5 striate and sulcate bony pyrenes.

Branchlets cinereous or brunneous, glabrous; elongated ones 4–10 cm. long, 2.5–3 mm. in diameter, brunneous, longitudinally plicate, the lenticels conspicuous, elliptic, the terminal buds ovoid or broadly conic, glabrous, the inner scales ciliate; abbreviated branchlets 3–50 mm. long (tenth year's growth about 3 cm. long), glabrous, rugose with persistent bud-scales, leaf-scars and scars of the pedicels, the lenticels lacking, the terminal buds subglobose-ovoid, glabrous, with ciliate inner scales. Leaves on elongated shoots 10–25 mm. apart, 3–5 crowded at the tips of the abbreviated shoots; stipules minute, acute, deltoid, often obscure; petioles 11–20 mm. long, one-fifth to one-half the length of the lamina, those on the elongated shoots shorter, the distal fourth winged by the decurrent leaf-base, the rest narrowly and deeply canaliculate, hirsute in the groove; lamina chartaceous or membranaceous, brunneous or olivaceous-brunneous, opaque on both surfaces, sparsely hirsute especially on the veins above, glabrous, rarely puberulous beneath, ovate or broad-elliptic, 4–8 cm. long, 2.5–4.7 cm. wide, rounded at the base, but tapering sharply at the petiole, becoming decurrent, shortly deltoid-acuminate, rarely acute, at the apex, the acumen 4–7 mm. long; margin argutely serrate; midrib narrowly impressed and hirsute above, elevated and glabrous beneath, the lateral nerves 6–8 pairs, hirsute, often slightly impressed above, prominent beneath, the reticulation of the veinlets obscure above, evident beneath. Staminate inflorescence: fasciculate, the fascicles 2–5-flowered, the individual branches uniflorous, the pedicels 4–7 mm. long, glabrous; flowers 5-merous; calyx patelliform, 2.5 mm. across, glabrous, deeply 5-lobed, the lobes ovate-deltoid, 1 mm. long and wide, acute or obtuse, often erose, ciliate; corolla rotate and reflexed, 5 mm. across, the petals ovate-oblong, 2 mm. long, 1.5 mm. wide, minutely ciliate, one-fifth connate at the base; stamens shorter than the petals, the anthers oblong, 1 mm. long; rudimentary ovary compressed, pulvinate, depressed and inconspicuously lobed at the center. Pistillate inflorescence: solitary, axillary to the scales or rarely to the leaves of the abbreviated shoots, not uncommonly axillary to the lower leaves of the elongated shoots; pedicels 6–7 mm. long, glabrous; flowers 5- or 6-merous; calyx and corolla as in the staminate flowers; staminodes three-fourths the length of the petals, the sterile anthers cordate; ovary ovoid, 1.75 mm. long, 1.5 mm. wide, the stigma thick-discoid. Fruit globose, 5 mm. in diameter, the persistent calyx explanate, 2.5 mm. across, stellate in outline, the lobes 5 or 6, acute, deltoid, ciliate, the stigma discoid, convex, 5- or 6-lobed. Pyrenes 5, oblong in outline, the ends obtuse, 4–4.5 mm. long, 2 mm. wide, longitudinally and reticulately striate and sulcate, the endocarp bony.

CHINA: Chekiang: Tien-tai-shan, *R. C. Ching 1403* (A); Tien-mu-shan, *T. N. Liu 257* (NY); *Chekiang Univ. s.n.* (staminate flower, LU; fruit, LU). Anhwei: Wang-shan, *W. C. Cheng 4115* (W); *R. C. Ching 3020* (A), *3048* (A, LU); *K. Ling* (ex NU Herb. no. *7772*) (A); Wu-Yuan, *R. C. Ching 3241* (A); Chiu-hwa-shan, *S. C. Sun 1445* (A, NY). Kiangsi: Lu-shan, *H. H. Hu 2354* (LU); *Y. Tsiang 10756* (NY). Hupei (Hupeh): *A. Henry 6107* (ISOTYPE of *Ilex dubia* var. *hupehensis*, A, G, NY); western Hupeh, *E. H. Wilson 2695A* (K); Hsing-shan-hsien, *E. H. Wilson 3090* (TYPE of *Ilex dubia* var. *pseudomacropoda*, A).

JAPAN: *Buerger* (ISOTYPE, A); *J. G. Jack* in 1905 (Aug. 12, A, G; Sept. 6, A; Oct. 26, A, G); *Maximowicz* in 1862 (NY), in 1863 (G, NY); ex Herb. *K. Miyabe* (A); *K. Sakurai* in 1904 (A); *K. Shiota 67* (A), *3456* (A), *7207* (A); *Siebold* (A, NY); *C. S. Sargent* in 1892 (Sept. 2, 24, A; Oct. 24, G, A); *Tschonoski* in 1864 (G, NY); *J. H. Veitch* (A); *K. Uno 21884* (A, NY); *K. Watanabe* in 1888 (G); *E. H. Wilson* in 1914 (A).

KOREA: *U. Faurie 1634* (A), *1635* (B), *5522* (A); *Taquet 629* (A), *1348* (A), *2716* (A), *3183* (A); *E. H. Wilson 9503* (A).

CULTIVATED: I have seen two sterile specimens cultivated in the Arnold Arboretum.

Ilex macropoda was first described from Japan. The species, however, is very wide-spread and a fairly common tree in the woods or forests of the Lower Yangtze Provinces. The flowers appear in May, and the fruit reddens in September.

Ilex macropoda is closely related to an American deciduous species, *Ilex montana* Torr. & Gray, which differs in having very short-pedicellate fruits (shorter than the diameter of the mature fruit) and a styliferous ovary.

Upon the basis of a specimen collected by *Buerger,* Miquel in 1867 described *Ilex macropoda* as a long-petiolate species with broad-ovate glabrous leaves. Loesener in 1901 treated it as a variety of the American species, *Ilex dubia* (G. Don) B.S.P. But this type of Don's species has solitary, subumbelliform inflorescences. It is not the same as *Ilex macropoda* Miq. and, in fact, is not closely related to it.

Prof. Fernald (Rhodora 41: 428. 1939) treated *Ilex macropoda* Miq. as a variety of another American species, *Ilex montana* Torr. & Gray. With this also I cannot agree. The Asiatic species is closely related to *Ilex montana,* but geographically and morphologically, since it has distinct specific characters, it should be retained as a species. The following comparison shows these differences.

Ilex montana has (1) an ovary which is styliferous, the styles measuring 1–2 mm. in length; (2) fruiting pedicels 2–4 mm. long and shorter than the diameter of the mature fruit; (3) rudimentary ovary in the staminate flowers pulvinate with the center rostellate; and (4) pyrenes 6 mm. long, deeply striate and sulcate. On the other hand, *Ilex macropoda* has (1) the stigma sessile and discoid; (2) the fruiting pedicels 6–7 mm. long and longer than the diameter of the mature fruit; (3) the rudimentary ovary in the staminate flowers also pulvinate but with a depressed center; and (4) the pyrenes smaller (ca. 4.5 mm. long) and less deeply striate and sulcate.

Loesener in 1913 published *Ilex dubia* var. *pseudomacropoda* based on a staminate flower, *Wilson 3090.*. He distinguished this variety from typical *Ilex macropoda* as follows: "Ramulis abbreviatis crassis usque 4.5 cm. longis, foliis subtus glabris." These two characters, the length of the abbreviated shoot and the indumentum of the leaf surface, vary much in this group of *Ilex;* indeed, the characters suggested by Loesener for his variety are found even on Buerger's specimen, the collection on which Miquel's species was based.

10. **Ilex tsoii** Merr. & Chun in Sunyats. 1: 66. 1930; Hu & Chun, Ic. Pl. Sin. 4: *pl. 18.* 1935.

A deciduous shrub or small tree up to 4 m. high with elongated and abbreviated branchlets, chartaceous, pubescent, ovate, or ovate-elliptic serrate leaves, very shortly pedicellate fruits, and 5 reticulately striate-sulcate bony pyrenes.

Branchlets castaneous or atro-griseous, the annual growth of the elongated shoots 2.5–6 cm. long, 2–3 mm. in diameter, castaneous, or ochraceous, the lenticels conspicuous, elliptic, the terminal buds globose ovoid, glabrous, with ovate, acute, or cuspidate, densely long-ciliate scales; abbreviated shoots up to 3.5 cm. long, rugose with persistent bud-scales and scars, glabrous. Leaves 15–20 mm. apart on elongate shoots, 1–3 crowded at the ends of the abbreviated shoots; stipules broadly and shortly deltoid, callose, persistent; petioles 6–10 mm. long, one-sixteenth to one-ninth the length of the lamina, and narrowly winged by its decurrent base, glabrous, canaliculate above; lamina chartaceous, olivaceous, opaque, prominently marked with small areoles, glabrescent or pubescent, especially along the veins of both surfaces, ovate or ovate-elliptic, 5–10 cm. long, 3–5 cm. wide, rounded at the base, acute at the apex, the acumen 7–15 mm. long, serrate and cuspidate; margin finely and argutely serrate; midrib deeply and narrowly impressed and puberulent above, elevated and hirsute, glabrescent in age beneath, the lateral nerves 9 or 10 pairs, slightly elevated, prominent and pubescent on both surfaces, the veinlets densely reticulate, forming distinct minute areoles on both surfaces. Staminate inflorescences: fasciculate, the fascicles 1–3-flowered, the individual branches uniflorous; pedicels 3–4 mm. long, glabrous; flowers 6-merous; calyx patelliform, 4 mm. across, deeply 6-lobed, the lobes unequal in size, deltoid or ovate, 1 mm. long, 1 mm. wide, acute, rarely rounded, ciliate; corolla rotate, 6–7 mm. across, the petals oblong, 2 mm. long, very minutely ciliate, one-fourth connate at the base; stamens shorter than the petals, the anthers oblong; rudimentary ovary pulvinate, the center plane, inconspicuously lobed. Pistillate inflorescences: solitary, axillary to scales or rarely to leaves on the abbreviated or elongated shoots, the scales ovate, deltoid, acute or cuspidate, ciliate; pedicels 1–3 mm. long, glabrous; flowers 5–7-merous; the calyx and corolla as in the staminate flowers; staminode very small, one-fifth the length of the petals, the sterile anthers cordate; ovary ovoid, 2 mm. in diameter, the stigma thickly discoid, convex. Fruit globose, 6–8 mm. in diameter, the persistent calyx explanate, stellate in outline, the stigma thickly discoid or capitate, prominent. Pyrenes 6, oblong in outline, the ends obtuse, 5 mm. long, 2.5 mm. wide on the back, deeply ridged and sulcate, the striae reticulate, the endocarp bony.

CHINA: Chekiang: Tih-tai-shan, *R. C. Ching 1522* (A, US); between Ping-yung and Tai-suan, *R. C. Ching 2113* (A, LU, US). Kweichow: Fan-ching-shan, *Steward, Chiao & Cheo 405* (A, NY, US). Kwangtung: Huang-tung, *S. S. Sun 9158* (NY); Jen-hwa, *W. T. Tsang 26266* (A), *26386* (A), *26391* (material for the description of pistillate flower, A), *26396* (A); Ho-yuen, *W. T. Tsang 28850* (A); Lok-chong, *C. L. Tso 20778* (TYPE, NY; photo, A). Kwangsi: Shuen-yuen, *S. C. Chung (T. S. Tsoong) 81544* (A); Chuen-yuen *S. C. Chung (T. S. Tsoong) 82014* (A); Tsu-yuen, *Z. S. Chung (Tsoong) 83507* (A).

Ilex tsoii was first discovered at Lok-chang on the northern Kwangtung border. Additional material indicates that it is a common species in warm-temperate South and East China, where it grows as a large shrub in thickets or as a tree in the woods. The flowers appear in May, and by July the fruits have become dark purple.

In the size of the leaves, the length of the pedicels, and the sculpture of the pyrenes *Ilex tsoii* is almost identical with *Ilex montana* Torr. & Gray, a native of North America. Besides occurring on different continents, there are certain technical characters that serve to distinguish these two species. *Ilex montana* has broad-elliptic or obovate leaves, acute or acuminate at the base, 2–5-flowered individual branches of the staminate fascicles, rostellate rudimentary ovaries, styliferous ovaries and fruits, and larger

(6 mm. long, 3 mm. wide) pyrenes. Furthermore, the characteristic minute but distinct areoles on the leaf-surfaces of *Ilex tsoii* are lacking in the leaves of *Ilex montana*.

Ilex tsoii differs from *Ilex macropoda* Miq. in having very short fruiting pedicels (1–2 mm. long). From *Ilex fragilis* Hook, f. it differs in having only 5 or rarely 6 pyrenes which are not only larger, but are deeply and reticulately striate and sulcate.

B. Subgenus EUILEX Loesener

Ilex subgenus **Euilex** Loes. in Verh. Bot. Ver. Brand. **33**: 25, 26. 1891, in Engl. & Prantl, Nat. Pflanzenfam. Nachtr. 218. 1897, et in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. **78**: 94 (Monog. Aquifol. 1: 94). 1901.

Ilex subgenus *Aquifolium* (Gray) Rehder, Man. Cult. Trees Shrubs 541. 1927, et Bibliog. Cult. Trees Shrubs 399. 1949.

Ilex §1. *Aquifolium* Gray, Man. Bot. N. U. S. 276. 1848.

Ilex sect. *Ilex* Maxim. in Mém. Acad. Sci. St. Pétersb. VII. **29**(3): 26. 1881.

Trees or shrubs with branchlets all elongated, the lenticels usually lacking on the current, second or even the third year's growth; leaves evergreen, thick-coriaceous, coriaceous or rarely chartaceous; inflorescences solitary or fasciculate.

Key to the Sections

A. Pistillate and staminate inflorescences both solitary, axillary, on the current year's growth; pyrenes unicanaliculate or 3-striate and 2-sulcate on the dorsal surfaces; endocarp coriaceous or sublignescent.. .... Sect. V. *Lioprinus*.

AA. Pistillate flowers solitary, axillary on the current year's growth (except in some *Ilex triflora* Blume), the staminate flowers fasciculate on the second year's growth or rarely solitary on the current year's growth; pyrenes smooth, or striate and esulcate with insculpt striae, or slightly roughened; endocarp coriaceous........ Sect. VI. *Paltoria*.

AAA. Pistillate and staminate inflorescences both fasciculate, axillary, on the second year's or even older growth; pyrenes rugose and pitted or striate with elevated striae; endocarp coriaceous, woody or stony.

B. Pyrenes 4, rarely less; the endocarp woody or stony; individual branches of the pistillate fascicles uniflorous................. .... Sect. VII. *Aquifolium*.

BB. Pyrenes 6 or 7, rarely less or more, the endocarp coriaceous or sublignescent; individual branches of the pistillate fascicles cymose, umbelliform, or uniflorous.

C. Individual branches of the staminate and the pistillate fascicles trichotomous compound cymes or subumbels, each with more than 10 flowers; leaves 10–20 cm. long, 4–7 cm. wide....... .... Sect. VIII. *Lauroilex*.

CC. Individual branches of the fascicles 1-, 3-, or sometimes 5-flowered; leaves rarely up to 10 cm. long, 3.5 cm. wide.... .... Sect. IX. *Pseudoaquifolium*.

SECTION V. LIOPRINUS (LOES.), STAT. NOV.

Ilex subgen. *Euilex* Loes. ser. *Lioprinus* Loes. in Verhandl. Bot. Ver. Prov. Brandenb. 33: 26, 27. 1891, in Engler & Prantl, Nat. Pflanzenfam. Nachtr. 218. 1897, et in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. 78: 95 (Monog. Aquif. 1: 95). 1901.

Evergreen trees or shrubs with solitary inflorescences in the axils of the leaves or scales on the current year's growth.

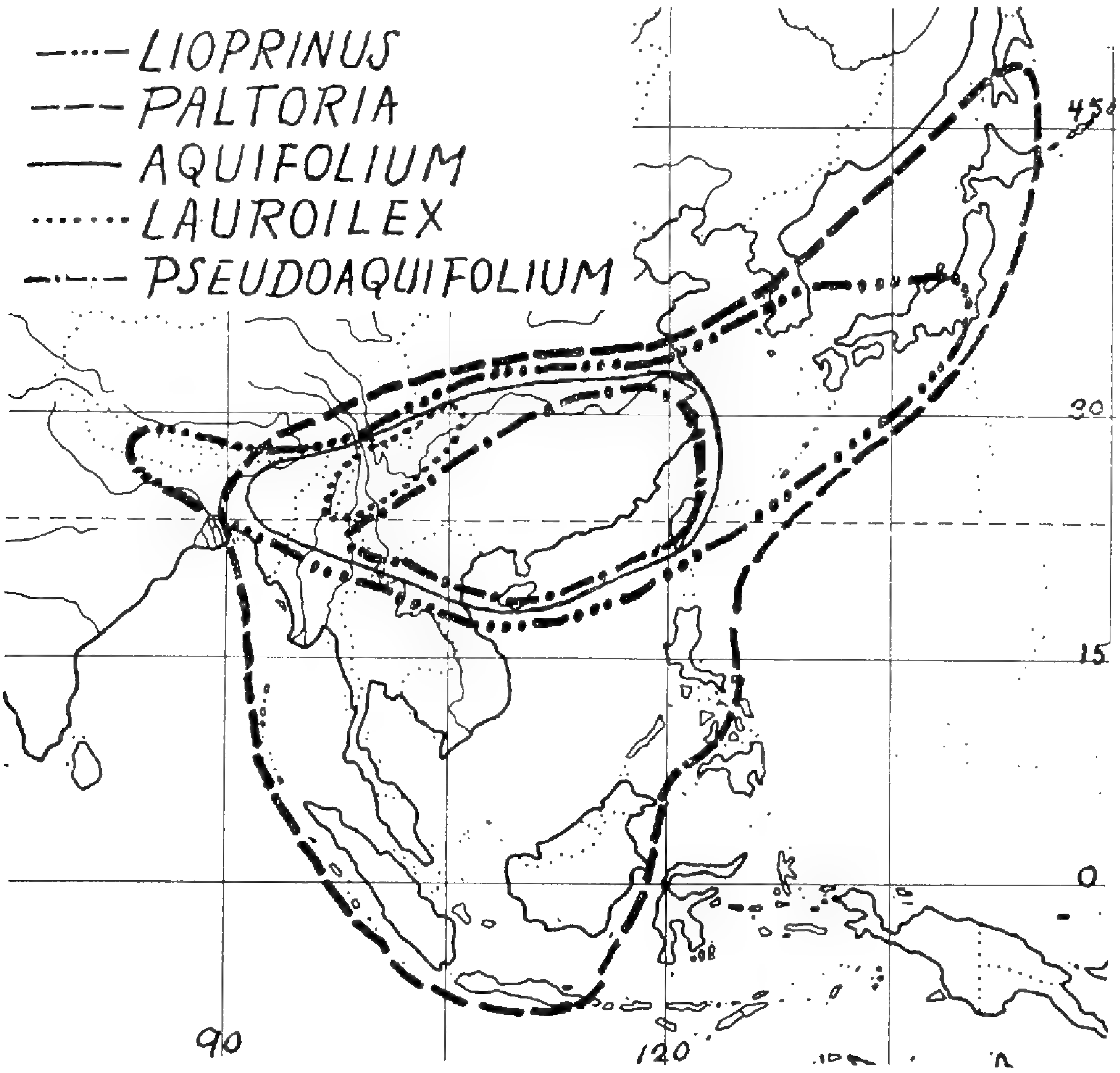

FIG. 5. Geographic distribution of the Eastern Asiatic representatives of the five sections of the subgenus Euilex.

KEY TO THE SERIES

A. Pyrenes unicanaliculate on the dorsal surfaces; inflorescences cymose; leaves usually crenate, serrate, rarely entire.....Series 1. *Chinenses.*

AA. Pyrenes 3-striate and 2-sulcate on the dorsal surfaces; inflorescences usually umbelliform, rarely cymose; leaves entire..Series 2. *Umbelliformes.*

SERIES 1. CHINENSES, SER. NOV.

Arbor vel frutex; foliis chartaceis vel coriaceis, brunneis vel atrobrunneis; stipulis nullis vel minutis; inflorescentiis cymosis vel subumbelliformibus, solitariis, axillaribus; floribus 4–6-meris; fructibus ellipsoideis raro globosis; pyrenis 4–6, laevibus, dorso longitudinaliter profunde unicanaliculatis, raro impressis; endocarpio coriaceo vel sublignescente.

KEY TO THE SPECIES

A. Leaves entire, thickly coriaceous (except in *I. lonicerifolia* of Taiwan).
  B. Infructescence a compound cyme, the secondary axis well developed; leaves large, 13–14 cm. long and 4–8 cm. wide. (Kwangtung-Kwangsi) .... 11. *I. maclurei.*
  BB. Infructescence a simple cyme, the secondary axis not developed; leaves less than 11–12 cm. long.
    C. Fruit solitary, 10–12 mm. in diameter; peduncles and pedicels together less than 4 mm. long, shorter than the diameter of the fruit. (Hainan) .... 12. *I. lancilimba.*
    CC. Fruit in simple loose cymes or subcapitate umbels, less than 10 mm. in diameter; peduncles longer than the diameter of the fruit.
      D. Infructescence a subcapitate umbel; fruiting pedicels 0.5–2 mm. long, much shorter than the peduncles. (Taiwan) .. .. 13. *I. tugitakayamensis.*
      DD. Infructescence a loose umbel or cyme; fruiting pedicels equaling or longer than the peduncles.
        E. Plants densely pubescent; petioles 4–10 mm. long, one-seventeenth to one-eighth the length of the lamina.
          F. Leaves coriaceous, less than 6 cm. long, 2.5 cm. wide. (S. China) .... 14. *I. dasyphylla.*
          FF. Leaves thinly coriaceous or chartaceous, over 8 cm. long, 3 cm. wide. (Taiwan) .... 15. *I. lonicerifolia.*
        EE. Plants glabrous; petioles 10–25 mm. long, one-fifth to one-fourth the length of the lamina.
          F. Leaves ovate; cymes loose, the peduncles 2–3 cm. long, the pedicels 1–1.5 cm. long. (Hainan, Kwangtung) .... 16. *I. sterrophylla.*
          FF. Leaves elliptic; cymes compact, the peduncles less than 2 cm. long, the pedicels even shorter. (East, Central and West China) .... 17. *I. editicostata.*

AA. Leaves crenate or serrate (except in *I. manneiensis*), subcoriaceous, chartaceous or membranaceous (except in *I. suaveolens*).
  B. Leaves ovate, less than 5 cm. long. (Yunnan) .. 18. *I. ferruginea.*
  BB. Leaves usually elliptic, 8–15 cm. long.
    C. Leaves coriaceous; inflorescences subumbelliform, the peduncles 15–33 mm. long, usually longer than the petioles. (Central China) .... 19. *I. suaveolens.*
    CC. Leaves subcoriaceous or chartaceous; inflorescences cymose, the peduncles less than 15 mm. long, usually shorter than the petioles.

D. Leaves entire, the midrib ferruginously and densely pubescent beneath; pedicels very short (1–2 mm. long), shorter than the peduncles. (Yunnan) ....20. *I. manneiensis.*

DD. Leaves crenulate, the midrib glabrous or puberulent; pedicels 4–5 mm. long, usually longer than peduncles.

E. Branchlets glabrous; leaves rarely 10 cm. long, glabrous; fruits ellipsoid; pyrenes narrowly canaliculate. (East, Central, South, and West China, Japan, much cultivated) ....21. *I. chinensis.*

EE. Branchlets puberulous; leaves over 12 cm. long, usually puberulous; fruits subglobose; pyrenes broadly U-shaped or triangular in cross-section.

F. Cymes compound, the secondary axis well developed; peduncles 5–12 mm. long, longer than the pedicels; pyrenes broadly U-shaped. (South China) ....22. *I. kwangtungensis.*

FF. Cymes simple, secondary axis lacking; peduncles 2–3 mm. long, shorter than the pedicels; pyrenes triangular in cross-section. (Yunnan) ....23. *I. atrata.*

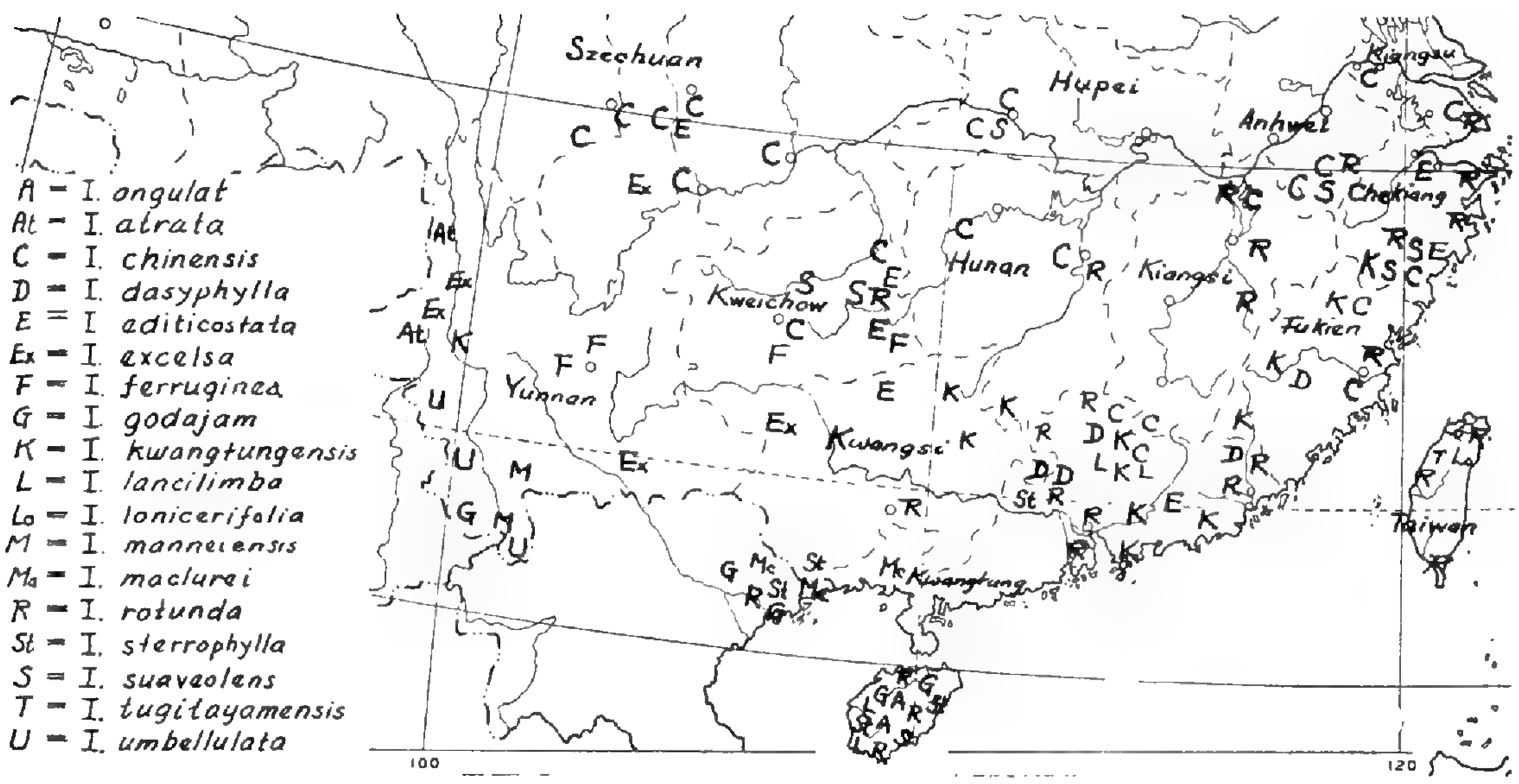

FIG. 6. Geographic distribution of the species of the section Lioprinus in China.

11. **Ilex maclurei** Merr. in Lingnan Sci. Jour. 13: 35. 1934.

A small tree or shrub about 3–4 m. high with large coriaceous entire glossy oblong leaves, several times di- or trichotomous infructescences, globose red drupes, and 4 pyrenes unicanaliculate on the back.

Branchlets stout, glabrous; second year's growth 5 mm. long, striate when dry, castaneous, the lenticels sparse, minute, elliptic, inconspicuous, the leaf-scars obovate or deltoid, very slightly elevated; current year's growth angular, 4–5 mm. thick, striate, sulcate, castaneous. Leaves occurring also on second year's growth, 4–20 mm. apart; stipules lacking;

petioles 15–20 mm. long, one-ninth to one-sixth the length of the lamina, robust, subcylindric, canaliculate above, plicate-rugose beneath, glabrous; lamina thick-coriaceous, olivaceous-brunneous, shiny above, opaque beneath, oblong or oblong-elliptic, 9–19 cm. long, 3.5–8.5 cm. wide; base obtuse or rounded; apex very obtuse, rounded, or rarely shortly and broadly acuminate; margin entire, slightly recurved, midrib plane above, elevated beneath, the lateral nerves in 10–12 pairs, obscure above, evident beneath, the reticulation of the veinlets obscure on both surfaces. Fowers not seen. Infructescence twice or thrice dichotomous, with 7–9 fruits; peduncles glabrescent or glabrous, 8–17 mm. long, compressed, enlarged at the distal end, the secondary axes 2–8 mm. long, the bracts deltoid to lanceolate, entire, glabrous, the pedicels 3–6 mm. long with 2 basal prophylla; fruiting calyx 4 mm. across, 4- or 5-lobed, the lobes rounded, very shortly ciliate. Fruit globose, 6–7 mm. in diameter, when dry black, shiny, plicate, the stigma mammiform. Pyrenes 4, oblong in outline, U-shape in cross-section, 4.5 mm. long, 3 mm. wide at the back, deeply unicanaliculate on the back, the endocarp thickly coriaceous.

CHINA: Kwangtung: Lim-kong, *F. A. McClure 643* (= LU *19822*) (TYPE, NY; ISOTYPE, LU; photo, A).

INDO-CHINA: Tonkin: *W. T. Tsang 27164* (A), *30335* (A).

In its oblong leaves and 2 or 3 times di- or trichotomous infructescences *Ilex maclurei* resembles *Ilex thorelii* Pierre, but the latter has thinner leaves and 9–12-celled ovaries. The Tsang Indo-Chinese collections come from immediately south of the Chinese border.

12. **Ilex lancilimba** Merr. in Lingnan Sci. Jour. 7: 312. 1929; Tanaka & Odashima in Jour. Soc. Trop. Agr. 10: 372. 1938; Masamune, Fl. Kainant. [Hainan] 174. 1943.

An evergreen tree 10 m. high with yellowish pubescent branchlets and inflorescences, lanceolate entire leaves, short fruiting pedicels, large, usually solitary fruits, and 4 unicanaliculate pyrenes.

Trunk 20 cm. in diameter; branchlets straight, the third year's growth cinereous-rufous, 6 mm. in diameter, plicate and rugose, the large semi-orbicular leaf-scars united with the scars of the peduncles immediately above them, the lenticels inconspicuous, cinereous-rufous; current year's growth nigrescent, plicate, angular, 1 mm. thick, minutely yellowish pubescent. Leaves crowded on the current year's growth, 3–10 mm. apart; stipules lacking; petioles compressed, 15–25 mm. long, 5 mm. wide, one-sixth the length of the lamina, sparsely puberulent, the upper half slightly winged by the decurrent leaf-base; lamina glabrous, thick-coriaceous, cinnamomeous or fumous, slightly shiny above, opaque beneath, lanceolate, 8–14 cm. long, 2–4 cm. wide; base cuneate or obtuse; apex acute or shortly acuminate, the acumen 5 mm. long; margin entire; midrib plane, slightly elevated and puberulent above, elevated and when young sparsely hirtulose beneath, the lateral nerves in 10–14 pairs, rather obscure on both surfaces, the reticulation of the veinlets usually obscure. Inflorescences cymose, tomentose, solitary, axillary to the basal scales or to the leaves of the current year's growth; flowers 4-merous. Staminate inflorescences: cymes 3 times di- or trichotomous, the peduncles 5–14 mm. long, the secondary axis often well developed, the pedicels 1.5–2 mm. long; calyx patelliform, 3 mm. across, 4-lobed, the lobes broadly deltoid, 1 mm. long, 2 mm. wide at the base, the apex rounded or obtuse; corolla pink-purple, rotate, 7 mm. across, the petals ovate-oblong, 2.5–3 mm. long, one-third connate at the base; stamens shorter than the petals, the anthers oblong, 1.5 mm. long; rudimentary ovary minute, conic. Pistillate inflorescences: cymes 3-flowered, the peduncles 2 mm. long, the pedicels 1–2 mm. long; flowers greenish white, 4- or 5-merous; calyx and corolla as in the staminate flowers; staminodes one-half the length of the petals, the sterile anthers cordate; ovary large, ovoid, 2 mm. in diameter, the stigma thickly discoid, 4-lobed. Fruit globose, usually solitary, very large for the genus, 10–12 mm. in diameter; fruiting pedicels 4–6 mm. long, 2–2.5 mm. thick, yellowish pubescent, the persistent calyx explanate, quadrangular in outline; the stigma discoid, 4-lobed. Pyrenes 4, smooth, oblong in outline, dorsally broadly canaliculate, in cross-section widely U-shaped; the endocarp sublignescent.

CHINA: Kwangtung: Ying-tak, *McClure 2680* (= CCC *14541*) (A, ISOTYPE, photo); Sin-fung, *Y. W. Taam 541* (A). Hainan: Fan-ya, *N. K. Chun & C. L. Tso 44096* (A, NY, US), *44125* (A, NY); Mo-san-leng, *N. K. Chun 44297* (A, NY), *44301* (A, NY, US); Yai-chow, *F. C. How 70136* (A, NY); Po-ting, *F. C. How 73681* (A); Sak-sa, *S. K. Lau 25947* (A), *26582* (A), *26588* (A); Lok-tung, *S. K. Lau 27303* (A); *L. Tang, 455* (A); *C. Wang 35115* (A, NY).

Ilex lancilimba is a forest tree in the tropical regions of Kwangtung and Hainan, where it grows up to an altitude of 1130 m. Its pink-purple staminate and greenish-white pistillate flowers appear in March, and by November the red fruits are mature.

In its large coriaceous entire leaves this species resembles the Taiwan *Ilex tugitakayamensis* Sasaki, but the latter has subcapitate-umbelliform infructescences, smaller fruits, and smooth pyrenes slightly impressed on the dorsal surfaces.

13. **Ilex tugitakayamensis** Sasaki in Trans. Nat. Hist. Soc. Form. **21**: 153, *fig. 3.* 1931; Kanehira, Form. Trees 383. 1936.

An evergreen tree with robust branchlets, large coriaceous elliptic entire leaves, unbelliform infructescences, very shortly pedicellate fruits, and 5 or 6 pyrenes with the dorsal surfaces flat or slightly concave.

Branchlets glabrous, when dry brunneous; rugose with elevated leaf-scars, annual growth very slight, only 4–5 mm. in the one specimen seen; third year's growth 5.5 mm. in diameter, the lenticels lacking, the leaf-scars deltoid; second and current year's growth 4–5 mm. in diameter, angular and plicate-rugose. Leaves rather crowded; stipules obsolete; petioles 2–2.5 mm. long, one-sixth to one-fifth the length of the lamina, shallowly and broadly canaliculate above, glabrous; lamina thickly coriaceous, ochraceous-brunneous, opaque on both surfaces, glabrous, elliptic or oblong-elliptic, 10–14 cm. long, 3–5 cm. wide; base acute; apex shortly acuminate, the acumen 5–10 mm. long, the very tip obtuse; midrib elevated on both surfaces, glabrous, the lateral nerves in 12–14 pairs, evident on both surfaces, branching and anastomosing near the margin, the reticulation of the veinlets rather obscure on both surfaces. Infructescences subumbelliform, puberulent, solitary, axillary, on current year's growth only; peduncles 8–9 mm. long, flattened, slightly enlarged at the distal end, umbels 5–7-flowered; bracts linear, 2–3 mm. long, puberulous; pedicels very short, 0.5–1 mm. long; flowers 5- or 6-merous; persistent calyx subexplanate, densely pubescent, 4 mm. in diameter, shallowly 5-lobed, the lobes deltoid, obtuse, pubescent and ciliate. Fruits ellipsoid-globose 5–7 mm. long, 5 mm. across, the stigma navel-like, inconspicuously 5- or 6-lobed. Pyrenes 4–6, usually elliptic in outline, trigonous in cross-section, 4 mm. long, 2 mm. wide on the back, the back flattened or slightly concave, the endorcarp smooth, coriaceous.

CHINA: Taiwan: Mt. Tugitaka, *Y. Simada 2538* (TU, TYPE).

Ilex tugitakayamensis Sasaki is known from a single collection. Through the courtesy of Dr. H. L. Li, Curator of the Herbarium, National Taiwan University, I have been able to study the type specimen.

Its large elliptic entire leaves, the flattened peduncles, and the short pedicels relate it to *Ilex lancilimba* Merr., but that species differs in having (very) short-pedicellate and very large solitary fruits 10–12 mm. in diameter and broadly canaliculate pyrenes. Though apparently rare, *Ilex tugitakayamensis* seems to be a valid species.

14. **Ilex dasyphylla** Merr. in Lingnan Sci. Jour. 7: 311. 1931; Chun in Sunyats. **2**: 68. 1934.

Ilex flaveo-mollissima Metcalf in Lingnan Sci. Jour. **11**: 14. 1932.

An evergreen tree up to 9 m. high, with ferrugineous-velutinous branchlets, leaves, and inflorescences, entire leaves, simple loose axillary cymes and deeply unicanaliculate pyrenes.

Branchlets zigzag, subterete; fourth year's growth 3.5–4 mm. in diameter, cinereous, pubescent, the lenticels numerous, inconspicuous, the leaf-scars small, triangular or semi-orbicular, hardly elevated; third and second years' growth 2.5–3 mm. in diameter, densely villose, the lenticels lacking; current year's growth 1.5–2 mm. thick, thickly ferrugineous-velutinous. Leaves occurring also on second year's growth, 2–8 mm. apart; stipules subulate, covered by the pubescence; petioles short, 4–5 mm. long, one-seventeenth to one-eighth the length of the lamina, very densely velutinous; lamina coriaceous, velutinous on both surfaces, brunneous, ovate, ovate-elliptic or ovate-lanceolate, 3–9 cm. long, 1.3–2.4 cm. wide; base obtuse, rarely rounded; apex acuminate, rarely acute, the acumen 3–12 mm. long; midrib impressed above, elevated beneath, the lateral nerves obscure. Inflorescences cymose, solitary, axillary on current year's growth, densely ferrugineous-villose; flowers 4- or 5-merous. Staminate inflorescences: cymes 3–5-flowered pseudumbelliform; peduncles slender, weak, 4–5 mm. long; bracts to individual flowers deltoid, buried in and covered with hairs; pedicels 2 mm. long with minute basal prophylla; calyx patelliform, densely velutinous and ciliate, 3 mm. across, the lobes deltoid or rounded; corolla rotate, the petals ovate-oblong, 3 mm. long, 2.5 mm. wide, reflexed at anthesis, one-fifth connate at the base; stamens equaling the petals in length; the anthers oblong, 1.5 mm. long; rudimentary ovary pyramidal, truncate at the apex. Pistillate inflorescences: cymes 1–3-flowered; peduncles 5–8 mm. long, the bracts linear-lanceolate, 1.5 mm. long; pedicels 3–8 mm. long, with minute basal prophylla; calyx and corolla as in the staminate flowers; staminodes one-half the length of the petals, the sterile anthers sagittate; ovary conic, 2 mm. wide at the base, the stigma mammiform; style rather prominent, 4-angled. Fruit globose, 5–6 mm. in diameter, red, when dry brownish red, smooth, shiny; the persistent calyx explanate, 4–5 mm. in diameter, the stigma thickly discoid. Pyrenes 4 or 5, short and plump, 4 mm. long, 2.5 mm. wide and unicanaliculate on the back, the endocarp coriaceous.

CHINA: Fukien: *Dunn* ex Hongkong Herb. no. *2464* (ISOTYPE of *Ilex flaveo-mollissima*, A). Kwangtung: Ying-tak, (*CCC*) *14775* (ISOTYPE, photo, A); Wung-yuen, *S. K. Lau 2796* (A); Sin-fung, *W. Y. Taam, 703* (A), *839* (A); Ta-pu, *W. T. Tsang 21625* (A, NY). Kwangsi: Wai-tsap, *W. T. Tsang 22725* (A).

This is a shrub or small tree up to 9 m. high. It flowers in May. The staminate flowers are red and odorless (ex Taam). The fruit turns red in September.

The species is a very distinct one. There is no other Chinese *Ilex* that has such a dense ferrugineous indument. Its unicanaliculate pyrenes and loose infructescences simulate those of *Ilex chinensis* Sims, which differs in having crenate-serrate glabrous leaves.

15. **Ilex lonicerifolia** Hayata, Icon. Pl. Form. 3: 54, *pl. 8,* 1913; Kanehira, Form. Trees 376, *fig. 332.* 1936.

A small evergreen tree with ferrugineous pubescence, subcoriaceous oblong-elliptic or rarely ovate-elliptic entire leaves, solitary subumbelliform axillary inflorescences, small ovoid-subglobose fruits and 5 or 6 elliptic unicanaliculate pyrenes, trigonous in cross-section.

Branchlets subterete, second year's growth 3 mm. in diameter, densely pubescent, sparsely rimulose, the lenticels very few, the leaf-scars semi-orbicular-deltoid; current year's growth 2 mm. in diameter, when dry castaneous, longitudinally sulcate, densely pubescent, the terminal buds conic, densely ferrugineously pubescent. Leaves occurring also on the second year's growth, 10–15 mm. apart; stipules minute, deltoid, often obsolete; petioles 4–8 mm. long, one-fifteenth to one-twelfth the length of the lamina, shallowly canaliculate above, pubescent or sparsely hirsute; lamina subcoriaceous, castaneous above, brunneous beneath, opaque on both surfaces, oblong, oblong-elliptic, rarely ovate-elliptic, (4.5–) 8–11 (–12) cm. long, 2–4.5 cm. wide; base obtuse, rarely rounded; apex short-acuminate, rarely acute, sometimes rounded, the acumen 3–7 mm. long, the very tip acute or mucronate; margin entire, recurved; midrib plane or slightly impressed and hirsute above, elevated beneath, the lateral nerves in 10–12 pairs, prominent on both surfaces, anastomosing near the margin, the reticulation of the veinlets evident above, obscure beneath. Inflorescences subumbelliform, axillary, found only on the current year's growth, often behind an axillary bud, hirsute, 3–11-flowered. Pistillate inflorescences: peduncles 1–2 cm. long; bracteoles bristle-like, 1 mm. long, pubescent, borne 1.5 mm. below the umbel, the pedicels 4–6 mm. long, with 0–2 deltoid callose basal prophylla; flowers 5- or 6-merous; calyx patelliform, 3.5 mm. across, pubescent, the lobes deltoid, obtuse, ciliate; corolla rotate, 7 mm. across, the petals ovate-oblong, 2.5–3 mm. long, eciliate, one-sixth connate at the base; staminodes three-fourths the length of the petals, the sterile anthers sagittate; ovary ovoid, 2 mm. long, 1.5 mm. wide at the base, glabrous; the stigma thickly discoid or mammiform, convex, 5- or 6-lobed. Staminate flowers unknown. Fruit ovoid-globose, 5–7 mm. in diameter, the persistent calyx subexplanate-patelliform, 4 mm. across, the stigma mammiform. Pyrenes 5 or 6, elliptic in outline, trigonous in cross-section, concave on the dorsal surface, 4–4.5 mm. long, back 2 mm. wide, the endocarp smooth, coriaceous.

FORMOSA: Lake Candidus, *J. L. Gressitt 230* (A); *E. H. Wilson 9977* (A); Taichu, Lake Jilugetutan, *Y. Kudo* in 1929 (A); Nokozan, *E. Matuda* in 1919 (TU); Sekiin, *Kudo & Sasaki 15245* (TU); Taihokusyu, *T. Suzuki 17025* (TU); without precise locality, *Kudo & Yamamoto* in 1930 (TU).

T. Suzuki's specimen has much smaller leaves than the other specimens examined. Its fruits are solitary. Judging from the length of the annual growth of the branchlets (which is very short) and the mosses thereon, the plant may have been a low one from deep forests. E. Matuda's specimen is less extreme and transitional to the typical forms of the species in size of leaves and in inflorescences. It bears both large and small leaves as well as both solitary and clustered fruits. The species is a variable one in these characters.

The subcoriaceous leaves, subumbelliform infructescences, and canaliculate pyrenes of *Ilex lonicerifolia* suggest close relationship between this species and *Ilex chinensis* Sims, which differs in having crenate leaves, larger fruits, and only 4 pyrenes.

15a. **Ilex lonicerifolia** var. **hakkuensis** (Yamamoto), comb. nov.

Ilex hakkuensis Yamamoto Suppl. Ic. Pl. Form. **1**: *32, fig. 14.* 1925; Kanehira, Form. Trees 373, *fig. 328.* 1936.

A completely glabrous tree with conspicuous lenticels on the second year's growth; leaves subcoriaceous, castaneous, oblong-elliptic, 5–11 cm. long, 2–4.5 cm. wide, the base obtuse, the apex shortly acuminate, the margin entire, the midrib plane or slightly impressed above, elevated beneath; inflorescences subumbelliform, solitary, axillary, the peduncles 7–15 mm. long, the pedicels 6–9 mm. long; fruits ovoid-globose, 4–5 mm. in diameter, the persistent stigma mammiform; pyrenes 5, 4 mm. long, 1.5–2 mm. wide, smooth, deeply unicanaliculate on the back, the endocarp coriaceous.

CHINA: Taiwan: Sekiin, *Kudo & Sasaki 15244* (TU); Lake Jitugelutan, *Y. Kudo* in 1929 (A).

The variety *hakkuensis* differs from typical *Ilex lonicerifolia* in being glabrous. There is much variation in the density of the ferrugineous indumentum of *Ilex lonicerifolia,* but the pubescence is always present at least in some degree. With species like *Ilex kwangtungensis* Merr., *Ilex macrocarpa* Oliv., and others, it is evident that the indumentum in the genus *Ilex* can be surprisingly variable. Since there are no other morphological differences nor any marked geographical differences of range between *Ilex lonicerifolia* Hayata and *Ilex hakkuensis* Yamamoto, I believe that this form is not worthy of more than varietal rank.

16. **Ilex sterrophylla** Merr. & Chun. in Sunyats. **5**: 110. 1940.

Ilex pedunculosa sensu Merr. & Chun in Sunyats. **2**: 265. 1935, non Miquel.

An entirely glabrous tree up to 15 m. high with a trunk as much as 70 cm. in diameter (ex Chun & Tso), with entire ovate or ovate-elliptic leaves, simple cymose axillary infructescences, small globose fruit and shallowly unicanaliculate pyrenes.

Branchlets stout, subterete, plicate-rugose; third year's growth 5–7 mm. in diameter, cinereous, the lenticels numerous, circular or deltoid; second year's growth rufous-castaneous, the lenticels conspicuous; current year's growth castaneous-nigrescent, plicate, very glabrous, 3–4 mm. in diameter, the terminal bud ovoid, the scales densely ciliate. Leaves occurring also on the second year's growth, rather crowded, 2–10 mm. apart; stipules obsolete; petioles 15–25 mm. long, one-fifth to one-fourth the length of the lamina, entirely glabrous, plane, the distal end evidently winged by the decurrent leaf-base; lamina coriaceous, completely glabrous, olivaceous or brunneous, ovate or elliptic, 5–8 cm. long, 2–4 cm. wide; base cuneate to subrotund, decurrent; apex acuminate, the acumen 5–10 mm. long; margin entire, very rarely obscurely 1- or 2-toothed; midrib elevated above, prominent underneath, glabrous, the lateral nerves in 8–10 pairs, obscure on both surfaces. Inflorescences cymose, glabrous, axillary, on current year's growth only; flowers 4- or 5-merous. Staminate inflorescences: cymes subumbelliform, 5–13-flowered; peduncles 15–30 mm. long, twice dichotomous; the secondary axes 1–2 mm. long, the bracts subulate, 1.25 mm. long, the pedicels 3–5 mm. long; calyx patelliform, glabrous, 4- or 5-lobed, the lobes deltoid or rounded, ciliate; corolla rotate, white (ex Lau), the petals oblong-obovate, one-fifth connate at the base; stamens 4 or 5, shorter than the petals, the anthers oblong, 1 mm. long; rudimentary ovary minute, ovoid, 1 mm. long, the center rostellate, with 4-parted apex. Pistillate inflorescences: cymes simple, 3-flowered; peduncles 12–23 mm. long, the pedicels 5–8 mm. long, the calyx ciliate; corolla as in the staminate flowers; staminodes three-fourths the length of the petals, the sterile anthers sagittate; ovary ovoid, 2 mm. wide, the stigma thickly discoid. Fruit ellipsoid, 7–9 mm. long, the persistent calyx explanate, 3 mm. across, rounded, ciliate, the stigma thickly discoid. Pyrenes 4, oblong, 5–6 mm. long, 3 mm. wide at the back, smooth, estriate, shallowly concave on the back, the endocarp coriaceous.

CHINA: Kwangtung: Yao-shan, *S. S. Sin 11022* (NY). Kwangsi: Shang-sze, *W. T. Tsang 22376* (A), *24365* (A, NY). Hainan: Fan-yah, *N. K. Chun & C. L. Tso 44093* (A, NY, US); Po-ting, *F. C. How 73683* (A, TYPE); Pak-sa, *S. K. Lau 26567* (A); Lok-tung, *S. K. Lau 27324* (A), *27334* (A); Five Finger Mt., *F. A. McClure* (CCC) *9387* (A).

INDO-CHINA: Mt. Bana, *J. & M. S. Clemens 4380* (A).

Ilex sterrophylla was first described from Hainan Island, where it occurs as a tree up to 15 m. high with a trunk 70 cm. in diameter (ex Chun & Tso). Its whitish flowers appear in May (McClure) and its fruits become dull red in late September.

Many of the specimens cited above have been misidentified as *Ilex pedunculosa* Miq. or as *Ilex purpurea* Hassk. (equals *I. chinensis* Sims). Because of their dorsally concave pyrenes they are not *Ilex pedunculosa*, and because of their entire leaves and long petioles they are likewise not *Ilex chinensis.*

Ilex sterrophylla is closely related to *Ilex suaveolens* (H. Lévl.) Loes. These two species resemble each other in that they both have simple cymose infructescences with slender long peduncles and dorsally concave pyrenes. *Ilex suaveolens,* however, can easily be distinguished by its sharp serrate leaves.

17. **Ilex editicostata** H. H. Hu & Tang in Bull. Fan Mem. Inst. Biol. 9: 248. 1940.

A small tree or shrub up to 6 m. high, with large coriaceous lanceolate acuminate leaves, simple cymose infructescences, puberulent pedicels, large fruits, and unicanaliculate pyrenes.

Branchlets stout, nigrescent, plicate; second year's growth 5–6.5 mm. in diameter, grayish brown to nigrescent, longitudinally rimulose, the lenticels sparse, circular, inconspicuous, the leaf-scars large, semicircular, slightly elevated; current year's growth 4–5 mm. in diameter, subterete, plicate and ridged when dry, glabrous. Leaves occurring also on second year's growth, 3–16 mm. apart; stipules lacking; petioles unusually long, compressed, 12–26 mm. long, one-fifth to one-fourth the length of the lamina, 3 mm. wide, flattened above, slightly keeled, plicate-rugose beneath; lamina lanceolate, 5–12 cm. long, 2–4 cm. wide, base cuneate; apex acuminate, the acumen 5–15 mm. long, triangular; margins entire, slightly recurved when dry; midrib elevated on both surfaces, more prominent above, glabrous, the lateral nerves in 10–12 pairs, usually obscure on both surfaces, the reticulations sometimes evident. Infructescence a simple cyme with 1–3 fruits; peduncle 3–6 mm. long, compressed, glabrescent, the secondary axis completely lacking; bracts linear, obtuse, puberulent, up to 2.5 mm. long, deciduous; pedicels 4–7 mm. long, plicate-striate, puberulent or glabrescent with basal deltoid prophylla 0.5 mm. long. Fruit subglobose, 9–10 mm. in diameter, red, when dry brunneous-nigrescent, the stigma discoid, convex, its margins lobed; the persistent calyx explanate, 5–6 mm. in diameter, the lobes 5 or 6, ovate, obtuse, or rounded, entire, ciliate. Pyrenes 4–6, oblong in outline, 7–8 mm. long, 2.5 mm. wide, broadly but shallowly unicanaliculate on the dorsal surface, the endocarp sublignescent.

CHINA: Chekiang: Tai-suan, *R. C. Ching 2219* (A, US). Kweichow: Fan-ching-shan, *Steward, Chiao & Cheo 691* (ISOTYPE, A, K, US). Kiangsi: Lung-nan, *S. K. Lau 4637* (A, US), *4743* (A, US). Kwangsi: Shang-sze, *W. T. Tsang 24460* (A); Kwei-ling, *W. T. Tsang 28487* (US).

According to field notes, *Ilex editicostata* grows in forests at altitudes of 600–700 m. It is a small tree or shrub up to 6 m. high and has a smooth grayish bark. The fruit turns red in late October.

The species agrees with its relative *Ilex maclurei* Merr. in having thick coriaceous entire leaves and unicanaliculate pyrenes. The latter differs in that the secondary axes of its infructescences are well developed, its pedicels are glabrous, and the midrib on the upper surface of its leaf is not impressed.

17a. **Ilex editicostata var. litseaefolia** (H. H. Hu & Tang), comb. nov.

Ilex litseaefolia H. H. Hu & Tang in Bull. Fan Mem. Inst. Biol. Bot. **9**: 247. 1940.

Leaves smaller, 4–7.5 cm. long, 1.6–3.2 cm. wide, elliptic-lanceolate or ovate, the apex short-acuminate, the acumen 4–6 mm. long, triangular; peduncles 4–5 mm. long, glabrescent; pedicels 2–3 mm. long, puberulent (Keng, Tsang) or glabrescent (Steward); fruit 4–7 mm. in diameter; pyrenes 5, very shallowly sulcate.

CHINA: Chekiang: Tien-tai-shan, *C. Y. Chiao 14522* (A); *Y. L. Keng 1058* (ISOTYPE of *Ilex litseaefolia*, A, SS). Kweichow: San-chiang-hsien, *Steward & Cheo 962* (A). Kwangtung: Mei-hsien, *W. T. Tsang 21540* (A).

This variety is a shrub less than 4 m. high which grows at altitudes of 800–2100 m. It differs from the typical form of the species chiefly in its lower habit and its smaller leaves. When Hu and Tang proposed *Ilex editicostata* they distinguished it from *Ilex litseaefolia* on the basis of its more robust habit, larger and thicker leaves and larger fruit with 6–8 pyrenes. The number of pyrenes is not a constant character, for in dissecting fruits of the isotype (*Steward, Chiao & Cheo 691*) I found many with only 5 pyrenes. The lanceolate entire leaves with the midrib elevated on the upper surface, the simple cymose infructescence with puberulent pedicels, and the shallowly canaliculate pyrenes of *Ilex litseaefolia*, all agree with the characters of *Ilex editicostata*. Furthermore, in *R. C. Ching 2219* the leaf-size is transitional. The lower smaller leaves are like the normal leaves of *Ilex litseaefolia*, and the upper larger ones are like those of *Ilex editicostata*. I therefore interpret *Ilex litseaefolia* as an ecotype from a somewhat higher altitude, and place it as a variety of *Ilex editicostata*.

17b. **Ilex editicostata var. chowii** (S. Y. Hu), comb. nov.

Ilex chowii S. Y. Hu in Ic. Pl. Omei. **2**: *pl. 157*. 1946.

Leaves elliptic-lanceolate, 7–15 cm. long, 2.5–5 cm. wide; infructescence with 3 or 4 fruits; peduncles 6–9 mm. long, compressed; pedicels 3–7 mm. long, entirely glabrous; calyx 5- or 6-lobed, glabrous, ciliate; fruits globose, 7–9 mm. in diameter, much wrinkled when dry; pyrenes 5 or 6, unicanaliculate on the back.

CHINA: Szechuan: Mt. Omei, *H. C. Chow 8138* (TYPE of *Ilex chowii*, Sz; ISOTYPE, A). Kwangsi: Kwei-lin, *W. T. Tsang 28487* (A); Yao-shan, *C. Wang 40342* (A).

This variety differs from the species chiefly in being entirely glabrous. In its coriaceous entire large leaves with acuminate tips, simple cymose infructescences, and unicanaliculate pyrenes, it conforms to *Ilex editicostata*. It is also related to *Ilex maclurei* Merr., which differs in having well-developed secondary axes in the infructescences.

18. **Ilex ferruginea** Hand.-Mzt. Symb. Sin. 7: 657, *pl. 10, fig. 24.* 1933.

A shrub (ex Schneider) or a tree (ex Handel-Mazzetti) with pubescent branchlets, ovate remotely crenate-serrate leaves, short petioles, simple cymose axillary infructescences and small unicanaliculate pyrenes.

Branchlets subterete, smooth; fourth year's growth 3–4 mm. in diameter, the lenticels minute, circular, sparse, the leaf-scars deltoid, slightly elevated; third and second years' growth puberulent, the lenticels lacking; current year's growth angular, densely villose, striate-sulcate, 1.5–2.5 mm. in diameter. Leaves found even on third year's growth, 8–12 mm. apart; stipules minute, buried in the indument; petioles short, 4 mm. long, one-thirteenth to one-tenth the length of the lamina, villose, flat or slightly grooved above; lamina coriaceous, olivaceous, villose especially along the midrib, ovate, those near the apex of the shoots ovate-elliptic, 2–5.5 cm. long, 1.5–3.5 cm. wide; base truncate or rounded, rarely cordate or obtuse; apex shortly acuminate, the acumen 3–4 mm. long; margins remotely crenate-serrate, the teeth nigrescent; midrib plane or very slightly impressed above, elevated beneath, villose on both surfaces, the lateral nerves in 8–10 pairs, obscure above, prominent underneath, the reticulations obscure. Staminate inflorescences: subumbelliform or cymose, 1–6-flowered, solitary, axillary to scales or leaves of the current year's growth; peduncles 5–10 mm. long, the pedicels 1–3 mm. long; secondary axis rarely developed, 1–2 mm. long; bracteoles lanceolate, pubescent; flowers 5–7-merous; calyx subcampanulate, pubescent, 2–3 mm. across, deeply 5–7-lobed, the lobes ovate-deltoid, 1 mm. long, obtuse, strongly ciliate; corolla rotate, 6 mm. across, the petals erose, eciliate, one-fifth connate at the base; stamens 5, equaling the petals in length, the anthers oblong; rudimentary ovary subglobose, the apex shortly rostellate, the beak densely hirsute. Infructescence a simple 3-flowered cyme found only on the current year's growth, axillary, villose; peduncles 6–10 mm. long, slightly enlarged at the distal end; bracts of the individual flowers linear-lanceolate, 5 mm. long, villose; pedicels 5–9 mm. long; prophylla basal, deltoid, minute. Fruit globose, 5–7 mm. in diameter, when dry shiny, castaneous, wrinkled, the stigma discoid, the persistent calyx explanate, 3–4 mm. in diameter, villose and ciliate, the lobes 4 or 5, broadly deltoid, acute. Pyrenes 5 (4–6 ex Handel-

Mazzetti), smooth, 2.5 mm. long, 1 mm. wide, and broadly unicanaliculate on the back.

CHINA: Kweichow: Ping-chow, *Y. Tsiang 7117* (NY). Yunnan: *F. Ducloux 148* (NY); Tung-chuan, north of Yunnanfu [Kunming], *Handel-Mazzetti 468* (ISOTYPE, A); *C. Schneider 293* (A, K).

The description of the staminate flowers is drawn from *Ducloux 148*.

Judging by its indumentum, its simple infructescences, and its broadly sulcate pyrenes, *Ilex ferruginea* is closely related to *Ilex kwangtungensis* Merr. which differs in having larger chartaceous elliptic leaves (up to 15 cm. long) and larger pyrenes up to 10 mm. long.

When Handel-Mazzetti first collected in China he traveled with C. Schneider, starting in March 1914. His number *468*, the type of *Ilex ferruginea*, was collected on the same day and in the same locality as *C. Schneider 293*. Most likely these specimens came from the same plant. On casual examination one gains the impression that the indumentum is ferrugineous, particularly along the midrib. On close examination, however, it is found that the supposedly ferrugineous color of the indumentum is due to the presence of minute particles of red earth lodged in it. This extraneous substance can be easily washed off; the pubescence is actually gray. Thus the specific name selected for the species is inappropriate. In his description of the fruits Handel-Mazzetti stated, "pyrenae 4–6, . . . dorso carinatae." Apparently he confused the dorsal and ventral sides. The pyrenes are not carinate on the back, but rather unicanaliculate. Furthermore, he placed *Ilex ferruginea* in the section Microdontae. This section is characterized by fasciculate inflorescences. He was apparently misled because the toothing of the leaves resembles that of *Ilex corallina* Franch., which does belong in the Microdontae. The presence or absence of teeth and their shape are very unreliable characters for use in the classification of *Ilex*. Since the inflorescences of this species are cymose, solitary, and axillary, and the pyrenes are unicanaliculate, its natural relationship is with *Ilex kwangtungensis* Merr.

19. **Ilex suaveolens** (H. Lévl.) Loes. in Ber. Deutsch. Bot. Ges. **32**: 541. 1914; H. Lévl. Fl. Kouy-tchéou 201. 1914; Rehd. in Jour. Arnold Arb. **14**: 239. 1933.

Celastrus suaveolens H. Lévl. in Fedde, Rep. Spec. Nov. **13**: 263. 1914.

Ilex purpurea sensu Hand.-Mzt. Symb. Sin. **7**: 655. 1933, in part; Rehd. in Jour. Arnold Arb. **14**: 239. 1933, in part; non Hassk.

A beautiful, entirely glabrous evergreen tree with coriaceous ovate-lanceolate leaves, subumbelliform, rarely cymose inflorescences, peduncles mostly exceeding the petioles in length, small globose fruits and smooth ecanaliculate or slightly dorsally impressed pyrenes.

Branchlets straight, the third year's growth ca. 5 mm. in diameter, cinereous, the lenticels minute, circular-ellipsoid, very numerous but inconspicuous, the leaf-scars obovate-deltoid, plane; current year's growth 3–4 mm. in diameter, castaneous or brunneous. Leaves occurring also on second year's growth, 3–15 mm. apart; stipules lacking or very minute and caducous; petioles unusually long, compressed, 15–30 cm. long, 2 mm. wide, one-fifth to one-fourth the length of the lamina, plane above, narrowly winged by the decurrent leaf-base; lamina coriaceous, olivaceous or brunneous, ovate, elliptic or lanceolate, 5–10 cm. long, 2.5–4 cm. wide; base rounded, obtuse or cuneate; apex acuminate, the acumen 5–10 mm. long; margin crenate-serrate or sometimes subentire, the tips of the teeth nigrescent; midrib elevated on both surfaces, the lateral nerves in 11–14 pairs, obscure above, evident beneath, the reticulations of the veinlets inconspicuous. Inflorescence subumbelliform, rarely cymose, solitary, axillary, on the current year's growth; cymes 3–7-flowered, twice or more dichotomous; peduncles glabrous, slender and long for the genus, 15–35 mm. long, usually longer than the petioles, compressed, gradually enlarged at the distal end; secondary axes usually poorly developed, 0–2 mm. long; bracts lanceolate, 2.5 mm. long, often ciliate. Staminate inflorescences: pedicels slender, 3–8 mm. long, in fruit 1 cm. long; flowers reddish white (ex Steward and Cheo), 4- or 5-merous; calyx broad subcampanulate, 3 mm. across, the lobes 4 or 5, ovate-deltoid, 1 mm. long, 1.5 mm. wide at the base, glabrous, ciliate, acute; corolla rotate, 6–7 mm. across, the petals ovate-oblong, 3 mm. long, 2.5 mm. wide, reflexed, one-eighth connate at the base; stamens shorter than the petals, the anthers ovoid, oblong, 1.25 mm. long; rudimentary ovary globose, 1.5 mm. in diameter. Pistillate inflorescences: peduncles 1.5–2.5 cm. long; calyx and corolla as in the staminate flowers; staminodes one-half the length of the petals, the sterile anthers cordate; ovary ovoid, globose, 2 mm. in diameter, the stigma thick-discoid, 4- or 5-lobed. Fruit globose-pomiform, 5–6 mm. in diameter, red, when dry brownish red, the stigma mammiform or discoid. Pyrenes 4 or 5, oblong in outline, trigonous in cross-section, 4–5 mm. long, smooth, estriate, esulcate, sometimes slightly depressed along the median dorsal line, the endocarp thickly coriaceous or sublignescent.

CHINA: Chekiang: Sia-chu, *R. C. Ching 1721* (A, NY, US), *2611* (A), *2614* (A); Ping-yung, *R. C. Ching 2221* (US), *2172* (NY, US); Yen-tang, *H. H. Hu 229* (A); Tai-shun, *Y. L. Keng 294* (A). Kiangsi: Wu-ling, *Y. K. Hsiung 5399* (A); Lin-ying-hsien, *Steward & Cheo 363* (NY). Hupei (Hupeh): *E. H. Wilson 2031* (A, K), (Veitch Exp.) *2031A* (A, K). Kweichow: Kwei-yang (or Kouy-yang), *E. Bodinier 2663* (TYPE, fragment and photo, A); Pin-fa, *J. Cavalerie 17 bis* (fragment and photo, A); Fan-ching-shan, *Steward, Chiao & Cheo 791* (A), *930* (A); *Handel-Mazzetti 10524* (A). Kwangsi: Lin-yuin, *Steward & Cheo 363* (A); Kwei-lin, *W. T. Tsang 28490* (A). Kwangtung: Sin-fung, *Y. W. Taam 109* (A), *971* (A).

Ilex suaveolens is closely related to and intermediate between *Ilex chinensis* Sims and *Ilex sterrophylla* Merr. In its ovate-elliptic-lanceolate leaves with crenate-serrate leaf-margins it resembles *Ilex chinensis*, which differs in having canaliculate elongated pyrenes, 2- or 3-dichotomous cymose inflorescences, and peduncles of the infructescences shorter than the petioles. In the long-pedunculate loose subumbelliform inflorescences, depressed-globose fruits, and nearly smooth pyrenes, it resembles *Ilex sterrophylla* Merr., which differs in having entire leaves.

20. **Ilex manneiensis**, sp. nov.

Arbor; ramulis puberulentibus; foliis chartaceis vel tenuiter coriaceis, ellipticis, 8–16 cm. longis, 2–4.5 cm. latis, basi rotundatis vel cuneatis et anguste decurrentibus, apice acuminatis, acuminibus 10 mm. longis deltoideis, brunneis; costa supra paullo elevata et dense villosa, subtus manifeste elevata flavo-tomentosa, maturitate glabrescente; nervis lateralibus utrinque 15–17, prominentibus; inflorescentiis solitariis, axillaribus, 3-floris, pedunculis 5–7 mm. longis, pedicellis 2 mm. longis; floribus 4–6-meris, calycibus 3 mm. diametro pubescentibus; corolla 6–7 mm. diametro, petalis sparsim ciliatis, staminodiis quam petalis brevioribus, ovario ovoideo, stigmate mammiforme; fructibus globosis, 9 mm. diametro, glabris; pyrenis 5 vel 6, laevibus, 8 mm. longis, dorso late sed non profunde 1-canaliculatis.

An evergreen tree up to 9 m. high with puberulent branchlets, chartaceous or thin-coriaceous lanceolate entire acuminate leaves, simple 3-flowered cymose inflorescences, very shortly pedicellate fruits, and unicanaliculate pyrenes.

Branchlets stout, plicate and rugose, brunneous; third year's growth 5 mm. in diameter, the lenticels numerous, circular, sometimes coalescent, conspicuous, the leaf-scars elevated, crescent-shaped, deltoid; second year's growth plicate, puberulent, the lenticels lacking; current year's growth yellowish pubescent with short curly hairs, subterete, plicate, the terminal buds ovate, 5 mm. long, the outermost scales yellowish pubescent, the inner ones glabrous, all densely ciliate. Leaves occurring also on second year's growth, 2–4 mm. apart; stipules wanting; petioles 15–20 mm. long, one-eighth to one-sixth the length of the lamina, yellowish pubescent when young, glabrescent at maturity, plane above, plicate-rugose beneath; lamina chartaceous or thin-coriaceous, brunneous, glabrous except on the midrib, elliptic, 8–16 cm. long, 2–4.5 cm. wide; base rounded to cuneate, narrowly decurrent; apex acuminate, the acumen up to 10 mm. long, deltoid; midrib slightly elevated and densely villose above, the indumentum persistent, elevated and yellowish tomentose beneath, the indumentum deciduous; the lateral nerves 15–17 pairs, prominent on both surfaces, parallel, anastomosing near the margin, the reticulations obscure above, evident beneath. Pistillate inflorescence a simple 3-flowered cyme, solitary, axillary, pubescent, on current year's growth; peduncles 5–7 mm. long, greatly compressed, in fruit 4 mm. wide; bracts minute, deltoid, ciliate; flowers 4–6-merous, their pedicels very short, 2–3 mm. long; calyx patelliform, 3 mm. across, puberulous, the lobes broadly deltoid or rounded, ciliate; corolla rotate, 6–7 mm. across, the petals oblong-ovate, sparsely ciliate, 3 mm. long, 2.5 mm. wide, one-sixth connate at the base; staminodes three-fourths the length of the petals, the sterile anthers ovoid; ovary ovoid, 2 mm. long, the stigmas mammiform. Staminate flowers not seen. Fruit globose, 9 mm. in diameter, castaneous when dry, the persistent calyx explanate, 5 mm. in diameter, 5- or 6-lobed, the lobes ciliate, the stigma discoid. Pyrenes 5 or 6, oblong in outline, trigonous in cross-section, back U-shaped, 8 mm. long, 2.5 mm. wide, smooth, shallowly but widely unicanaliculate on the back, the endocarp woody.

CHINA: Yunnan: Mannei, *A. Henry 9628* (TYPE, A; ISOTYPES, K, US); Mengtze, *A. Henry 11014* (A, K).

The description of the pistillate flower is drawn from *Henry 11014*.

In having the midrib yellowish tomentose beneath this species resembles *Ilex atrata* W. W. Sm., but the latter differs in having its leaves serrate, its pedicels longer than the peduncles, and its branchlets glabrous. In its entire leaves and indumentum it resembles *Ilex lancilimba* Merr., which differs in having very short peduncles and usually large solitary fruits.

21. **Ilex chinensis** Sims in Bot. Mag. **46**: *pl. 2043*. 1819; Lindl. in Donn, Hort. Cantab. ed. 10, 52. 1823; DC. Prodr. **2**: 14. 1825; P. N. Don in Donn, Hort. Cantab. ed. 13, 83. 1845; Maxim. in Mém. Acad. Sci. St. Pétersb. VII, **29**(3): 40. 1881; Forbes & Hemsl. in Jour. Linn. Soc. Bot. **23**: 115. 1886; Loes. in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. **78**: 495 (Monog. Aquif. **1**: 495). 1901.

Ilex purpurea Hassk. Cat. Hort. Bog. Alt. 230. 1844; Loes. in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. **78**: 111 (Monog. Aquif. **1**: 111). 1901; Rehd in Jour. Arnold Arb. **8**: 156. 1927, et **14**: 239. 1933; Hand.-Mzt. Symb. Sin. **7**: 655. 1933; Cheng ex P'ei, in Contr. Biol. Lab. Sci. Soc. China **9**(2): 171. 1934.

Ilex oldhami Miq. Ann. Mus. Bot. Ludg.-Bat. **3**: 105. 1867, et Cat. Mus. Bot. Ludg.-Bat. 19, 167. 1870; Franch. & Sav. Enum. Pl. Jap. **1**: 77. 1873; Maxim. in Mém. Acad. Sci. St. Pétersb. VII, **29**(3): 25, 38, *pl. 1, fig. 4*. 1881; Forbes & Hemsl. in Jour. Linn. Soc. Bot. **23**: 117. 1886; Dunn & Tutcher in Kew Bull. Add. Ser. **10**: 60. 1912; Chung in Mem. Sci. Soc. China **1**: 141. 1924; Belval in Mus. Heud. Not. Bot. Chin. **2**: 21. 1933.

Ilex lucida Blume ex Miq. Cat. Mus. Bot. Lugd.-Bat. 167. 1870, nom. nud.

Ilex purpurea var. *oldhami* (Miq.) Loes. ex Diels in Bot. Jahrb. **29**: 435. 1900, nom. nud.; et in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. **78**: 112 (Monog. Aquif. **1**: 112). 1901, et in Sarg. Pl. Wils. **1**: 76. 1911; Chung in Mem. Sci. Soc. China **1**: 141. 1924; Chen, Ill. Man. Chinese Trees 655, *fig. 546*. 1937. *Syn. nov.*

Callicarpa cavaleriei H. Lévl. in Fedde, Rep. Sp. Nov. **9**: 455. 1911, et Fl. Kouy-Tchéou 439. 1915.

Celastrus bodinieri H. Lévl. in Fedde, Rep. Sp. Nov. **13**: 263. 1914.

Embelia rubro-violacea H. Lévl. in Fedde, Rep. Sp. Nov. **10**: 375. 1912, et Fl. Kouy-Tchéou 285. 1914.

Symplocos courtoisii H. Lévl. in Mem. Acad. Cienc. Art. Barc. III, **12**: 256 (Cat. Pl. Kiang-sou 22). 1916.

Sjiroggi vel *Namome* Kaempf. Amoen. Exot. 779. 1717.

Namome Kaempf. Ic. Sel. Pl. ed. Banks, *pl. 35*. 1791.

A large entirely glabrous evergreen tree up to 13 m. high, with shiny deep green crenate-serrate leaves, bright red ellipsoid drupes, and dorsally 1-canaliculate pyrenes.

Trunk 30 cm. in diameter; bark gray, smooth (ex Ching & Tso); branchlets terete, third year's growth 5 mm. in diameter, cinereous, the lenticels minute, circular-ellipsoid, numerous and inconspicuous, the leaf-scars crescent-shaped or narrowly deltoid, slightly elevated; current year's growth 3 mm. in diameter, angular, plicate, castaneous-nigrescent, glabrous. Leaves occurring also on second year's growth, 3–10 mm. apart; stipules minute, deciduous; petioles 8–10 mm. long, one-eighth to one-sixth the length of the lamina, plane, sometimes slightly sulcate above, striate beneath, narrowly winged by the decurrent lamina; lamina thin-coriaceous, brunneous, elliptic, lanceolate or rarely ovate, 5–11 cm. long, 2–4 cm. wide; base obtuse or cuneate; apex acuminate, the acumen 5–10 mm. long; margin crenate or rarely serrate; midrib plane above, elevated beneath, the lateral nerves 6–9 pairs, rather obscure above, prominent beneath, glabrous, the reticulations evident beneath. Inflorescences cymose, solitary, axillary, glabrous, on current year's growth. Staminate inflorescences: cymes 7–15-flowered, 3 or 4 times dichotomous or sometimes irregularly dichotomous; peduncles 4–14 mm. long, usually exceeding the petioles; secondary axis well developed, 2–5 mm. long, the bracts of the ultimate cymules lanceolate, 2 mm. long, often ciliate; flowers lavender or red, 4- or 5-merous; pedicels 2 mm. long, glabrous with 0 or 1 deltoid ciliate prophyllum 0.5 mm. long; calyx subcampanulate, glabrous, ca. 2.5 mm. across, the lobes broadly deltoid, obtuse or rounded, ciliate; corolla rotate, the petals ovate, ca. 2.5 mm. long, 1.8 mm. wide, reflexed at anthesis; stamens shorter than the petals, the anthers ellipsoid, 1.5 mm. long; rudimentary ovary conic, 0.7 mm. long. Pistillate inflorescences: cymes 3–7-flowered, once or twice dichotomous; peduncles 3–10 mm. long, always shorter than the petioles, compressed, usually enlarged at the distal ends, the secondary axis poorly developed; pedicels 6–10 mm. long; calyx and corolla as in the staminate flowers; staminodes one-half the length of the petals, the sterile anthers cordate; ovary ovoid, the stigma thickly discoid, inconspicuously 4- or 5-lobed. Fruit ellipsoid, 10–12 mm. long, 6–8 mm. thick, shiny, red, when dry smooth, shiny, castaneous-nigrescent, the persistent stigma prominent, discoid, convex. Pyrenes 4 or 5, narrowly lanceolate in outline, trigonous in cross-section with a narrow U-shaped back, 9–11 mm. long, 2.5–3 mm. wide, smooth, deeply 1-canaliculate along the median dorsal line, the endocarp thick-coriaceous.

CHINA: Kiangsu: without precise locality, *Ch. d'Argy* in 1844–66 (TYPE of *Symplocos courtoisii*, photo and fragment, A); Shien-chuan-tze, *Ching & Tso 453* (A); I-shing, *Ching & Tso 481* (A); *Y. L. Keng 2669* (A); *K. King 12293* (NY); Ma-shan of Tai Lake, *Ching & Tso 697* (A), *701* (A); Soochow, *Ching & Tso 803* (A); *Tso 1686* (A); Nanking, *Y. Tsiang 337* (A); *Tso 1722* (A). Anhwei: Wang-shan, *W. C. Cheng 4550* (US); *N. K. Ip 5116* (A); *R. C. Ching 2758* (A); Chemen, *R. C. Ching 3172* (A); Chiu-hwa-shan, *R. C. Ching 7258* (US); *C. S. Fan & Y. Y. Li 260* (US); Chien-shan, *C. S. Fan & Y. Y. Li 127* (A). Chekiang: Hangchow, *C. Y. Chiao 18877* (NY, US), *18820* (US), *18877* (US); Sia-chu, *R. C. Ching 1588* (A, NY, US), *2597* (A), *4827* (A); Ping-yung, *R. C. Ching 2142;* Ning-po, *E. Faber* (NY); Tsing-tien, *Y. L. Keng 124* (A), *232* (A); Tai-shun, *Y. L. Keng 288* (A); I-wu, *Y. L. Keng 895* (A); Hai-ning, *T. N. Liu 549* (NY). Kiangsi: Tung-ku, *Y. K. Hsiung 615* (A); *H. H. Hu 875* (A); Kien-nan, *S. K. Lau 3922* (A, US), *4281* (A, US), *4397* (A, US); Lung-nan, *S. K. Lau 4842* (A, US); Fow-liang, *K. Ling,* in 1924 (A); Ch'uan-Hsien, *W. T. Tsang 27585* (A); Ling-chuan, *Y. Tsiang 9831* (NY); Tsoong-jen, *Y. Tsiang 10204* (NY); Tu-hwa Mountain, (ex Herb. Univ. Nank. *1562*) (A). Kiangsi-Fukien Border: *T. H. Wang 327* (A). Hupei (Hupeh): Yang-hsien-hsien, *H. G. Cheo 18343* (NY); Chien-shih, *H. C. Chow 1438* (A, NY), *1554* (A, NY); En-shih, *H. C. Chow 1877* (A, NY); western Hupei, *W. Y. Chun 4004* (A); *A. Henry 1562* (US), *3911* (B, US), *4440* (A), *6211* (A, NY, US); *E. H. Wilson 868* (A, NY), *1925* (A, NY, US), *2193* (K), *2193A* (K, NY), *2699A* (K), *2700A* (K); I-chang, *E. H. Wilson 689* (A, US), *3096* (US), *3097* (A, US); Chang-yang, *E. H. Wilson 1975* (K), *2697* (A, K, NY, US). Hunan: Sin-ning, *S. C. Fan & Y. Y. Li 549* (A); *Handel-Mazzetti 11291* (A); Chang-sha, *Handel-Mazzetti 11415* (A), *11525* (A, US); Wu-kang, *Handel-Mazzetti 11987* (A). Kweichow: Kwei-yang (kouy-yang), *E. Bodinier 2384* (TYPE of *Celastrus bodinieri,* fragment, A); Doo-shan (Tou-shan), *J. Cavalerie 2624* (TYPE of *Callicarpa cavaleriei,* fragment, A); without precise locality, *J. Esquirol 429* (ISOTYPE of *Embelia rubro-violacea,* A); Wong-mo, Chen-feng, *S. W. Teng 90962* (A); Kwei-ting, *Y. Tsiang 5558* (NY), *9229* (NY); Tuh-shan, *Y. Tsiang 6603* (NY); Yin-kiang, *Y. Tsiang 7908* (NY), *7851* (NY); Tu-yun, *Handel-Mazzetti 10730.* Szechuan: O-mei-shan (Mt. Omei), *C. Y. Chiao & C. S. Fan 271* (A); *C. L. Chow 6084* (Sz), *6101* (Sz), *7172* (Sz); *H. C. Chow 8222* (A), *12173* (A); *E. Faber 20344* (NY); *W. P. Fang 15412* (Sz), *15527* (Sz), *15619* (Sz), *15653* (Sz), *15671* (Sz), *15680* (Sz), *15700* (Sz), *18942* (Sz), *19115* (Sz), *19149* (Sz); *T. C. Lee 3452* (Sz), *4536* (Sz), *4618* (Sz), *4782* (Sz); *C. L. Sun 1224* (Sz); *S. C. Sun & K. Chang 713* (A), *818* (A), *1548* (A); *L. Y. Tai 473* (A), *1135* (A); *F. T. Wang 23503* (A), *23653* (A); *C. Y. Yao 5058* (SS); Chien-wei-hsien, *H. H. Chung 241;* without precise locality, *Faber 20* (A); Kwan-hsien, *W. P. Fang 12916* (Sz); *Y. L. Liu 1927* (A); Pien-hsien, *Y. S. Liu 2000* (A); Lo-shan-hsien, *F. T. Wang 23546* (A); Kia-ting, *H. H. Tai 135* (A), *243* (A); *L. Y. Tai 1441* (A); western China (probably Szechuan), *E. H. Wilson 3323* (K). Sikang: *C. Y. Chiao 1683* (A). Yunnan: *A. Henry 344* (NY). Fukien: Yen-ping, *H. H. Chung 3532* (A); Ku-tien, *H. H. Chung 7915* (A); Sin-kai-kau, *Dunn 2472* (A); Foochow, *Tang Siu Ging 7232* (A). Kwangtung: Tai-ping, *W. Y. Chun 5669* (A); Lin-hsien, *C. O. Levine* (CCC) *3186* (A); Loh-ch'ang, *W. T. Tsang 20771* (A, NY); Ch'uan-hsien, *W. T. Chang 27585* (US); Lok-chong, *C. L. Tso 20644* (NY); Yang-shan, *T. M. Tsui 718* (NY), *497* (A, NY, US). Kwangsi: Kwei-ling, *W. T. Tsang 27801* (A, US); Yao-shan, *C. Wang 40621* (A). Hainan: Lok-tung, *S. K. Lau 27274* (A).

JAPAN: *Buerger* (A); *R. Oldham 149* (A), *150* (A), *151* (ISOTYPES of *Ilex oldhami,* A, G, NY); Herb. Lugd.-Bat. (ISOTYPE of *Ilex lucida,* NY); *G. Masamune* in 1915 (NY), in 1923 (NY), in 1940 (NY); *Maximowicz* (G, NY); *Kenzo Shiota 5341* (A); *K. Sakurai* (A); *Jashiro* for *Wilson* (A).

Ilex chinensis is very well known among the Chinese, as it is extensively used as an ornamental tree. The branchlets with their deep green shiny leaves and bright red fruits are used to decorate temple-courts and large halls during the period from December to February which includes the Chinese New Year. It is known as "Tung-ching," meaning "wintergreen," or "wan-sho-hong," meaning "everlasting red." It has been collected in thirteen Chinese provinces and on Hainan Island, at altitudes ranging from sea level in East China up to 2000 m. in West China. It is often cultivated, developing into a tree up to 12 m. high and forming a trunk up to 30 cm. in diameter. Its lavender flowers appear in May, and its fruits begin to turn red in September. Quantities of fruiting branches are sold for ornamental purposes at the time of the Chinese New Year festival in February. The young shoots are sometimes blanched and used for salad. The crushed pyrenes are reputed to have tonic effects and are used in medicine.

This beautiful ornamental plant attracted the attention of early European collectors in the coastal cities. It was introduced into England in 1810 (ex Donn). Sims in July, 1814, studied and illustrated a flowering male plant growing in Messrs. Malcolm & Sweet's Nursery said to have been introduced from China. He named it *Ilex chinensis* and published his description and colored plate in 1819. Apparently only male plants were then available in England and the species soon disappeared from cultivation there. DeCandolle in 1825 knew it only from Sims' illustration and suggested that it might be a synonym of *Ilex dahoon* Walt. = *Ilex cassine* Linn. The species was soon forgotten. Maximowicz in 1881 remarked concerning *Ilex chinensis,* "Planta nunc obsoleta videtur, a Goeppert in enumeratione *Ilicum* hortensium omissa . . . omnino omittitur." Forbes & Hemsley in their Enumeration of Chinese Flowering Plants regarded it as a doubtful species, stating, "The cymose, . . . inflorescence on peduncles exceeding the petioles is unknown to us among Chinese hollies, and there may be some error as to the origin of this species." Even Loesener in his Monographia Aquifoliacearum also listed *Ilex chinensis* as a species of doubtful status.

Before the eighteenth century Japan had essentially a Chinese culture. Many cultigens were introduced into that country from China, and among them this *Ilex* which I interpret as *Ilex chinensis.* In 1844 Hasskarl based his *Ilex purpurea* on specimens from Nanawe, Japan. Twenty-three years later Miquel based *Ilex oldhami* on specimens collected by Oldham at Nagasaki. Fruiting specimens received from various parts of China, of course, did not match Sims' illustration of the male plant, *Ilex chinensis.* Some were named *Ilex purpurea* and others *Ilex oldhami,* but finally the older of these two names became very generally accepted for this widely distributed Chinese species. Being now convinced that these numerous staminate specimens of the present species do represent the long obscure and misunderstood *Ilex chinensis,* I accept this name as the oldest valid one for the species and reduce *Ilex purpurea* Hassk. (1884), *Ilex oldhami* Miq. (1867), and *Ilex purpurea* Hassk. var. *oldhami* (Miq.) Loes. (1901) to synonymy. I agree with Rehder in the reduction of the several Léveillé binominals.

22. **Ilex kwangtungensis** Merr. in Jour. Arnold Arb. **8**: 8. 1927; Groff in Lingnan Sci. Bull. **2**: 64. 1930; Chun in Sunyats. **2**: 71. 1934; Tanaka & Odashima in Jour. Soc. Trop. Agr. **10**: 372. 1938; Chun in Sunyats. **4**: 224. 1940; Merr. & Chun. in Sunyats. **5**: 106. 1940; Masamune, Fl. Kainant. [Hainan] 174. 1943.

Ilex kwangtungensis var. *pilosior* Hand.-Mzt. Symb. Sin. **7**: 654. 1933. *Syn. nov.*

Ilex kwangtungensis var. *pilosissima* Hand.-Mzt. op. cit. 655. *Syn. nov.*

Ilex shweliensis Comber in Notes Bot. Gard. Edinb. **18**: 57. 1933. *Syn. nov.*

Ilex latifrons Chun in Sunyats. **2**: 69. 1934. *Syn. nov.*

Ilex phanerophlebia Merr. in Lingnan Sci. Jour. **13**: 36. 1934. *Syn. nov.*

Ilex latifrons var. *pilosissima* (Hand.-Mzt.) Chun op. cit. 70. *Syn. nov.*

Small evergreen tree up to 9 m. high with puberulent branchlets and inflorescences, large ovate-elliptic finely serrate or subentire pubescent leaves, long lanceolate bracts, large ellipsoid fruits and deeply and broadly canaliculate pyrenes.

Branchlets straight, terete, the third year's growth 4–5 mm. in diameter, cinereous-brunneous, glabrescent, the lenticels minute, dense, circular, rather evident, the leaf-scars semicircular, slightly elevated; second year's growth 3 mm. thick, smooth, nigrescent or brunneous, cinereously puberulent under a lens; current year's growth angular, 2–3 mm. thick, ferrugineous or fulvous-pubescent. Leaves found even on third year's growth, 5–30 mm. apart; stipules lacking; petioles robust, 10–18 mm. long, 2 mm. thick, one-ninth to one-seventh the length of the lamina, triangular, narrowly sulcate above, fulvous-pubescent; lamina subcoriaceous, brunneous or atro-olivaceous, curly villose on both surfaces, sparsely so above, densely so beneath and along the midrib, ovate-elliptic, oblong or lanceolate, 7–16 cm. long, 3–6 cm. wide; base rounded or obtuse; apex acuminate, the acumen 5–10 mm. long; margin minutely serrate or subentire, slightly recurved; midrib plane or slightly elevated and densely villose above, very prominent, elevated and villose beneath, the lateral nerves 9–11 pairs, slightly impressed above, elevated beneath, the reticulation of the veinlets evident. Inflorescence a loose compound cyme, solitary, axillary, on current year's growth only. Staminate inflorescences: cymes 12–20-flowered, 3 or 4 times dichotomous, pubescent; peduncles 9–12 mm. long, secondary axes usually present 3–6 mm. long; bracts filiform, lanceolate, fulvous-villose, often up to 7 mm. long, basal to the tertiary axis; flower 4- or 5-merous, red or pink, 7–8 mm. across; pedicels 2 mm. long, fulvous-villose becoming nearly glabrous; calyx patelliform, 2.5–3 mm. across, the lobes orbicular-ovate, rounded, puberulous, entire, ciliate; corolla rotate, the petals oblong, 3.5 mm. long, 2 mm. wide, one-sixth connate at the base; stamens shorter than the petals, the anthers oblong, 1.5 mm. long; rudimentary ovary narrowly conical, 1.5 mm. long, the apex rostellate. Pistillate inflorescences: cymes 3–7-flowered, 1 or 2 times dichotomous, pubescent, the secondary axes 3–4 mm. long, the bracts lanceolate, submedian on the secondary axis; flowers 4-merous; pedicels

4–7 mm. long, flavous-villose or glabrescent; calyx ciliate; corolla rotate, the petals ovate, 2.5 mm. long; staminodes shorter than the petals, the sterile anthers ovoid; ovary ovoid, 2 mm. in diameter, the stigma mammiform, 4-lobed. Fruit red, ellipsoid, 12 mm. long, 9 mm. in diameter, nigrescent when dry, brown, wrinkled, shiny, the persistent calyx explanate, ciliate, the stigma prominent, 4-lobed and slightly ridged. Pyrenes 4, smooth, 6 mm. long, 3 mm. wide on the back, dorsally unicanaliculate, the canal 2 mm. deep, 1.7 mm. wide, the endocarp sublignescent.

CHINA: Chekiang: Tai-suan, *R. C. Ching 2142* (A, US). Fukien: Dunn, (Hongk. Herb. no. *2476*) (A); Tien-hwa-schan (Tingchow), *Handel-Mazzetti 400* (ISOTYPE of *Ilex kwangtungensis* var. *pilosior*, A). Kwangtung: Lung-t'au Mt., *To, Tsang & Tsang* (CCC) *12741* (A), *12383* (A, LU, US), *12764* (A, LU, US); Pok-lor, *Fung Hom A556* (=LU *18971*, TYPE of *Ilex phanerophlebia*, NY); Wung-yuen, *S. K. Lau 2393* (A); Sin-fung, *Y. W. Taam 199* (A), *307* (A), *383* (A); Kow-loon, *Y. W. Taam 2300* (A); Ta-pu, *W. T. Tsang 21188* (A); Hwei-yang, *W. T. Tsang 25607* (A), *25695* (A), *25899* (A). Hainan: Po-ting, *F. C. How 72489* (A), *73047* (A), *73349* (A), *73730* (A); *C. Wang 33520* (A, US); Lok-tung, *S. K. Lau 26978* (A); Bo-ting, *S. K. Lau 28021* (A), *28277* (A). Kwangsi: Kwei-lin, *W. T. Tsang 28122* (A, US); Yao-shan, *C. Wang 39321* (A), *39376* (A). Hunan: Chang-ning-hsien, *C. S. Fan & Y. Y. Li 259* (A). Kweichow: Tuh-shan, *W. Y. Chun 6977* (A, US); *Y. Tsiang 6977* (NY). Yunnan: *G. Forrest 15947* (ISOTYPE of *Ilex shweliensis*, A).

The characters Chun and Handel-Mazzetti used to set off *Ilex latifrons* and its varieties and *Ilex kwangtungensis* var. *pilosior* fall within the range of variation exhibited by the original material of *Ilex kwangtungensis*. It is almost identical with *To, Tsang & Tsang* (CCC) *12383*, a paratype of that species. *Wang 33520* from Hainan fits the description of *Ilex latifrons* Chun very well, it being but a large-leaved form of *Ilex kwangtungensis*. With abundant material I can find no tangible characters to differentiate Chun's species and Handel-Mazzetti's varieties from *Ilex kwangtungensis*. The curly indumentum of the branchlets, inflorescences, and vegetative characters of *Forrest 15947* conform to *Ilex kwangtungensis;* its pyrenes, however, are smaller, and the canals are shallower.

Ilex kwangtungensis is related to *Ilex chinensis* Sims, but the latter has very glabrous branchlets and inflorescences, smaller pyrenes with narrow and shallow dorsal canals.

The pink staminate flowers and the red pistillate flowers of *Ilex kwangtungensis* appear in May and June. The fruits turn greenish yellow in August–October and become red at maturity in November.

23. **Ilex atrata** W. W. Smith in Notes Bot. Gard. Edinb. 10: 40. 1917; Anon. in Notes Bot. Gard. Edinb. 17: 167. 1930; Comber in op. cit. 18: 40. 1933.

An evergreen tree with large terminal buds, ciliate bud-scales, large chartaceous or thin-coriaceous, finely serrate leaves, flavous-tomentose midribs, simple cymose infructescences, and convex pyrenes, slightly impressed at one end on the back.

Branchlets subterete, castaneous-nigrescent; second year's growth 3–4.5 mm. in diameter, when dry plicate-sulcate, the lenticels rather numerous, obscure or evident, the leaf-scars slightly elevated, crescent-shaped; current year's growth 3–4 mm. in diameter, angular, glabrous, the terminal buds large (especially when unfolding in October), the bud-scales ovate, the outer ones 8 mm. long, 5 mm. wide, slightly keeled, their margins entire and densely ciliate. Leaves 5–10 mm. apart; stipules lacking; petioles 15–25 mm. long, one-eighth to one-fifth the length of the lamina, 3 mm. wide, plane or slightly canaliculate above, plicate-rugose beneath, glabrous; lamina chartaceous or thin-coriaceous, castaneous or brunneous, elliptic, 12–16 cm. long, 3.5–5 cm. wide; base rounded, obtuse or broadly cuneate; apex acuminate, the acumen 10–12 mm. long with margins finely serrate or crenate-serrate; midrib prominent, plane, glabrous above, much elevated and flavous-tomentose beneath, sometimes glabrescent, the lateral nerves 14–18 pairs, prominent on both surfaces, the reticulation dense, evident on both surfaces. Infructescence a simple cyme, axillary to the leaves of the current year's growth, 1–3-flowered, glabrous; peduncles 2–3 mm. long, the pedicels 5–8 mm. long; persistent calyx explanate, 4 mm. in diameter, the lobes ovate, minutely and very shortly ciliate. Fruit globose, 6 mm. in diameter, red, when dry brunneous-nigrescent, shiny, wrinkled, the stigma discoid, 4- or 5-lobed. Pyrenes 5, oblong in outline, trigonous in cross-section, 5.5 mm. long, 2.5 mm. wide at the back, smooth, estriate, esulcate, the dorsal surface slightly impressed at the basal end, the endocarp coriaceous.

CHINA: Yunnan: Teng-yueh, *G. Forrest 9419* (ISOTYPE, A).
UPPER BURMA: Nam Tamai Valley, *Kingdon Ward 13228* (B).

In the leaf-form, size, and texture, and in the simple cymose infructescences, *Ilex atrata* closely resembles *Ilex kwangtungensis* Merr., which differs in having pubescent inflorescences, large drupes with deeply unicanaliculate pyrenes. When Smith described the species he mentioned the terminal bud as 2 cm. long. The terminal bud of the isotype in the Arnold Arboretum is in the unfolding stage. It is 2 cm. long, and the bud scales are loose. I think that the ciliate bud scales are a more significant character than the size of the bud. Although various collectors have visited the classical locality since this species was described, they have apparently not rediscovered the plant.

23a. **Ilex atrata var. wangii**, var. nov.

Arbor; ramulis glabris; foliis chartaceis, ellipticis, 15 cm. longis, 4.5–5.5 cm. latis; costa subtus elevata, tomentosa; inflorescentiis cymosis, puberulentibus; pedunculis 10 mm. longis; pedicellis 5 mm. longis; calycibus puberulentibus, ciliatis; pyrenis 7, dorso planis vel canaliculatis.

CHINA: Yunnan: Chiu-kiang, West of Champutung, *C. W. Wang 67359* (TYPE, A).

This variety differs from the species chiefly in having the peduncles longer than the pedicels, both being puberulent, but the single collection seen is not fully mature. The infructescence is of the same type as that of *Ilex manneiensis* S. Y. Hu, but because of the serrate margins and tomentose midrib I place it as a variety of *Ilex atrata*.

Series 2. UMBELLIFORMES (Loes.), stat. nov.

Ilex subgen. *Euilex* Loes. ser. *Lioprinus* Loes. sect. 1. *Excelsae* Loes. subsect. a, *Umbelliformes* Loes. in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. 78: 95 (Monog. Aquif. 1: 95). 1901.

Evergreen trees; leaves subcoriaceous or chartaceous, entire; inflorescences cymose or subumbelliform, solitary, axillary in current year's growth; flowers 4–10-merous; petals distinctly one-fourth to one-sixth connate; stamens equal to or slightly longer than the petals; rudimentary ovary rostellate, the beak 3–7-cleft at the apex; fruits medium- to small-sized; pyrenes 4–10, usually 5 or 6, 3-striate, 2-sulcate or rarely esulcate, the endocarp coriaceous, sublignified or woody.

Key to the Species

A. Pyrenes smooth or 3-striate, esulcate; endocarp coriaceous. (Himalaya, Yunnan, Kwangsi) .... 24. *I. excelsa*.

AA. Pyrenes 3-striate and sulcate; endocarp sublignified or woody.

B. Staminate inflorescence a loose cyme, the peduncle 3–13 mm. long; fruit ellipsoid or globose; calyx erose eciliate (very rarely ciliate in *I. rotunda* var. *microcarpa*).

C. Leaves (4–)5–8(–9) cm. long, 2–4 cm. wide, the petioles 1–2 cm. long, one-fifth to one-fourth the length of the lamina; rudimentary ovary rostellate. (Japan, East and South China) .. .. 25. *I. rotunda*.

CC. Leaves (2–)3(–4.5) cm. long, 1–2 cm. wide, the petioles 4–6 mm. long, one-tenth to one-eighth the length of the lamina. (Hainan) .... 26. *I. angulata*.

BB. Staminate inflorescence an umbel, the peduncle 14–20 mm. long; fruit depressed-globose or globose, when dry ochraceous or brunneous; calyx ciliate.

C. Branchlets pubescent; fruit ca. 3.5 mm. in diameter; pyrenes 5 or 6, ca. 2 mm. long. (Himalayan region to Hainan) .... 27. *I. godajam*.

CC. Branchlets glabrous; fruit ca. 6 mm. in diameter; pyrenes 6–10, 2.5–4 mm. long. (Himalaya) .... 28. *I. umbellulata*.

24. **Ilex excelsa** (Wall.) Hook. f. Fl. Brit. Ind. 1: 603. 1875; Maxim. in Mém. Acad. Sci. St. Pétersb. VII, **29** (3): 23. 1881; Loes. in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. **78**: 104 (Monog. Aquif. 1: 104). 1901; Chung in Mem. Sci. Soc. China 1: 140. 1924; Comber in Notes Bot. Gard. Edinb. **18**: 46. 1933.

Cassine excelsa Wall. in Roxb. Fl. Ind. **2**: 376. 1824; Spreng. Syst. **4**: Cur. Post. 124. 1827.

Ilex elliptica D. Don, Prodr. Fl. Nep. 189. 1825; DC. Prodr. **2**: 15. 1825.
Ilex rotunda sensu D. Don, l.c., non Thunb.
Ilex doniana DC. op. cit. 644.
Ilex nepalensis Spreng. Syst. **4**: Cur. Post. 48. 1827.
Ilex exsulca Wall. List no. 4328. 1830; Brandis, For. Fl. Brit. Ind. 76. 1874.

An evergreen tree up to 10 m. high with chartaceous or subcoriaceous elliptic entire leaves, solitary cymose inflorescences, small ovoid-ellipsoid fruits and 5, rarely 4 or 6, smooth or striate, esulcate pyrenes.

Branchlets rugose and angular; third year's growth 4 mm. in diameter, cinereous, with few lenticels; second year's growth 3 mm. in diameter, plicate-rugose; current year's growth 2 mm. in diameter, ridged, glabrous, the terminal buds poorly developed, with loose glabrous scales. Leaves on current year's growth only, 3–10 mm. apart; stipules lanceolate, 1–1.5 mm. long, acute; petioles slender, 10–12 mm. long, about one-seventh the length of the lamina, glabrous, narrowly canaliculate above; lamina chartaceous or subcoriaceous, brunneous-olivaceous, opaque on both surfaces, elliptic or oblong-elliptic, 5–10 cm. long, 2–3.5, rarely 5 cm. wide; base cuneate, obtuse or rarely rounded; apex acuminate, the acumen 5–12 mm. long, mucronate; margin entire; midrib impressed above, elevated beneath, glabrous, the lateral nerves 7 or 8 pairs, evident on both surfaces, anastomosing near the margin, the reticulations of the veinlets obscure. Inflorescences cymose, solitary, cymes 3–7 (–15) -flowered, the bracts deltoid, acute, the flowers 4–6-merous. Staminate inflorescences: peduncles 4–8 mm. long, hirsute, the pedicels 2–5 mm. long, puberulous with 1 or 2 basal prophylla; calyx patelliform, deeply 4- or 5-lobed, the lobes rounded, eciliate; corolla rotate, 5 mm. across, the petals oblong, 2 mm. long, eciliate, one-sixth connate at the base; stamens equal or slightly longer than the petals, the anthers oblong, 1 mm. long; rudimentary ovary pulvinate, long-rostellate, the beak evident, 1 mm. long, with distinctly 5-cleft apex. Pistillate inflorescences: peduncles 5–12 mm. long, minutely puberulous, the pedicels 3–4 mm. long; calyx 2.5 mm. across, 5- or 6-lobed, the lobes deltoid, eciliate; corolla rotate, 5 mm. across; the petals broad-ovate, 2 mm. long; staminodes one-half the length of the petals, the anthers sagittate; ovary ovoid, 1.5 mm. in diameter, the stigma discoid. Fruit ovoid-ellipsoid, 5 mm. in diameter, the persistent calyx explanate, 2.5 mm. across, the stigma thickly discoid, convex. Pyrenes usually 5, occasionally 4 or 6, elliptic in outline, trigonous in cross-section, 2.75 mm. long, 1.25 mm. wide, smooth or 2- or 3-striate, esulcate, the endocarp coriaceous.

CHINA: Kwangsi: Yung-hsien, *Steward & Cheo 757* (A, NY), *838* (A, NY). Yunnan: Shweli-Salween Divide, *G. Forrest 15865* (A), *16062* (A); Mengtze, *A. Henry 13691* (A); Lung-ling-hsien, *H. T. Tsai 55633* (A); without precise locality, *Wang, Chang & Liu 85048* (A); Mien-ning, *T. T. Yu 17829* (A).

NEPAL: *Wallich 4328* (ISOTYPE, G; fragment, A), *4328A* (A).

INDIA: Himalayan region, *Griffith 2008* (A, G), *Thomson* (G);

Kangra, *Parker 3317* (A); Kumaon, *Strachey & Winterbottom 1* (G); Khasia Mountains, *Hooker & Thomson* (G).

The chartaceous elliptic acuminate entire leaves, the cymose inflorescences, and the rostellate rudimentary ovary of *Ilex excelsa* indicate a close relationship between this species and *Ilex rotunda* Thunb. of Japan and eastern China. The latter usually has larger fruits and striate-sulcate pyrenes. The variations in the size of the fruits of the Japanese species and in the striation of the pyrenes of the Chinese material are so great that it is difficult to decide to which species specimens collected from areas like Kwangsi, which are geographically intermediate between the two, should belong.

24a. **Ilex excelsa** var. **hypotricha** (Loes.), comb. nov.

Ilex hypotricha Loes. in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. **78**: 103 (Monog. Aquif. **1**: 103). 1901.

Branchlets puberulous; leaves chartaceous, puberulous on the lower surfaces or only along the midrib beneath, oblong-elliptic, 5–8 cm. long, 2.5–4 cm. wide, shortly acuminate; inflorescences cymose, solitary, the flowers 4- or 5-merous; fruit small, ellipsoid, ca. 5 mm. long, 3 mm. wide; pyrenes 5, 4 mm. long, 1.25 mm. wide, 3-striate, esulcate, the endocarp coriaceous.

CHINA: Yunnan: without precise locality, *G. Forrest 17938* (A), *18014* (A), *27200* (TYPE, A); Ping-pien-hsien, *H. T. Tsai 60502* (A).

INDIA: East Bengal, *Griffith 2008* (A, fragment; G, ISOTYPE of *Ilex hypotricha*).

This variety differs from typical *Ilex excelsa* in its puberulent branchlets and lower leaf-surfaces. The Yunnan form is a shrub or small tree.

25. **Ilex rotunda** Thunb. Fl. Jap. 77. 1784; Willd. Sp. Pl. 1 (2): 711. 1797; Pers. Syst. Veg. 174. 1797, et Syn. Pl. **1**: 151. 1805; Poir. in Lam. Encycl. Suppl. **3**: 67, 1813; Roem. & Schult. Syst. **3**: 492. 1818; DC. Prodr. **2**: 16. 1825; Spreng. Syst. **1**: 496. 1825; Dietr. Syn. Pl. **1**: 555. 1839; Sieb. & Zucc. in Abh. Bay. Ak. Wiss. IV, **2**: 149. 1845; Miq. Ann. Mus. Bot. Lugd.-Bat. **3**: 106 (Prol. Fl. Jap. 106). 1867; Franch. & Sav. Enum. Pl. Jap. **1**: 77. 1873; Maxim. in Mém. Acad. Sci. St. Pétersb. VII, **29**(3): 23. 36, *pl. 1, fig. 5*. 1881; Hance in Jour. Bot. **21**: 296. 1883; Forbes & Hemsl. in Jour. Lin. Soc. Bot. **23**: 118. 1886; Loes. in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. **78**: 106 (Monog. Aquif. **1**: 106). 1901; Hayata, Ic. Pl. Form. **1**: 134. 1911; Lecomte, Fl. Gén. Indo-Chine **1**: 851. 1912; Chung in Mem. Sci. Soc. China **1**: 141. 1924; Kanehira, Form. Trees 386, *fig. 337*. 1936; Kia, Pl. Sin. Ill. 492, *fig. 833*. 1937; Chen, Ill. Man. Chin. Trees 656, *fig. 547*. 1937; Masamune Fl. Kainant. [Hainan] 175. 1943; Tardieu-Blot in Fl. Gén. Indo-Chine Suppl. **1**: 767. 1948.

Ilex laevigata Blume ex Miq. Cat. Mus. Bot. Lugd.-Bat. 167. 1870.

Ilex kosunensis Yamamoto, Suppl. Icon. Pl. Formos. **1**: 36, *fig. 16*. 1925. *Syn. nov.*

Ilex sasakii Yamamoto, op. cit. 39, *fig. 19.* 1925. *Syn. nov.*

A large, entirely glabrous evergreen tree reaching 20 m. in height and developing a trunk as much as 1 m. thick, with entire leaves, loose simple umbelliform cymes, ellipsoid fruit, 3-striate and 2-sulcate lanceolate pyrenes.

Branches straight, rough, with slightly elevated obovate or deltoid leaf-scars; third year's growth 4–5 mm. in diameter, cinereous, obscurely rimulose, the lenticels inconspicuous; current year's growth 2–3 mm. thick, fuscous, longitudinally ridged, glabrous. Leaves occurring on current year's growth only, 1–10 mm. apart; stipules minute, 0.5–1 mm. long, subulate, deciduous; petioles 10–20 mm. long, one-sixth to one-fourth as long as the lamina, glabrous, canaliculate above, striate and rugose beneath; lamina thin-coriaceous or chartaceous, olivaceous or brunnescent, entirely glabrous, ovate to obovate or elliptic, 4–9 cm. long, 1.8–4 cm. wide; base cuneate or obtuse; apex shortly acuminate, the acumen deltoid, 5–8 mm. long, the tip cuspidate; margin entire, narrowly recurved; midrib slightly impressed above, elevated beneath, especially toward the basal half, the lateral nerves 6–9 pairs, obscure above, visible beneath, reticulate near the margin, the tertiary veins inconspicuous. Inflorescences cymose or umbelliform, cymes (3–) 4–6 (–13) -flowered, solitary, axillary, on current year's growth only. Staminate inflorescences: peduncles 3–10 mm. long, the pedicels 4–5 mm. long with 0–2 brown deltoid basal acute prophylla; flowers 4-merous; calyx patelliform, 2 mm. across, shallowly 4-lobed, the lobes deltoid, eciliate; corolla rotate and reflexed, 6 mm. across, the petals oblong, 2.5 mm. long, 1.5 mm. wide, one-sixth connate at the base; stamens longer than the petals, the anthers ellipsoid; rudimentary ovary pulvinate, 1 mm. in diameter, the middle rostellate, with the beak 5- or 6-cleft at the apex. Pistillate inflorescences: peduncles 9–13 mm. long, 3–7-flowered, glabrous, the pedicels 4–8 mm. long, glabrous; flowers white, 5–7-merous; calyx subpatelliform, 2 mm. in diameter, glabrous, the lobes deltoid, erose, 0.5 mm. long, 0.75 mm. wide; corolla rotate, the petals one-fifth connate, the lobes obovate-oblong, 2 mm. long, 1.5 mm. wide; staminodes three-fourths the length of the petals, the filaments much dilated at the base, the sterile anthers cordiform; ovary ovoid-conic, 2 mm. long, the stigma subglobose. Fruits ellipsoid, 6–8 mm. long, the stigma capitate when young, discoid and 5–7-lobed at maturity. Pyrenes 5–7, lanceolate in outline, trigonous in cross-section, ca. 6 mm. long, 1.25 mm. wide, 3-striate, 2-sulcate on the dorsal surfaces, the sides smooth, the endocarp sublignified.

CHINA: Chekiang: Sia-chu, *R. C. Ching 1796* (A, US); Chua-an-hsien, *Y. L. Keng 736* (A). Hunan: Yi-chang, *W. T. Tsang 23724* (US). Fukien: Hing-hwa, *H. H. Chung 975* (A); Ku-liang, *H. H. Chung 6636* (A). Kwangtung: Ren-hwa, *W. Y. Chun 5616* (A), *5638* (A); Lo-chang, *Y. Tsiang 1423* (A); Lok-chang, *C. L. Tso 20945* (NY). Kwangsi: Seh-feng-dar-shan, *R. C. Ching 7803* (NY, US); Shang-sze, Shap-man-taai-shan, *W. T. Tsang 22102* (A). Hainan: Dung-la, *N. K. Chun & C. L. Tso 43358* (A, NY); Ching-mai, *C. L. Lei*

488 (A, NY); Taam-chau, *Tsang & Fung 440* (NY); *W. T. Tsang 497* (A); without precise locality, *H. Y. Liang 64514* (NY, US); *L. Tang 410* (A); *C. Wang 34337* (NY). Taiwan: South Cape, *A. Henry 929* (NY), *1973* (US); Takao Province, *Y. Kudo* in 1928 (A); without precise locality, *N. Fukuyama 7317* (TU), *E. Matuda 1212* (TU), *Nakamura 3952* (TU); Taihoku, *S. Sasaki* in 1929 (A, TU); Koshu Province, *E. H. Wilson 11042* (A).

JAPAN: *K. Beattie & Y. Kurihara 10452* (A); *Buerger* (A, G); *U. Faurie 3844* (A); *Goto 4803* (A); *Maximowicz* (G), in 1863 (NY); *K. Miyabe* (A); *R. Oldham 142* (G), *143* (G), in 1862 (ISOTYPE of *Ilex laevigata*, NY); *Siebold* (A); *Sargent* (A); *T. Tanaka 100420* (A); *E. H. Wilson 6157* (A), *6209* (A), *7828* (A), *8157* (A). Liu-kiu Islands: *U. Faurie 3805* (A); *Yokohama Nursery Co.* (A, NY).

KOREA: *U. Faurie 497* (A), *1633* (A, B), *1636* (A, B), *1640* (A); *T. Taquet 144* (A), *2720* (A), *3922* (A), *3923* (A), *4462* (A); *E. H. Wilson 9556* (A).

INDO-CHINA: Tonkin: *A. Pételot 889* (US), *1200* (A); *W. T. Tsang 27364* (A), *29989* (A).

Ilex rotunda was first described from Japan and stated to be an entirely glabrous plant. This typical form has been collected from a few coastal provinces in China and Indo-China. In China the plant becomes a tree and develops a trunk up to 30 cm. in diameter. The white fragrant flowers appear in April, and the red fruit lasts until February or March of the following year.

25a. **Ilex rotunda** var. **microcarpa** (Lindl. ex Paxt.), comb. nov.

Ilex microcarpa Lindl. ex Paxt. Fl. Gard. **1:** 43. 1850; Loud. Encycl. Pl. Suppl. **2:** 1302. 1855.

Ilex rotunda sensu Forbes & Hemsl. Jour. Linn. Soc. Bot. **23:** 118. 1886; sensu Dunn & Tutcher in Kew Bull. Add. Ser. **10:** 59. 1912; sensu Loes. in Sarg. Pl. Wils. **1:** 78. 1911; sensu Chien in Contr. Biol. Sci. Soc. China **3:** 58. 1927; sensu Rehd. in Jour. Arnold Arb. **7:** 156. 1927; sensu Groff in Lingnan Sci. Bull. **2:** 64. 1930; sensu Belval in Mus. Heud. Not. Bot. Chin. **2:** 22. 1933, non Thunb.

An evergreen tree with chartaceous entire leaves; lamina oblong-elliptic, rarely ovate, 5–9 cm. long, 2.5–4 cm. wide, the base obtuse, rarely rounded or cuneate, the apex shortly acuminate and cuspidate; inflorescences sub-umbelliform 3–13-flowered; the peduncles 5–12 mm. long, the pedicels 2–6 mm. long, both minutely puberulous; flowers 4–7, usually 6-merous, the calyx erose, rarely sparsely ciliate; fruit globose, rarely ovoid or ellipsoid, 5 mm. in diameter, very rarely 7 mm. in diameter; pyrenes 6, rarely 5 or 7, elliptic in outline, in cross-section trigonous, 4 mm., rarely 5–6 mm. long, the back 1 mm. wide, 3-striate, 2-sulcate, the sides smooth, the endocarp sublignified.

CHINA: Kiangsu: I-shing, *Ching & Tso 621* (A). Anhwei: Wangshan, *W. C. Cheng 3885* (US); *R. C. Ching 2914* (A, US); Chimen, *R. C. Ching 3157* (A), *3329* (A). Chekiang: Yen-tang-shan, *C. Y. Chiao* (ex Herb. Univ. Nanking no. *14741*) (A, US); Hangchow, *C. Y. Chiao* (ex Herb. Univ. Nanking no. *18814*) (NY, US); Sia-chu, *R. C. Ching 1688*

(A, US), *2566* (A, US); Tsing-tien, *Y. L. Keng 204* (A); Nin-hai-hsien, *Y. L. Keng 1099* (A); Ning-po, *D. MacGregor* (A). Kiangsi: Ku-ling, *W. Y. Chun 4301* (A); *E. H. Wilson 1611* (A); Shang-yu-hsien, *H. H. Hu 912* (A); Ta-yu-hsien, *H. H. Hu 977* (A); Kien-nan-hsien, *S. K. Lau 3963* (A, US). Hunan: Chang-ning-hsien, *C. S. Fan & Y. Y. Li 421* (A). Kweichow: Fang-chin-shan, *Steward, Chiao & Cheo 841* (A, US). Fukien: Min-how-hsien, *Tang Siu-ging 6786* (A); *H. H. Chung 2080* (A), *6617* (A, NY), *6764* (A), *6868* (A); *J. B. S. Norton 1573* (US). Kwangtung: Shao-chow, *W. Y. Chun 5507* (A); Ta-ching, *W. Y. Chun 5510* (A); Ma-hang, *W. Y. Chun 5547* (A); Ren-hwa, *W. Y. Chun 5616* (A), *5638* (A); Chang-kiang, *W. Y. Chun 6115* (A); Ting-wu-shan, *W. Y. Chun 6470* (A, US); *C. O. Levine* (CCC) *737* (A, US), *3096* (A); Kook-kiang, *S. P. Ko 50419* (NY). Wung-yuen-hsien, *S. K. Lau 656* (A, NY, US), *692* (A, NY), *2220* (A, US); Kao-yao, *S. Y. Lau 20237* (NY); Canton, *C. O. Levine* (CCC) *1* (A, US), *656* (A, US), *1205* (US), *1299* (A, US), *1656* (A, US), *1815* (A, US), *1830* (A, US), *2110* (A), *2177* (A); Lin-hsien, *C. O. Levine* (CCC) *3366* (A, US); Lung-t'au Mt., *To, Tsang & Tsang* (CCC) *12206* (US); Po-tau-chai, *F. A. McClure 232* (A); Sam-shu, *F. A. McClure 1348* (US); Loh-fau Mt., *Fung Hom 556* (NY); *E. D. Merrill 10249* (A), *10891* (A); Sin-fung-hsien, *Y. W. Taam 280* (A), *584* (A), *771* (A), *1049* (A); Chung-shaan, *W. T. Tsang 2* (NY); Ta-pu-hsien, *W. T. Tsang 21190* (A, NY); Hwei-yang-hsien, *W. T. Tsang 25732* (A); *T. M. Tsui 102* (US); Jen-hwa-hsien, *W. T. Tsang 26437* (A); Ting-wu-shan, *Y. Tsiang 784* (A), *1495* (A); Ko-chow, *Y. Tsiang 912* (A); Lo-fou-shan; *Y. Tsiang 1679* (A); Sun-wui-hsien, *Y. Tsiang & Tso 2017* (A); Ho-yuen, *C. L. Tso 21553* (NY), *21554* (NY); Lung-chun, *C. L. Tso 21653* (NY); Ko-chong, *C. L. Tso 20421* (NY), *20658* (NY), *20848* (NY); Yang-shan-hsien, *T. M. Tsui 514* (NY, US), *627* (A, NY, US); Chu-don, *C. Wang 472* (A). Kwangsi: Lu-chen: *R. C. Ching 5221* (NY); Shang-sze: *W. T. Tsang 24503* (NY). Hongkong: *N. C. Chun 40207* (NY); *C. Ford* (NY); *Y. Tsiang 2949* (NY). Hainan: Dung-ka, *N. K. Chun & C. L. Tso 43827* (NY); Yai-chow, *F. C. How 70446* (A, NY); Po-ting, *F. C. How 71509* (A), *71737* (A), *72606* (A); Lok-tung, *S. K. Lau 26757* (A); Bak-sa, *S. K. Lau 26296* (A); Ching-mai, *C. L. Lei 1* (NY, US); Seven Finger Mts., *H. Y. Liang 61775* (A, NY); No-dao, *F. A. McClure* (CCC) *7705* (A); without precise locality, *J. L. Gressitt 838* (A), *1119* (B); Ch'ang-kiang, *S. K. Lau 1899* (A, NY); Taam-chau, *W. T. Tsang 70* (A, US), *364* (NY, US), *497* (NY, US); *C. Wang 34280* (A, NY), *35117* (A, NY), *35727* (NY). Taiwan: Tai-hoku-syu, *K. Odashima* (ex Herb. Taihoku Imp. Univ. no. *17750*) (A, NY, US); *S. Suzuki* (A); Lake Candiduis, *R. Kanehira 21336* (A); *E. H. Wilson 11121* (A, US), *11180* (A, US).

The specimens from Fukien have rather small inflorescences. They even suggest *Ilex stewardii* S. Y. Hu, but for the most part they are poorly selected and are not to be considered as typical. The variety differs from typical *Ilex rotunda* in having puberulous peduncles and pedicels. In general its fruits are smaller and its pyrenes are shorter and less sulcate.

The cultivated plants that Lindley saw in Standish and Noble's Bagshot Nursery were introduced by R. Fortune during his second trip to China, 1848–50. On this trip he collected in Shanghai and in the vicinity of

Ning-po. He also proceeded from Ning-po across the province of Chekiang to southern Anhwei. He states that his objective was to discover the secret of manufacturing tea. On this trip he was handicapped by fear and suspicion. For this reason, he probably could not collect many specimens from the interior parts of Anhwei and Chekiang. It is most likely that his original material of *Ilex microcarpa* came from the vicinity of Ning-po, where it is common.

In fruit-size, leaf-texture, and the indumentum of the inflorescences, the variety resembles *Ilex excelsa* (Wall.) Hook. f. more closely than *Ilex rotunda*. Because of the striate-sulcate pyrenes I place it as a variety of *Ilex rotunda* Thunb. As I interpret the group, *Ilex rotunda* var. *microcarpa* is a variant intermediate between the Japanese *Ilex rotunda* and the Himalayan *Ilex excelsa*.

26. **Ilex angulata** Merr. & Chun in Sunyats. **2**: 266. 1935.

An evergreen shrub or small tree up to 4 m. high with striate puberulent twigs, entire chartaceous elliptic-lanceolate leaves, solitary or cymose infructescences, large ellipsoid fruits and striate-sulcate pyrenes with rough excavated backs.

Branchlets slender, zigzag; fourth year's growth usually 3–4 mm. in diameter, angularly ridged, rimose, the lenticels lacking, the leaf-scars semi-orbicular; third and second year's growth thinner, puberulent; current year's growth very slender, 1–1.5 mm. in diameter, ridged and narrowly canaliculate, pubescent in the grooves, the terminal buds lacking. Leaves occurring even on the third year's growth, 2–8 mm. apart; stipules minute, subulate and falcate, persistent; petioles short, 4–6 mm. long, one-tenth to one-eighth the length of the lamina, canaliculate above; lamina chartaceous or membranaceous, olivaceous, broad-elliptic, elliptic or lanceolate, 2.5–4.5 cm. long, 1–2.3 cm. wide; cuneate or acute at the base; acuminate and cuspidate at the apex, the acumen 5–8 mm. long; margin entire, very rarely near the apex inconspicuously but sharply serrulate; midrib sulcate and puberulent above, prominent, elevated and glabrous beneath, the lateral nerves 5–7 pairs, rather obscure on both surfaces. Inflorescences solitary, axillary, only on current year's growth, pubescent; cymes simple, 1–3-flowered, when 1-flowered the pedicels short, 3–5 mm. long, with 2 sub-basal prophylla, when 2- or 3-flowered the peduncles 3–5 mm. long, the pedicel subequal; bracts to individual flowers deltoid, sparsely pubescent. Staminate inflorescences: cymes usually 3-flowered, calyx patelliform, 3–5 mm. across, deeply 5-lobed, the lobes membranaceous, suborbicular, 1.5 mm. long and wide, eciliate, rounded or obtuse; corolla rotate, 6–8 mm. across, the petals ovate, 3 mm. long, 2–2.5 mm. wide, one-sixth connate at the base; stamens three-fourths the length of the petals, the anthers oblong; rudimentary ovary globose, 1 mm. in diameter. Pistillate inflorescences: calyx and corolla as in the staminate flowers; staminodes one-third the length of the petals, the sterile anthers sagittate; ovary ovoid, the stigma mammiform, discoid at the apex, 2.5 mm. long, 2 mm. wide at the base; rudimentary ovary globose, 1 mm. in diameter. Fruit ellipsoid, 6–7 mm. long, 5–6 mm. in diameter, striate and sulcate, dark brown, the persistent calyx explanate, 5 mm. in diameter, the style evident, the stigma discoid, irregularly lobed. Pyrenes 5 or 6, 5 mm. long, 1.5 mm. wide, the dorsal surface 3-striate and sulcate, the middle ridge usually deeply impressed, the endocarp lignescent.

CHINA: Hainan: Po-ting, *F. C. How 71993* (A); Dung-ka, *N. K. Chun & C. L. Tso, 43779* (ISOTYPE, A; TYPE, NY), *43781* (A, NY); without precise locality, *C. Wang 34675* (NY, US).

This species is endemic to Hainan Island. There it grows at altitudes of 450–500 m. Its pink staminate flowers appear in April (ex How).

26a. **Ilex angulata var. longipedunculata,** var. nov.

Frutex pubescens; foliis late ellipticis, 2.5–4.5 cm. longis, 1.5–2.3 cm. latis, apice acuminatis; inflorescentiis cymosis, pedunculis 8–10 mm. longis, pedicellis aequilongis, pedicellis fructibus solitariis 15–18 mm. longis, pubescentibus; fructibus ellipsoideis, 9–10 mm. longis, 6 mm. diametro; pyrenis 5 mm. longis, striatis, endocarpio sublignescento.

CHINA: Hainan: Po-ting, *F. C. How 72497* (A), *73020* (TYPE, A).

This variety differs from the typical *Ilex angulata* in having larger fruiting pedicels and fruits.

27. **Ilex godajam** (Colebr.) Wall. List. no. 4329. 1839; Hook. f. Fl. Brit. Ind. **1**: 604. 1875; Loes. in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. **78**: 101 (Monog. Aquif. **1**: 101). 1901; Maxim. in Mém. Acad. Sci. St. Pétersb. VII, **29** (3): 23. 1881; Pitard in Lecomte, Fl. Gén. Indo-Chine **1**: 854. 1912; Tardieu-Blot in Fl. Gén. Indo-Chine Suppl. **1**: 767. 1948.

Prinos godajam Colebr. ex Wall. Pl. As. Rar. **3**: 38, *pl. 261.* 1832.
Ilex godajam var. *genuina* Kurz in Jour. As. Soc. Bengal. **44**(2): 158. 1875.
Ilex capitellata Pierre, Fl. For. Cochinch. **4**: *pl. 278b.* 1893.
Ilex godajam var. *capitellata* (Pierre) Loes. op. cit. 102. 1901. *Syn. nov.*
Ilex rotunda Thunb. var. *piligera* Loes. op. cit. 108.
Ilex umbellulata sensu Merr. in Lingnan Sci. Jour. **6**: 327. 1928, non Loes.
Ilex fabrilis sensu Merr. & Chun in Sunyats. **5**: 106. 1940, non Pierre.
Ilex rotunda sensu auct. plur., non Thunb.

An evergreen shrub or tree up to 8 m. high, with pubescent branchlets, entire thin-coriaceous or chartaceous leaves, umbelliform inflorescences, small globose fruit, and minute 3-striate and 2-sulcate pyrenes.

Branchlets crooked, the third year's growth 5 mm. in diameter, subterete, light cinereous, the lenticels lacking, the leaf-scars semi-orbicular, not elevated; second year's growth 4 mm. in diameter, striate; current year's growth 2 mm. in diameter, pubescent, brown, the terminal bud lacking or very weak. Leaves occurring also on second year's growth, 10–20 mm. apart; stipules minute, broadly deltoid, acute; petioles very slender, 10–15 mm. long, one-ninth to one-fourth the length of the lamina, pubescent, narrowly canaliculate above; lamina thin-coriaceous or chartaceous, olivaceous, when young silky, especially on the lower surface, ovate or oblong, 5–8 cm. long, 2.5–4.6 mm. wide; base rounded, seldom obtuse; apex obtuse or very short-acuminate, the acumen 3–5 mm. long, broadly deltoid; margin entire; midrib impressed, often puberulent above, strongly elevated and pilose or glabrescent beneath, the lateral nerves 7–11 pairs, straight and parallel, curved upward near the margin, the reticulation of the veinlets obscure. Inflorescences umbelliform, axillary, on current year's growth, pilose, often when the shoot fails to develop appearing paniculate; flowers 4–6-merous. Staminate inflorescences: umbels 8–23-flowered; peduncle 14–18 mm. long, the secondary axes often evident, 1–2 mm. long, the pedicel 2–4 mm. long, with 2 subulate basal prophylla; flowers 4- or 5-merous; calyx patelliform, 2.5 mm. across, pubescent, deeply 4- or 5-lobed, the lobes ovate, obtuse, erose and ciliate; corolla rotate, the petals oblong, ca. 2 mm. long, 1 mm. wide; one-eighth connate at the base; stamens equaling the petals in length, the anthers ovoid, 0.5 mm. long; rudimentary ovary globose, 0.75 mm. in diameter, rostellate, the beak 4- or 5-cleft. Pistillate inflorescences: umbels 3–13-flowered; peduncles 10–13 mm. long, the bracts minute, deltoid, crowded and imbricate; pedicels 2–5 mm. long, with deltoid acute basal prophylla; calyx as in the staminate flowers; corolla and staminodes not seen; ovary ovoid, 1.5 mm. in diameter, constricted below the capitate stigma. Fruit globose, small, 3.5 mm. in diameter, the exocarp thin. Pyrenes 5 or 6, small, 2 mm. long, 1.5 mm. wide at the back, 3-striate, 2-sulcate, the endocarp woody.

CHINA: Hainan: Nodoa, *W. Y. Chun 4633* (US); Yai-chow, *F. C. How 70672* (A), *70462* (NY, US), *70473* (NY), *71056* (A, NY); *F. C. How & N. K. Chun 70198* (A, NY, US); *C. Wang 33205* (A, US); Man-ning, *F. C. How 71430* (A); Ngai-hsien, *S. K. Lau 390* (A, NY, US); without precise locality, *H. Y. Liang 63135* (NY, US), *64952* (NY), *65364* (NY); Taam-chau, *W. T. Tsang 36* (LU *16785*) (A, NY, US); *C. Wang 34295* (NY). Kwangsi: Tian-chen, *R. C. Ching 7803* (A), *7314* (A, NY, US), *7315* (NY); Tai-chin-shan, *S. P. Ko 55103*. Yunnan: Che-li-hsien, *C. W. Wang 77582* (A).

INDO-CHINA: Tonkin: *Harmand 1297* (ISOTYPE of *Ilex capitellata*, P); *Du Pasquier 3026* (A); *A. Pételot 6400* (A).

INDIA: *E. O. Shebbean 11776A* (A); Assam, *Prain's Collector 765* (A), Reporter on Economic Products *11223* (A); *J. O. Voigt 416* (A).

Ilex godajam was originally based on material from Silhet and Assam and described as pubescent. Additional collections indicate that it has a much wider distribution than the closely related glabrous species *Ilex umbellulata* (Wall.) Loes. It flowers about April (from late March to early May) and matures its red fruit in late August.

Ilex godajam is closely related to *Ilex umbellulata* (Wall.) Loes., and is perhaps merely a pubescent variety of it. The two are alike in their pseudo-umbelliform, long-pedunculate, pubescent inflorescences. However, whereas *Ilex godajam* is pubescent on branchlets, petioles, midribs, and often young leaves, *Ilex umbellulata* is glabrous. In general, *Ilex godajam* also has smaller leaves and fruits, thinner exocarp, and less sulcate pyrenes. It has another close relative in *Ilex rotunda* Thunb. var. *microcarpa* (Lindl.

& Paxt.) S. Y. Hu, which differs in having glabrous branchlets and elliptic leaves with cuneate bases and long-acuminate apices.

28. **Ilex umbellulata** (Wall.) Loes. in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. 78: 99 (Monog. Aquif. 1: 99). 1901; Pitard in Lecomte, Fl. Gén. Indo-Chine 1: 862. 1912; Tardieu-Blot in Fl. Gén. Indo-Chine Suppl. 1: 767. 1948.

Ehretia umbellulata Wall. in Roxb. Fl. Ind. **2**: 344. 1824; Wall. List no. 4329. 1829. 1832; Spreng. Syst. **4**: Cur. Post. 66. 1827.

Ilex sulcata Wall. List no. 4330, nom. nud.; Hook. f. Fl. Brit. Ind. **1**: 604. 1875, descr.

Pseudehretia umbellulata (Wall.) Turcz. in Bull. Soc. Nat. Mosc. **36**: 607. 1863.

Ilex godajam (Colebr.) Wall. var. *sulcata* (Wall.) Kurz in Jour. As. Soc. Bengal **44**(2): 158. 1875.

Ilex umbellulata var. *megalophylla* Loes. op. cit. **2**: 272. 1908; Chung in Mem. Sci. Soc. China **1**: 141. 1924. *Syn. nov.*

A large evergreen tree up to 18 m. high, with trunk up to 40 cm. in diameter, glabrous branchlets, large entire oblong leaves, axillary subumbelliform inflorescences, globose small fruits with 6–10 3-striate, 1- or 2-sulcate pyrenes.

Branchlets rather crooked, roughened by elevated scars of former flowering shoots; third year's growth 4 mm. thick, cinereous, longitudinally plicate, the lenticels usually small, inconspicuous; current year's growth 2–3 mm. in diameter, brown or castaneous, glabrous. Leaves occurring even on the third year's growth, 5–15 mm. apart; stipules subulate, falcate, acute, 1.25 mm. long; petioles slender, 8–10 mm. long, one-fifteenth to one-ninth as long as the lamina, glabrous, canaliculate above, rugose beneath; lamina chartaceous, membranaceous when young, olivaceous, opaque on both surfaces, oblong, 10–15 mm. long, 5–6.2 mm. wide; base rounded or obtuse; apex obtuse or very shortly and abruptly acuminate, the acumen 5 mm. long, broadly deltoid; margin entire, often undulate, when dry very narrowly recurved; midrib impressed and glabrous above, strongly elevated beneath, the lateral nerves in 9–12 pairs, evident above, prominent beneath, curving upward and anastomosing near the margin, the reticulation of the veinlets obscure. Inflorescences subumbelliform, axillary, at the basal parts of the newly developed branches and often, when the branches fail to develop, appearing paniculate. Staminate inflorescences: individual pseudo-umbels 6–16-flowered, the bracts broad-deltoid, scaly, 1 mm. wide; peduncles 18–30 mm. long, puberulent, the pedicels 3–5 mm. long, puberulent, with deltoid acute basal prophylla; flowers 4- or 5-merous; calyx patelliform, puberulent, 2–3 mm. across, deeply 4- or 5-lobed, the lobes semi-orbicular, 1 mm. long, 1 mm. wide at the base, pubescent and ciliate; corolla rotate, the petals oblong, 2 mm. long, 1.5 mm. wide, one-eighth connate at the base; stamens slightly longer than the petals, the anthers ovoid, 0.75 mm. long; rudimentary ovary pulvinate, 1 mm. in diameter, rostellate, the beak acute, 4- or 5-cleft at the apex. Pistillate flowers not seen. Fruit globose or depressed-globose, 6 mm. in diameter, red, very fleshy, rather smooth or slightly striate-sulcate, the exocarp rather hard, brown, the stigma thickly discoid or cristate. Pyrenes 6–10, trigonous or laterally much compressed, suborbicular in outline, 2.5–4 mm. long, 1.5–2.5 mm. wide on the dorsal surface, 3-striate, 1- or 2-sulcate, the endocarp woody.

CHINA: Yunnan: Szemao, *A. Henry 11926* (A, K), *13486* (TYPE of *Ilex umbellulata* var. *megalophylla,* A; K); Lan-tsang-hsien, *C. W. Wang 73370* (A); Fo-hai, *C. W. Wang 74938* (A); Che-li-hsien, *C. W. Wang 75648* (A), *75956* (A), *75881* (A), *77805* (A), *77815* (A), *77854* (A), *78050* (A), *78765* (A), *79105* (A); Jenn-yeh-hsien, *C. W. Wang 80554* (A).

INDIA: Tenasserim & Andamans: *J. W. Helfer* ex Herb. East India Company no. *1998* (G); Bengal: *J. W. Helfer* in 1836–38 (duplicates of material used by J. D. Hooker for the description of *Ilex sulcata* Wall., A); Chittagong Hill Tracts, *King's Collector* in 1887 (*419*) (A).

Ilex umbellulata was originally described from Silhet and Assam, India, as a glabrous plant with pubescent umbelliform inflorescences. In China it has been collected in mixed forests of southwestern Yunnan at an altitude of 780–1350 m. There its white flowers appear in April. Its red fruits mature in late August or September (ex Wang).

Both of the Helfer specimens are immature, the flowers not fully open. The leaves of these two specimens are membranaceous, as J. D. Hooker described them, but they are not fully grown. The texture and size of the leaves of King's Collector *419* are the same as in *Henry 13486,* holotype of *Ilex umbellulata* var. *megalophylla* Loes., as is the case with the other specimens. I see no reason to maintain the Yunnan form as a large-leaved variety.

SECTION VI. PALTORIA (RUIZ & PAVON) MAXIMOWICZ

Ilex sect. **Paltoria** (Ruiz & Pavon) Maxim. in Mém. Acad. Sci. St. Pétersb. VII, **29** (3): 20, 21. 1881. TYPE SPECIES: *Ilex Paltoria* Pers. = *Paltoria ovalis* Ruiz & Pavon = *Ilex ovalis* (Ruiz & Pavon) Loes.

Paltoria Ruiz & Pavon, Fl. Peruv. Prodr. 2, *pl. 33, fig. 1–9.* 1797, et Fl. Peruv. **1**: 54, *pl. 84, fig. b.* 1798. TYPE SPECIES: *Paltoria ovalis* Ruiz & Pavon.

Ilex subgenus *Euilex* Loes. series *Paltoria* (Ruiz & Pavon) Loes. in Verhandl. Bot. Ver. Brandenb. **33**: 26. 1891, et in Engler & Prantl, Nat. Pflanzenfam. Nachtr. 218. 1897.

Ilex subgenus *Aquifolium* (Gray) Rehd. sect. *Lioprinus* (Loes.) Rehd. Man. Cult. Trees Shrubs 343. 1927, et Bibliog. Cult. Trees Shrubs 401. 1949, pro parte.

Shrubs; low creeping or up to 5 m. high; leaves coriaceous or subcoriaceous, serrate or crenate, rarely subentire or entire, the lower surface glandular-punctate or epunctate; staminate inflorescences fasciculate on the second year's growth or solitary on the current year's growth, the pistillate flowers usually solitary, rarely 3-flowered cymose, axillary on the current year's growth (occasionally fasciculate in *Ilex triflora*); flowers 4-merous, rarely 5- or 6-merous, the petals of the pistillate flower one-fifth connate at the base; fruit 6–9 mm. in diameter, with thin exocarp and mesocarp; pyrenes 4 (rarely 5, or 6 in *Ilex sugeroki*), large, smooth or rarely slightly rugose on the dorsal surface, striate, esulcate, the endocarp coriaceous.

Key to the Series

A. Leaves punctate; pyrenes 4, ca. 4 mm. wide, striate with the striae usually slightly insculpt.....................Series 1. *Stigmatophorae.*

AA. Leaves not punctate; pyrenes 4 or sometimes 5 or 6, 2–3 mm. wide, estriate or (in *Ilex pedunculosa* Miq.) longitudinally unistriate on the back...................................Series 2. *Cassinoides.*

Series 1. STIGMATOPHORAE (Loes.), stat. nov.

Ilex subgen. III *Euilex* Loes. ser. C. *Aquifolium* (Tournef.) Maxim., sect. 3. *Microdontae* Loes. subsect. c. *Stigmatophorae* Loes. in Engler & Prantl, Nat. Pflanzenfam. Nachtr. 220. 1897, et in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. 78: 343 (Monog. Aquif. 1: 343). 1901.

Puberulent shrubs or small trees with coriaceous or subcoriaceous, crenate or serrate, punctate leaves, 1–7-flowered fasciculate, or solitary, cymose, staminate inflorescences, uniflorous fasciculate or solitary pistillate inflorescences, 4-merous (rarely 5–7-merous) flowers, depressed-globose or subglobose black fruits, and 4 large smooth striate coriaceous pyrenes, sometimes slightly ridged on the back.

The characters of various members of this section are rather uniform. The chief differences seem to be in leaf-form and indumentum, which in their case prove very unstable characters for taxonomic work. The section includes two strongly contrasted elements, the northern, *Ilex crenata* Thunb., a low shrub with small obtuse or acute leaves, and the southern, *Ilex triflora* Blume, a shrub or small tree with usually larger, shortly acuminate leaves. Variants intermediate between the two occur in the warm-temperate China and in Taiwan. These might be treated as weak species or as varieties of either element. The distribution of all species of this series is illustrated on the following map.

Key to the Species

A. Fruits solitary, axillary to leaves, rarely to scales on current year's growth; staminate inflorescences 1–7-flowered, when cymose the peduncles (up to 5 mm. long) longer than the pedicels; rudimentary ovaries subglobose.

B. Leaves shiny above, the midribs depressed; flowers 4-merous; calyx 5 mm. across, rounded and entire; stigma of fruit applanate, conspicuous, 2.5 mm. in diameter, rounded; pyrenes subrugose, slightly ridged on the back. (Anhwei to Kwangtung)......29. *I. viridis.*

BB. Leaves usually opaque above, the midribs plane or slightly impressed; flowers 4–7-merous; calyx 3 mm. across, erose or dentate;

stigmas of fruit slightly elevated, small, 1 mm. in diameter, distinctly 4-lobed; pyrenes smooth, striate, the striae slightly impressed.

C. Leaves small, usually 1–3 cm. long, the apex obtuse or acute, never acuminate, lateral nerves 2 or 3 on each side of the midrib; pedicel of fruit 4–5 mm. (rarely longer) long; flowers 4-merous. (Japan, cultivated in North China) .... 30. *I. crenata.*

CC. Leaves 4–7 cm. long, the lateral nerves 6 or 7 on each side of the midrib, the apex shortly acuminate; pedicels of fruit 8–10 mm. long; flowers 4–9-merous. (Central and West China) .. .. 31. *I. szechwanensis.*

AA. Fruits usually fasciculate, axillary to leaves of second year's growth, rarely solitary on undeveloped current year's branchlets; staminate inflorescences 1–3 (rarely more)-flowered, when cymose the pedicels equaling or longer than the peduncles, which are 1–2 mm. long; pyrenes smooth, estriate, esulcate; rudimentary ovary pyramidal. (Java to southeastern Asia) .... 32. *I. triflora.*

As far as our specimens indicate, the northern element, *Ilex crenata* Thunb., does not reach Taiwan or even the Liu Kiu Islands. Yamamoto in 1925 reported *Ilex crenata* Thunb. var. *scoriatum* W. W. Sm. [*scoriarum*] from Taiwan. Koidzumi in 1929 thought that "The formosan plants differs from SMITH'S species in having glabrous petioles, . . . fasciculate female inflorescens, leaves not glandulòso-punctate on the under surfaces." He named this Liu Kiu species *Ilex scoriatulum.* I have not seen his material, but in *Gressitt 608,* which I assume to represent the same plant, the branchlets are puberulous, the leaves obovate, shortly acuminate or acute, 3–4.5 cm. long, 1.5–2.5 cm. wide, the petioles 7–10 mm. long, one-fourth the length of the lamina. The long petioles distinguish it from the rest of the Stigmatophorae. Its punctate leaves and large pomiform-subglobose fruits are like those of *Ilex viridis* Champ. ex Benth. If this is what Koidzumi meant by *Ilex scoriatulum,* then his species is a valid one.

Belonging to this section are three other species occurring beyond the area covered by this work. They are *Ilex thomsonii* Hook. f. (1875) from Himalaya, *Ilex luzonica* Rolfe (1886) from the Philippine Islands, and *Ilex radicans* Nakai (1930) from Japan. Merely on the basis of leaf size and form Loesener in 1901 reduced Hooker's species to a variety of *Ilex crenata* Thunb. and Rolfe's species to a form of the same species. Of *Ilex thomsonii* Hook. f. I have seen three specimens cited by Loesener, *Griffith 2003* from East Bengal (G), *Griffith 520* (G), and *Hooker & Thomson* ex Herb. Ind. Or. no. *9* (G), also a small-leaved form from Sumatra, *Hamel 596* (NY, US), and *Yates 2008* (NY). The leaves of these specimens are 1.5–3 cm. long, and vary from broadly elliptic to ovate and even obovate, and the apices from acute to obtuse or even round. The staminate inflorescences are fasciculate, 1–3-flowered. When cymose, the peduncles are shorter than the pedicels. The fruits are solitary only on the current year's growth. *Hooker & Thomson 9* is intermediate between the Bengal and the Sumatra specimens. Since it shares characters with both the northern and the southern elements in the section and has a different geographic distribution, I consider it better to retain *Ilex thomsonii* Hook. f. as a distinct small-leaved species of the Indo-Malayan region.

Concerning *Ilex luzonica* Rolfe, of which *Eurya myrtilloides* Elm. is a synonym, I have examined the following specimens: *Elmer 7784, 8810, 9105, 11464, 11670,* and *Merrill 1571.* The tuberculate branchlets, the retuse apex of the leaf, the 4–6-merous flowers, and the smooth estriate pyrenes are characters strong enough to warrant retaining it as a distinct species.

Ilex radicans Nakai (1930) is a creeping plant with leaves like those of *Ilex crenata* Thunb., but larger. It occurs in Asia at the northernmost limits not only of the section Stigmatophorae but also for the genus *Ilex,* being known only from Yezo and Sachalin.

29. **Ilex viridis** Champ. ex Benth. in Hook. Jour. Bot. Kew Gard. Miscel. 4: 329. 1852; Walp. Ann. 4: 430. 1857; Benth. Fl. Hongk. 65. 1861; Maxim. in Mém. Acad. Sci. St. Pétersb. VII, **29** (3): 46. 1881; Forbes & Hemsl. in Jour. Linn. Soc. Bot. **23**: 118. 1886; Dunn & Tutcher in Kew. Bull. Add. Ser. **10**: 59. 1912; McClure in Lingnan Sci. Bull. 3: 25. 1931; Belval, Mus. Heud. Not. Bot. Chin. **2**: 22. 1933.

Ilex triflora var. *viridis* (Champ.) Loes. in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. **78**: 345 (Monog. Aquif. **1**: 345). 1901; Rehd. in Jour. Arnold Arb. **8**: 157. 1927; Chien in Contr. Biol. Sci. Soc. China **3**: 58. 1927.

An evergreen shrub or small tree up to 5 m. high with ovate, obovate, or broadly elliptic serrate conspicuously punctate leaves, solitary fruits, conspicuous stigmas 2.5 mm. in diameter, and sublignified pyrenes slightly ridged on the back.

Branchlets subquadrangular; third year's growth 3–5 mm. in diameter, subterete, greenish, strongly ridged, the lenticels oblong, elliptic, forming 2 longitudinal lines between the ridges; second year's growth ridged and angular, the ridges glabrous, the furrows puberulous, the leaf-scars semi-orbicular; current year's growth 2 mm. in diameter, ridged and canaliculate, puberulous in the grooves; terminal buds narrowly conic, acute, glabrous. Leaves occurring also on the second year's growth, 2–8 mm. apart; stipules narrowly deltoid, 1 mm. long; petioles 4–5 mm. long, one-thirteenth to one-sixth the length of the lamina, puberulous or glabrescent, deeply canaliculate above, rugose underneath, narrowly winged by the decurrent leaf-base; lamina thick-coriaceous, green, shiny above, dull and conspicuously punctate beneath, ovate, obovate or elliptic, 2.5–7 cm. long, 1.5–3 cm. wide, the margins slightly recurved, especially toward the base, crenate-serrate, the teeth 10–18 (usually 12–15) on each side, their tips brunnescent; midrib deeply canaliculate, shortly and sparsely puberulous above, elevated and glabrous beneath, the lateral nerves 5–7 pairs, obscure on both surfaces. Staminate inflorescences: 1–5-flowered cymose, solitary, axillary to the scales or lower leaves of the current year's growth or fasciculate on the second year's growth; peduncles 3–5 mm. long, the pedicels 2 mm. long with 1 or 2 basal or submedian subulate prophylla, the uniflorous pedicels 3–6 mm. long, with 1 or 2 medial or supermedial prophylla; flowers 4-merous; calyx patelliform, 2–3 mm. across, glabrous, deeply 4-lobed, the lobes broadly deltoid, erose, eciliate; corolla rotate, ca. 7 mm. across, the petals obovate or orbicular, 2.5 mm. in diameter, one-fourth connate at the base; stamens two-thirds as long as the petals, the anthers oblong, 1.5 mm. long; rudimentary ovary narrowly conic, minute, the apex acute or shortly rostellate. Pistillate inflorescence: solitary, axillary, on current year's growth only; pedicels 12–15 mm. long, glabrous, gradually enlarged toward the distal half, with 2 subulate median prophylla; calyx 4–5 mm. in diameter, glabrous, 4-lobed, the lobes suborbicular; corolla rotate, 7 mm. across, ovate, 2.5 mm. long, one-fourth connate at the base; staminodes one-third as long as the petals, the sterile anthers sagittate; ovary ovoid, 2 mm. long, the stigma discoid, convex. Fruit globose or depressed-globose, black, 8 mm. long, 9 mm. in diameter, the persistent calyx explanate, 5 mm. in diameter, the stigma discoid-mammiform, the exocarp tunicate, the mesocarp very thin. Pyrenes 4, oval in outline, trigonous in cross section, back convex, rugose, striate, the striae slightly elevated, the sides smooth, 4–6 mm. long, 3–5 mm. wide, the endocarp sublignified or thick-coriaceous.

CHINA: Anhwei: Wang-shan, *R. C. Ching 3025* (A, LU). Chekiang: Siachu, *R. C. Ching 1747* (A, US), *1795* (A). Kiangsi: Lung-nan, *S. K. Lau 4711* (A). Fukien: Pu-cheng-kong, *R. C. Ching 2504* (A, NY, US); Ku-liang, *H. H. Chung 6786* (LU); *Tangsiu-ging 6763* (A). Kwangtung: Wung-yuen, *S. K. Lau 794* (A, NY); Sin-fung, *Y. W. Taam 609* (A), *675* (A), *725* (A), *946* (A); Tseng-shing, *W. T. Tsang 20195* (NY), *20411* (A, NY); Tsung-fa, *W. T. Tsang 20601* (NY); Ta-pu, *W. T. Tsang 21256* (A, NY), *21649* (A, NY). Hongkong: *Ford* (fruit, A, NY); *Ford* (pistillate flower, NY).

Ilex viridis Champ. ex Benth. was first described from specimens collected at Hongkong. It grows as a shrub up to 5 m. high. Its white flowers appear in May and its black fruits mature in October.

Loesener placed this species as a variety of *Ilex triflora* Blume. In superficial appearance the leaves and fruits of these two species are alike, but on close examination *Ilex viridis* can readily be distinguished from Blume's species by the inflorescences, fruit, and pyrenes. In *Ilex triflora* the staminate inflorescences are shortly pedunculate, the pistillate flowers are fasciculate, the fruits have small elevated stigmas, and the pyrenes are striate but esulcate. In *Ilex viridis* the staminate inflorescences have peduncles longer than the pedicels, the pistillate flowers are always solitary, the drupes have flat large stigmas, and the pyrenes are slightly rugose.

Professor E. S. Barghoorn of Harvard University has devised a method for microscopic study of the epidermis of both living and fossil plants as a means of identification. At his suggestion, I have examined both the lower and the upper epidermis of the punctate-leaved species of *Ilex*.

The lower epidermis of *Ilex viridis* with its numerous stomata arranged in groups is very different from that of *Ilex triflora* with a few diffused stomata.

30. **Ilex crenata** Thunb. Fl. Jap. 78. 1784; Willd. Sp. Pl. 1 (2): 710. 1797; Pers. Syst. Veg. 174. 1797, et Syn. Pl. 1: 151. 1805; Poir. in Lam. Encycl. Suppl. 3: 66. 1813; Roem. & Schult. Syst. 3: 491. 1818; DC. Prodr. 2: 16. 1825; Spreng. Syst. 1: 495. 1825; Dietr. Syn. Pl. 1: 556. 1839; Sieb. & Zucc. in Abh. Bay. Ak. Wiss. IV, 2: 147. 1845; Regel in Gartenflora 13: 39. 1864; Miq. in Ann. Mus. Bot. Lugd.-Bat. 3: 104 (Prol. Fl. Jap. 268). 1867; Franch. & Sav. Enum. Pl. Jap. 1: 76. 1873; Maxim. in Mém. Acad. Sci. St. Pétersb. VII, 29 (3): 21, 33. 1881; Tanaka & Ono, Useful Pl. Jap. 3: 2, *fig. 668.* 1889; Matsumura, Shokubutsu Mei-i 149. 1895; Ito & Matsum. in Jour. Sci. Col. Univ. Tokyo 12: 367. 1899; Nakagawa in Bot. Mag. (Tokyo) 13: 108. 1899; Loes. in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. 78: 199 (Monog. Aquif. 1: 199). 1901; Dallimore, Holly Yew Box 9, 120. 1908; Rehd. in Mitt. Deutsch. Dendr. Ges. 1908: 160. 1908, et in Bailey Stand. Cycl. Hort. 3: 1640. 1915; Chung in Mem. Sci. Soc. China 1: 140. 1924; Kia, Pl. Sin. Ill. 490, *fig. 828.* 1937; Chen, Ill. Man. Chin. Trees 657, *fig. 548.* 1937; Merr. & Chun in Sunyats. 5: 106. 1940; Makino, Ill. Fl. Nip. ed. 2, 369, *fig. 1106.* 1940; Rehd. Bibliog. Cult. Trees Shrubs 402. 1949.

Ilex elliptica Sieb. ex Miq. in Ann. Mus. Bot. Lugd.-Bat. 3: 104. 1867.
Celastrus adenophylla Miq. op. cit. 2: 85. 1865, 3: 104. 1867.
Ilex crenata Thunb. var. *typica* Loes. forma *genuina* Loes. op. cit. 201. 1901. *Syn. nov.*
Ilex crenata Thunb. var. *typica* Loes. forma *kusnetzoffii* Loes. op. cit. 202. 1901. *Syn. nov.*

A much-branched evergreen shrub up to 5 m. high with puberulous branchlets, small (usually less than 3 cm. long) coriaceous obtuse, rounded or acute, crenate-serrate leaves, 1–7-flowered cymose staminate inflorescences and solitary, (rarely in 3-flowered cymes) pistillate flowers.

Branchlets straight, cinereous, rarely castaneous or nigrescent, the side-shoots sometimes becoming thorn-like; third year's growth 3–4 mm. in diameter, plicate-rugose, minutely rimose, the lenticels sparse, oval or orbicular, the leaf-scars minute, crescent-shaped, elevated; second year's growth 2–3 mm. in diameter, puberulous; current year's growth 1–1.5 mm. in diameter, angular, cinereous or castaneous, densely pubescent, the terminal buds usually poorly developed, broadly conic, the scales loose, puberulous. Leaves occurring even on second year's growth, 3–10 mm. apart; stipules small, 1 mm. long, subulate, persistent; petioles short, 2–3 mm. long, one-eighth to one-sixth the length of the lamina, channeled above, keeled and transversely rugose beneath, pubescent or puberulous; lamina thickly coriaceous, olivaceous-brunneous, shiny and plicate-rugose above, opaque and punctate beneath, obovate, ovate or oblong-elliptic, 1–2.5 cm. (rarely up to 4 cm.) long, 0.5–1.5 (rarely up to 2) cm. wide; base obtuse, acute or cuneate; apex rounded, obtuse, or subacute, mucronulate; margin crenate or serrate, the teeth 6–10 on each side; midribs plane or slightly impressed and puberulous above, prominent, elevated near the base beneath, the lateral nerves 2 or 3 pairs, obscure. Staminate inflorescences: cymose, 1–7-flowered, solitary and axillary to the scales or the lower leaves of the current year's growth or rarely pseudofasciculate on the second year's growth; peduncles 4–9 mm. long, the secondary axis when present 1 mm. long, the pedicels 2–3 mm. long with 1 or 2 sub-basal prophylla, the uniflorous pedicels 4–8 mm. long with 1 or 2 submedian prophylla; flowers 4-merous; calyx 2 mm. in diameter, glabrous, 4-lobed, the lobes broadly deltoid, erose; corolla 4 mm. across, the petals broadly elliptic, 2 mm. long, one-fifth connate at the base; stamens shorter than the petals, the anthers ellipsoid, 0.7 mm. long; rudimentary ovary conical, the apex slightly apiculate. Pistillate inflorescences: flowers solitary, or very rarely 2- or 3-flowered cymose, axillary, on the current year's growth only; pedicels 4–6 mm. long, club-shaped, ridged, with 1 or 2 submedian prophylla; flower 4-merous; calyx 3 mm. in diameter, the lobes rounded; corolla rotate, 6 mm. across, the petals ovate, 3 mm. long, one-third connate at the base; staminodes one-half the length of the petals, the sterile anthers sagittate; the ovary ovoid-conic, 2 mm. long, style sometimes evident, the stigma discoid, 4-lobed. Fruit black, globose, 6–8 mm. in diameter, the persistent calyx 3 mm. in diameter, explanate, the stigma minute, thickly discoid, 1 mm. in diameter, distinctly lobed. Pyrenes 4, oblong-elliptic in outline, 5 mm. long, 3–3.5 mm. wide on the back, smooth, striate, esulcate, the striae slightly impressed, the endocarp coriaceous.

CHINA: Fukien: Yen-ping, *Dunn 2468* (A).

JAPAN: Yezo: *S. Hori* in 1887 (A); *T. Tanaka* in 1929 (A). Hondo: *S. Arimoto* in 1903 (A); *R. K. Beattie & Y. Kurihara 10438* (A); *Horomui* in 1885 (A); *J. G. Jack* in 1905 (A, G); *Maximowicz* in 1861 (G), in 1862 (G); *K. Miyabe* in 1891 (A); *Sargent,* Aug. 1892 (A), Oct. 1892 (A); *Siebold* (A); *Shiwaya* in 1885 (A); *K. Shiota 68* (A); *K. Uno 19111* (A); *Warburg 8067* (A), *8071* (A); *E. H. Wilson 7112* (A), *8195* (A); *Watanabe* in 1889 (G); *C. Wright* in 1853 (G). Shikoku: *E. H. Wilson 7790* (A).

KOREA: *U. Faurie* (A); *E. H. Wilson 9452* (A).

Loesener differentiated his two forms, *genuina* and *kusnetzoffii,* by the shape of their leaves, those of the former being obovate or ovate-elliptic, and of the latter ovate or ovate-elliptic. Among our numerous specimens I find many with both forms of leaves on the same branchlet. Thus there is no reason to separate them.

Ilex crenata Thunb. is a native of Japan, where it is widely distributed. Various cultivated forms occur there, whence they have been introduced into Europe and North America. The plant is hardy in the United States as far north as Boston. It is hoped that the following treatment will clarify the nomenclature of these cultivated forms, which has been badly confused.

Key to the Varieties and Forms

A. Length of the leaves less than 3 times the width; the lamina ovate or obovate.
  B. Leaves on normal twigs ovate, obovate, oblong, elliptic, or even lanceolate, but not suborbicular and not crowded at the tips of the twigs.
    C. Leaves plane on both surfaces, the form and apices variable.
      D. Staminate cymes 1–5-flowered; the peduncles 2–5 mm. long; pedicels of the fruit 4–6 mm. long.
        E. Leaves over 15 mm. long, oblong-elliptic, the apex obtuse or subacute................30a. f. *latifolia.*
        EE. Leaves less than 15 mm. long, ovate or oblong, the apex rounded.
          F. Margin of the leaves serrate, the teeth more than 6 on each side............30b. f. *microphylla.*
          FF. Margin of the leaves subentire or with 2–6 teeth on each side; a greatly dwarfed shrub......... ....30c. f. *helleri.*
      DD. Staminate cymes 1–7-flowered; peduncles 10 mm. long; pedicels of the fruit 10 mm. long..30d. f. *longipedunculata.*
    CC. Leaves convex, oblong, the apex rounded.....30e. f. *convexa.*
  BB. Leaves crowded at the ends of the twigs, suborbicular......... ....30f. var. *mariesii.*
AA. Length of the leaves 3–5 times the width, the lamina narrow-elliptic or lanceolate.
  B. Lamina entirely green.....................30g. var. *longifolia.*
  BB. Lamina variegated.....................30h. f. *luteo-variegata.*

30a. **Ilex crenata** Thunb. forma **latifolia** (Goldr.) Rehd. Bibliog. Cult. Trees Shrubs 402. 1949.

Ilex fortunei hort. ex Miq. in Ann. Mus. Bot. Lugd.-Bat. **3**: 104 (Prol. Fl. Jap. 268). 1865, pro syn., non Lindl. 1857.
Ilex elliptica Siebold ex Miq. l.c., pro syn., non H.B.K., 1825.
Ilex crenata latifolia Goldr. in Garden **31**: 129. 1887.
Ilex crenata var. *major* Nicholson in Kew Hand-list Trees Shrubs **1**: 61. 1894, nom.; Dallimore, Holly Yew Box 121. 1908.
Ilex crenata var. *rotundifolia* Maxim. ex Matsumura, Shokubutsu Mei-i, 149. 1895, nom.; Murakoshi, Ic. Encycl. Bot. **5**: *72, fig. 152.* 1935, descr.

A broad-leaved form with oblong or elliptic mature leaves 2–3 cm. long, 1–1.5 cm. wide, the margin serrate, the apex obtuse or subacute, the staminate cymes 1–3-flowered, the peduncles 3 mm. long, the pedicels 1–2 mm. long, in fruit 6 mm. long.

JAPAN: Yezo: *U. Faurie 6894* (A). Hondo: *U. Faurie 6120* (A); *C. S. Sargent* in Sept. 1892 (A), in Oct. 1892 (A); *S. Tashiro* for *E. H. Wilson* in 1917 (A).

This broad-leaved form is much cultivated in parts of Europe, Great Britain, and the United States.

30b. **Ilex crenata** Thunb. forma **microphylla** Rehd. in Mitt. Deutsch. Dendr. Ges. **1908**: 160. 1908, et Bibliog. Cult. Trees Shrubs 402. 1949.

Ilex crenata var. *microphylla* Maxim. ex Matsumura, Shokubutsu Mei-i, 149. 1895, nom.; Rehd. in Bailey, Stand. Cycl. Hort. **3**: 1640. 1915.

A dwarf shrub, the leaves oblong, ovate or obovate, the margin serrate with 6 or more teeth on each side, 9–17 mm. long, 5–6 mm. wide, the staminate cymes 1–5-flowered, subumbelliform, the peduncles 5 mm. long, the pedicels 1–3 mm. long, in fruit 5–6 mm. long.

JAPAN: *J. G. Jack* in 1905 (A); *Kotobuki Idrikawa 104* (A); *R. Oldham 140* (G, NY).

KOREA: *U. Faurie 713* (A, B); *T. Taquet 624* (A).

30c. **Ilex crenata** Thunb. forma **helleri** Rehd. in Jour. Arnold Arb. **20**: 417. 1939.

Ilex helleri Verkade's Nurseries Cat. **1936**: 13. 1936; Craig, Descr. Price-list, **1937**: 31. 1937.

Ilex crenata helleri Fleming, Flem. Nurseries, **1937**: 17. 1937, nom.; L. Chadwick in Am. Nurseryman **79**(1): 21, *fig.* (*cover*). 1944; Rehd. Bibliog. Cult. Trees Shrubs 402. 1949.

A dwarf shrub of compact and crowded habit, the mature leaves elliptic, 8–11 mm. long, the margin crenate-serrulate with 2–4 teeth on each side.

CULTIVATED: United States: *E. Morell* in 1937 (A).

30d. **Ilex crenata** Thunb. forma **longipedunculata**, f. nov.

Frutex; foliis 2–3 cm. longis, 1–2 cm. latis, oblongis, obovato-ellipticis vel obovatis, apice rotundatis, obtusis vel subacutis; ♂ inflorescentiis cymosis, 1–7-floris, pedunculis 10 mm. longis, pedicellis 2–3 mm. longis; ♀ floribus solitariis, pedicellis 10–12 mm. longis.

A broad-leaved form, with mature leaves 2–3 cm. long, 1–1.5 cm. wide, oblong, obovate-elliptic or obovate, the apex rounded, obtuse or subacute, the staminate cymes 1–7-flowered, the peduncles 10 mm. long, the secondary axis well developed, 1–2 mm. long, the pedicels 2–3 mm. long, in fruit 10–12 mm. long.

CHINA: Shantung: Tsingtao, First Park, *C. Y. Chiao 2584* (TYPE, A; NY, UN, US, SS).

JAPAN: *P. H. Dorsett & W. J. Morse* in 1929 (A); *J. G. Jack* in 1905 (A); *G. Masamune* (NY); *Rikuzen* (G); *Jugiyama Seiichi* in 1931 (A); *K. Sakurai* in 1911 (A); *C. Wright* (G).

30e. **Ilex crenata** Thunb. forma **convexa** (Makino) Rehd. Bibliog. Cult. Trees Shrubs 402. 1949.

Ilex crenata var. *convexa* Makino in Jour. Jap. Bot. **5**: 27. 1928; Terasaki Nipp. Shokubutsu Suppl. 2866. 1938; Makino, Ill. Fl. Nip. ed. 2, 369, *fig. 1107*. 1940.

Ilex crenata f. *bullata* Rehd. in Jour. Arnold Arb. **12**: 73. 1931.

This convex-leaved shrub is cultivated in Japan (fide Makino) and in the United States. I have seen specimens collected in the Arnold Arboretum by Judd and Rehder.

30f. **Ilex crenata** var. **mariesii** Bean in Kew Hand-list Tree Shrubs ed. 2, 89. 1902, nom.; Dallimore, Holly Yew Box 122. 1908, descr.

Ilex mariesii Veitch ex Bean, Trees Shrubs Brit. Isl. **1**: 646. 1914, pro syn.
Ilex nummularia Franch. & Sav. Enum. Pl. Jap. **2**: 311. 1878, non Reissek. 1861.
Ilex crenata var. *nummularia* (Franch. & Sav.) Yatabe in Bot. Mag. (Tokyo) **6**: 157. 1892; Loes. in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. **78**: 202 (Monog. Aquif. **1**: 202). 1901; Murakoshi, Ic. Encycl. Bot. ed. 3, **5**: *72, pl. 14, fig. 151*. 1935; Makino, Ill. Fl. Nip. *369, fig. 1107*. 1940; Rehd. Bibliog. Cult. Trees Shrubs 402. 1949. *Syn. nov.*

A small shrub 1–2 m. high with leaves crowded at the ends of the twigs, the lamina ovate or suborbicular, 3–11 mm. long and wide, subentire or obscurely crenate, the teeth 1–3 on each side.

This form is cultivated in Japan and also at Kew (J. W. Bean!) and at the Arnold Arboretum (Rehder!). I accept the varietal name *mariesii* Bean (1902) as validated by Dallimore (1908) because Yatabe's varietal name *nummularia* was based on an invalid specific name.

30g. **Ilex crenata** Thunb. var. **longifolia** Goldr. in Garden **31**: 129. 1887.

Ilex crenata f. *longifolia* (Goldr.) Rehd. in Mitt. Deutsch. Dendr. Ges. **1908**: 161. 1908, et Bibliog. Cult. Trees Shrubs 402. 1949.

Mature leaves lanceolate or oblong-elliptic, 1–3 cm. long, 4–11 mm. wide, the normal length 4 or more times the width, the apex acute.

JAPAN: *E. H. Wilson 6220* (A); Herb. Sci. College, Imp. Univ. Japan, in 1886 (A); *Sargent* in 1892 (A).

This variety is cultivated in Germany, Great Britain, and the United States.

30h. **Ilex crenata** Thunb. forma **luteo-variegata** (Regel) Rehd. in Mitt. Deutsch Dendr. Ges. **1908**: 161. 1909.

Ilex crenata luteo-variegata Regel in Gartenfl. **13**: 39. 1864.
Ilex crenata var. *aureo-variegata* Goldr. in Garden **31**: 129. 1887.
Ilex crenata var. *variegata* Nichols. in Kew Hand-list Trees Shrubs **1**: 61. 1894, nom.; Rehd. in Mitt. Deutsch. Dendr. Ges. **1908**: 161. 1908; Bean, Trees Shrubs Brit. Isles **1**: 646. 1914; Dallimore, Holly Yew Box 122. 1908.
Ilex fortunei forma *aureo-variegata* hort. ex Schelle in Beissner & al., Handb. Laubh.-Ben. 291. 1903, nom.

A form distinguished chiefly by its yellow or golden variegated leaves.

Cultivated at Kew. I have examined specimens collected by J. W. Bean and G. Nicholson.

31. **Ilex szechwanensis** Loes. in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. **78**: 347 (Monog. Aquif. **1**: 347). 1901, et in Sarg. Pl. Wils. **1**: 80. 1911; S. Y. Hu in Ic. Pl. Omei. 2: *pl. 169*. 1946.

Ilex szechwanensis forma *calva* Loes. ex Diels in Bot. Jahrb. **29**: 436. 1900, nom. nud., et in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. **78**: 348 (Monog. Aquif. **1**: 348). 1901, descr. *Syn. nov.*
Ilex szechwanensis forma *puberula* Loes. l.c. *Syn. nov.*
Ilex crenata Thunb. var. *scoriarum* W. W. Sm. in Notes Bot. Gard. Edinb. **10**: 41. 1917; Anon. in op. cit. **17**: 278, 285, 305. 1930.

Ilex triflora Blume var. *viridis* sensu Comber in Notes Bot. Gard. Edinb. 18: 58. 1933, non Loes.

An evergreen shrub 1–3 m. high with puberulous subquadrangular branchlets, ovate-elliptic, ovate-oblong, or sublanceolate serrate, rarely crenate, punctate leaves, 1–7-flowered staminate cymes, peduncles of cymes longer than the pedicels, solitary pistillate flowers on current year's growth, 4–7-merous flowers, small elevated stigmas, and smooth striate esulcate pyrenes.

Branchlets olivaceous-brunneous, subquadrangular, third year's growth 3–4 mm. in diameter, the lenticels obscure or obsolete, the leaf-scars crescent-shaped, slightly elevated; second year's growth 2.5–3 mm. in diameter, subquadrangular in cross section, under a lens puberulous; current year's growth ridged and canaliculate, 1.5–2 mm. in diameter, minutely puberulous, especially the grooves; terminal buds usually well developed, conic, pubescent. Leaves occurring also on the second year's growth, 3–15 mm. apart; stipules scale-like, ovate-deltoid, acute, 1 mm. long, persistent; petioles 4–6 mm. long, one-tenth the length of the lamina, puberulous, shallowly grooved above, much or slightly winged by the decurrent leaf-base; lamina subcoriaceous or coriaceous, olivaceous, opaque or sometimes slightly shiny above, definitely opaque and punctate, sometimes puberulous especially along the midribs beneath, ovate-elliptic, ovate-oblong or rarely sublanceolate, 3.5–7 cm. long, 2–4 cm. wide, the base obtuse, rarely acute, the apex acuminate, the acumen deltoid, 3–5 mm. long; midrib plane or slightly impressed, puberulous above, elevated and glabrous or puberulous beneath, the lateral nerves 6 or 7 pairs, usually evident or sometimes obscure on both surfaces, the reticulation of the veinlets obscure. Staminate inflorescence: 1–7-flowered, cymose, solitary, axillary to the scales or basal leaves of the current year's growth, rarely fasciculate; peduncles 4–8 mm. long, the pedicels 2–3 mm. long, with 1 or 2 median or supermedian prophylla, the uniflorous pedicels 3–5 mm. long; flowers white, 4–7-merous; the calyx patelliform, glabrous or slightly puberulous, 2–2.5 mm. across, deeply 4–7-lobed, the lobes ovate-deltoid, 1 mm. long, erose or dentate, rarely ciliate; the corolla rotate, the petals 4 or 5-lobed, the lobes ovate, eciliate, one-fourth connate at the base; stamens shorter than the petals, anthers ovate-oblong; staminodes one-half the length of the petals, the sterile anthers sagittate; rudimentary ovary subglobose, the center shortly rostellate, inconspicuously lobed. Pistillate inflorescence: flowers solitary, axillary, on current year's growth only; pedicels 8–10 mm. long, with 2 supermedian prophylla; flowers 4-merous; calyx patelliform, 3 mm. across, shallowly 4-lobed, the lobes rounded, erose; corolla suberect, 4 mm. across, the petals ovate, 2.5 mm. long, one-sixth connate at the base; staminodes very minute, one-fifth the length of the petals, the sterile anthers sagittate; ovary subglobose-ovoid, 1.5 mm. in diameter, the style sometimes evident, the stigma thick-discoid, convex. Fruits globose or depressed-globose, 6 mm. long, 7–8 mm. in diameter, the persistent calyx explanate, 3.5–4 mm. in diameter, the stigma small, 1 mm. in diameter, thickly discoid, distinctly 4-lobed, slightly elevated. Pyrenes 4, oval or suborbicular in outline, trigonous in cross section, 4.5–5 mm. long, 4 mm. wide, smooth, striate, the striae slightly impressed, the endocarp coriaceous.

CHINA: Kwangtung: Loh-chong, *C. L. Tso 21157* (NY). Kwangsi: Tsu-yuen-hsien, *T. S. Tsoong* (*Z. S. Chung*) *83425* (A); Yao-shan, *C. Wang 40222* (A). Hupei (Hupeh): *A. Henry 5808* (ISOTYPES of *Ilex szechwanensis* var. *puberula,* A, US), *6912* (ISOTYPE, G); I-chang, *E. H. Wilson 461* (A, US); Chien-shi, *E. H. Wilson 1333* (NY); Chang-yang, *E. H. Wilson 1333A* (fragment, A); without precise locality, *E. H. Wilson 1964* (A, NY, US). Hunan: Mo-fou-shan, *Y. K. Hsiung 5900* (A). Kweichow: Fan-ching-shan, *Steward, Chiao & Cheo 434* (A, NY), *634* (A, NY, US), *756* (A, NY, US); Kiang-kow, *Y. Tsiang 7528* (NY), *7550* (A); Yin-kiang, *Y. Tsiang 7845* (NY), *7974* (NY). Szechuan: Wu-shan, *A. Henry 5716* (ISOTYPES, G, NY; fragment, A); Chung-king, *S. Y. Hu 5001* (WU); Opien, *T. S. Chao 595* (SS); *C. Y. Yao 4438* (SS), *4576* (SS); Hung-ya, *C. W. Yao 2266* (SS), *3900* (SS); Mt. Omei, *C. Y. Chiao & C. S. Fan 807* (A); *E. H. Wilson 4783* (A); Kwan-hsien, *F. T. Wang 20770* (A). Sikang: Tienchuan, *Y. S. Liu 1322* (A); Zayul, *Kingdon Ward 10978* (B). Yunnan: Meng-tze, *A. Henry 11012* (A, NY), *11303* (A); *G. Forrest 7867* (ISOTYPE of *Ilex crenata* var. *scoriarum,* staminate flower, A), *8113* (ISOTYPE of *Ilex crenata* var. *scoriarum,* pistillate flower, A), *17642* (A), *17755* (A), *27391* (A), *27557* (A); Teng-yueh, *J. F. Rock 7261* (A, US); Ping-pien-hsien, *H. T. Tsai 60062* (A), *60276* (A), *61434* (A), *61660* (A).

Ilex szechwanensis was based on material collected on the Hupei-Szechuan border not very far from where the living *Metasequoia* has been recently discovered. There it grows as a shrub in thickets or on slopes, often near bamboo groves. Its white flowers appear in April and the fruit turns black in October. When Loesener described the species he cited no specimens. However, he enumerated three forms distinguished on the bases of the indumentum and leaf-form. I have before me isotypes of the first two forms, *calva* and *puberula.* With the numerous specimens from the same general area for comparison, I note such gradual variations in the density of the indumentum and in the leaf-form that I see no reason for maintaining Loesener's named forms. As to his forma *angulata,* I have seen no authentically named specimens, but I judge that it might prove to be merely a vigorous growth shoot.

The Yunnan and Kweichow specimens are much more pubescent than the other material; even the leaf-surfaces are puberulous. But the staminate inflorescences are cymose, and the peduncles are decidely longer than the pedicels. These characters, plus the larger size of the leaves and the geographic factors involved, persuade me that it is better placed with *Ilex szechwanensis* than with *Ilex crenata* Thunb.

Ilex szechwanensis is intermediate between *Ilex crenata* Thunb. and *Ilex triflora* Blume. Like the former, it has staminate cymes with the peduncles longer than the pedicels and striate pyrenes with the striae slightly impressed. Like the latter, it has larger and thinner leaves. Its solitary fruits indicate kinship with *Ilex viridis* Champ. ex Benth., but the latter has shiny leaves, impressed midribs, 4-merous flowers, plane and broad (2.5 mm.) stigmas and rugose pyrenes. Because of the widely separated geographic areas concerned, hybrid origin seems to be scarcely possible.

32. **Ilex triflora** Blume Bijdr. 1150. 1826; Dietr. Syn. Pl. **1**: 555. 1839; Miq. Fl. Ind. Bot. 1 (2): 594. 1859; Loes. in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. **78**: 344 (Monog. Aquif. 1: 344). 1901; Val. in Med. Dep. Landb. **18**: 25 (Koord. & Val. Bijdr. Booms. Java 13). 1914; Groff in Lingnan Sci. Bull. **2**: 64. 1930; Pitard in Lecomte, Fl. Gén. Indo-Chine **1**: 852. 1912; Tardieu-Blot in Fl. Gén. Indo-Chine Suppl. **1**: 719. 1948.

Ilex horsfieldii Miq. Fl. Ind. Bat. **1**(2): 594. 1895; Maxim. in Mém. Acad. Sci. St. Pétersb. VII, **29**(3): 21. 1881.
Ilex triflora Blume var. *horsfieldii* (Miq.) Loes. op. cit. 347. 1901; Valeton in Med. Dep. Landb. **18**: *27* (Koord. & Val. Bijdr. Booms. Java 13). 1914; Koord. & Val. Atlas Baum. Java *fig. 790, F-H*. 1918. *Syn. nov.*
Ilex triflora Blume var. *javensis* Loes. l.c.; Valeton op. cit. 25. 1914; Koord. & Val. op. cit. *fig. 790, A-E*. 1918. *Syn. nov.*
Ilex lobbiana Rolfe in Jour. Linn. Soc. Bot. **21**: 309. 1884.
Ilex triflora Blume var. *lobbiana* (Rolfe) Loes. op. cit. 346. 1901; Hand.-Mzt. Symb. Sin. **7**: 658. 1933. *Syn. nov.*
Ilex griffithii Hook. f. Fl. Br. Ind. **1**: 601. 1875.
Ilex triflora var. *kurziana* Loes. op. cit. 346. 1901. *Syn. nov.*
Ilex theicarpa Hand.-Maz. in Sinensia **3**: 188. 1933. *Syn. nov.*
Ilex fleuryana Tardieu in Not. Syst. XII, **15**: 119. 1945. *Syn. nov.*

An evergreen shrub or small tree with pubescent branchlets, oblong-elliptic or rarely ovate-elliptic or ovate minutely serrate leaves with punctate lower surfaces, fasciculate inflorescences, pubescent and ciliate calyx, globose or ellipsoid fruits and 4 smooth estriate, esulcate pyrenes.

Branchlets zigzag, ridged, subquadrangular in cross-section, rarely subterete; third year's growth 2 mm. in diameter, puberulous, plicate-rugose, the lenticels lacking, the leaf-scars subsemi-orbicular, slightly elevated; the second and current years' growth 1–1.5 mm. in diameter, ridged and canaliculate, pubescent; terminal buds poorly or not at all developed. Leaves even found on third year's growth, 2–12 mm. apart; stipules deltoid, acute, 1 mm. long, persistent; petioles 4 mm. long, about one-tenth the length of the lamina; lamina subcoriaceous, brunneous-olivaceous, opaque on both surfaces, puberulous or glabrescent at maturity, punctate beneath, elliptic, oblong or ovate-elliptic, rarely ovate or lanceolate, 3–9 cm. long, 1.5–4 (usually 2.5) cm. wide; base rounded or obtuse; apex acute or very shortly acuminate, the acumen 3–5 mm. long, very rarely obtuse; margin serrate, subundulate; midrib impressed and pubescent above, elevated and puberulent underneath, the lateral nerves 7–11 pairs obscure above, the reticulation of the veinlets obscure. Inflorescences fasciculate with abortive or rarely active terminal buds, axillary, distinctly pubescent all over; flowers 4-merous. Staminate inflorescences: individual branches of the fascicles 1–3-flowered, the peduncles of the 3-flowered cymes 2 mm. long, the pedicels 2–3 mm. long, the prophylla 1 or 2, basal or submedian; the calyx patelliform, 3 mm. across, pubescent and sparsely ciliate; corolla rotate, 5 mm. across, the petals broadly ovate, one-fourth connate at the base; stamens slightly shorter than the petals, the anthers elliptic; rudimentary ovary pyramidal, the apex shortly rostellate, cleft. Pistillate inflorescences: individual branches of the fascicles uniflorous, the pedicels 6–14, rarely up to 18 mm. long with 2 median or submedian prophylla; calyx as in the staminate flowers; corolla suberect, the petals ovate; staminodes one-third the length of the petals, the sterile anthers cordiform; ovary ovoid, 1.5 mm. in diameter, the stigma thickly discoid, inconspicuously lobed. Fruit globose or ellipsoid, 7–8 mm. long, 7 mm. in diameter, the persistent calyx explanate, 4 mm. across, sparsely ciliate, the stigma discoid, 4-lobed. Pyrenes 4, oval-elliptic in outline, 6 mm. long, 4 mm. wide, smooth, striate, the striae slightly impressed, the endocarp coriaceous.

CHINA: Kiangsi: Hong-san, *J. L. Gressitt 1545* (A); Yu-du-hsien, *H. H. Hu 1177* (A); Kien-nan, *S. K. Lau 3947* (A, US), *4474* (A, US). Kweichow: Cheng-feng, *Y. Tsiang 4527* (NY); Tung-tze, *Y. Tsiang 4997* (NY); Tuh-shan, *Y. Tsiang 6645* (NY), *7031* (NY), *7073* (NY). Fukien: C. Fukien, *Dunn* (Herb. Hongk. no. *2467*) (A); Hing-hwa, *H. H. Chung 925* (A); Min-how-hsien, *H. H. Chung 2190* (A); Ku-tien, *H. H. Chung 4054* (A); Ku-liang, *H. H. Chung 6444* (A, LU), *6786* (LU), *6878* (A); Ku-dien, *H. H. Chung 7944* (A, LU); Hok-chiang, *Tang Siu-ging 15052* (LU), *15143* (LU), *15176* (LU). Kwangtung: Canton, *C. O. Levine* (CCC) *1477* (A, G); Lung-t'un Mt., *To, Tsang & Tsang* (CCC) *12315* (US); Wu-tung, *W. Y. Chun 5772* (A); Pan-ling-tsze, *W. Y. Chun 5909* (A, US); Nan-hao, *W. Y. Chun 7752* (A); Wung-yuen, *S. K. Lau 2145* (A), *2791* (A); Loh-fau Mt., *E. D. Merrill 10930* (A); *Y. Tsiang 1665* (A); Yao-shan, *S. S. Sun 9968* (NY); Sin-fung, *Y. W. Taam 213* (A), *336* (A), *705* (A), *853* (A); *W. T. Tsang 900A* (A); Ta-pu, *W. T. Tsang 21022* (A, NY), *21187* (A, NY); Lung-men, *W. T. Tsang 25318* (A), *25337* (A); Pok-lo, *T. M. Tsui 80* (NY); Ying-tak, *T. M. Tsui 407* (A, NY, US); Yang-shan, *T. M. Tsui 780* (NY, US); Sun-wui, *Tso & Tsiang 2043* (A, NY). Hongkong: *C. Ford* (US); *C. Wright* (US, G). Lantao Island: *W. T. Tsang* (Herb. Lingnan no. *16584*) (A, LU, US). Hainan: Dung-ka, *N. K. Chun & C. L. Tso 43846* (A, NY); Ling-shiu, *H. Fung 20212* (NY, US); Po-ting, *F. C. How 73163* (A); *S. K. Lau 28047* (A); Yai-chow, *H. Y. Liang 62081* (A), *62526* (A, NY). Kwangsi: W. Po-seh, *R. C. Ching 7520* (ISOTYPE of *Ilex theicarpa*, NY; photo & fragment, A); Lu-chen, *R. C. Ching 5793* (LU), *5899* (LU), *7058* (LU); Seh-feng-dar-shan, *R. C. Ching 7805* (NY); S. Nan-ning, *R. C. Ching 8210* (A, NY, US); Lin-yuin-hsien, *A. N. Steward & H. G. Cheo 557* (A, NY); Shang-sze, *W. T. Tsang 22071* (A), *22131* (A), *22377* (A); Wai-tsap, *W. T. Tsang 22719* (A), *23235* (A), *24548* (NY); Hang-on-yúen, *T. S. Tsoong (Z. S. Chung) 81732* (A); Yao-shan, *C. Wang 39163* (A), *40592* (A). Yunnan: Sze-mao, *A. Henry 12018* (A), *12018A* (A, US), *12018B* (A, US), *12018C* (A, US), *12018D* (A); without precise locality, *E. E. Maire 3874* (photo and fragment, A); Shang-pa-hsien, *H. T. Tsai 54396* (A); Ta-li, *C. W. Wang 71723* (A); Fo-hai, *C. W. Wang 73508* (A), *73521* (A), *73715* (A), *73844* (A), *75058* (A), *80178A* (A).

INDO-CHINA: Tonkin: *Fleury 32126* (TYPE of *Ilex fleuryana*, fragment, A); *A. Pételot 5557* (A), *5756* (A), *5868* (A), *6278* (A); *W. T. Tsang 27008* (A), *27069* (A), *27379* (A), *27488* (A), *29800* (A), *29043* (A), *29153* (A), *29329* (A), *30659* (A).

INDIA: Assam: *Jenkins* (ISOTYPE of *Ilex griffithii*, G); *Prain's Collector 876* (A); Reporter Econ. Prod. Government India *11256* (A). East Bengal: *Griffith 2001* (ISOTYPE of *Ilex griffithii*, A).

MALAY PENINSULA: *M. R. Henderson 7349* (NY); *R. E. Holttum* (A); *Griffith* (ISOTYPE of *Ilex griffithii*, G).

SUMATRA: *Rahmat Si Bolla 852* (A).

JAVA: *Blume* (A), *Blume* from Mt. Salak (A, probably a duplicate of the type); *H. O. Forbes 1000A* (A, G), *2901* (fragment, A, G); *Koorders 9917* (fragment, A); *Zollinger* (A).

BORNEO: *H. Hallier 2471* (fragment, A), *2483* (fragment, A); Sarawak, *Richards 1963* (A).

The Lobb specimen at Kew labeled as from Luzon did not come from the Philippines. The Lobb specimens were mislabeled, duplicates of the same collection distributed as from Java, Borneo, the Malay Peninsula and Luzon. This specimen is the basis of *Ilex lobbiana* Rolfe, which, because of its supposed geographic occurrence, Loesener placed as a variety of the Javan *Ilex triflora* Blume. The specimen undoubtedly was from Java, though there is a bare possibility that it may have come from the Malay Peninsula or Borneo. See Merrill, E. D. Philipp. Jour. Sci. 10 (C): 190. 1915.

With all the specimens cited above, I cannot find any key character to separate the material collected from various geographic areas. I conclude, therefore, that *Ilex triflora* is a variable species. The species was first described from material collected in Java. The few Javan specimens available exhibit as great variation in indumentum, shape and size of the leaves, and length of the fruit pedicels as do the specimens from the several other geographic areas involved.

Loesener referred *Forbes 1000A* and *2901* from Java, as well as Horsfield's specimen, to *Ilex triflora* var. *horsfieldii*. I have compared the duplicates of these two numbers with authentic specimens of *Ilex triflora* and found no differences between them except that Forbes' specimens have longer pedicels (10–18 mm.) than those of Blume's which are in a flowering stage.

Loesener referred to *Ilex triflora* var. *lobbiana* not only the original Lobb material from "Luzon (?)" (which did not come from that island), but also a Griffith specimen from Malacca, a Teysmann specimen from Borneo and a Warburg specimen from Fuchow, China. I have seen duplicates of several of these. They are all similar to Blume's specimens in indumentum, color and texture of the leaves and fruits, and I see no reason for recognizing even a variety here, much less a species.

Ilex griffithii Hook. f. was based on a Jenkins specimen from Assam and Griffith specimens from Malacca and Assam. Griffith's Malaccan specimen is normal *Ilex triflora*. Jenkins' Assam specimen has rather large glabrescent oblong-elliptic leaves, more numerous lateral nerves, and fasciculate inflorescences. It agrees with specimens cited from Yunnan and Indo-China.

When Handel-Mazzetti described *Ilex theicarpa* he overlooked the glands on the lower surfaces of the leaves. He says: "Proximae, quamvis

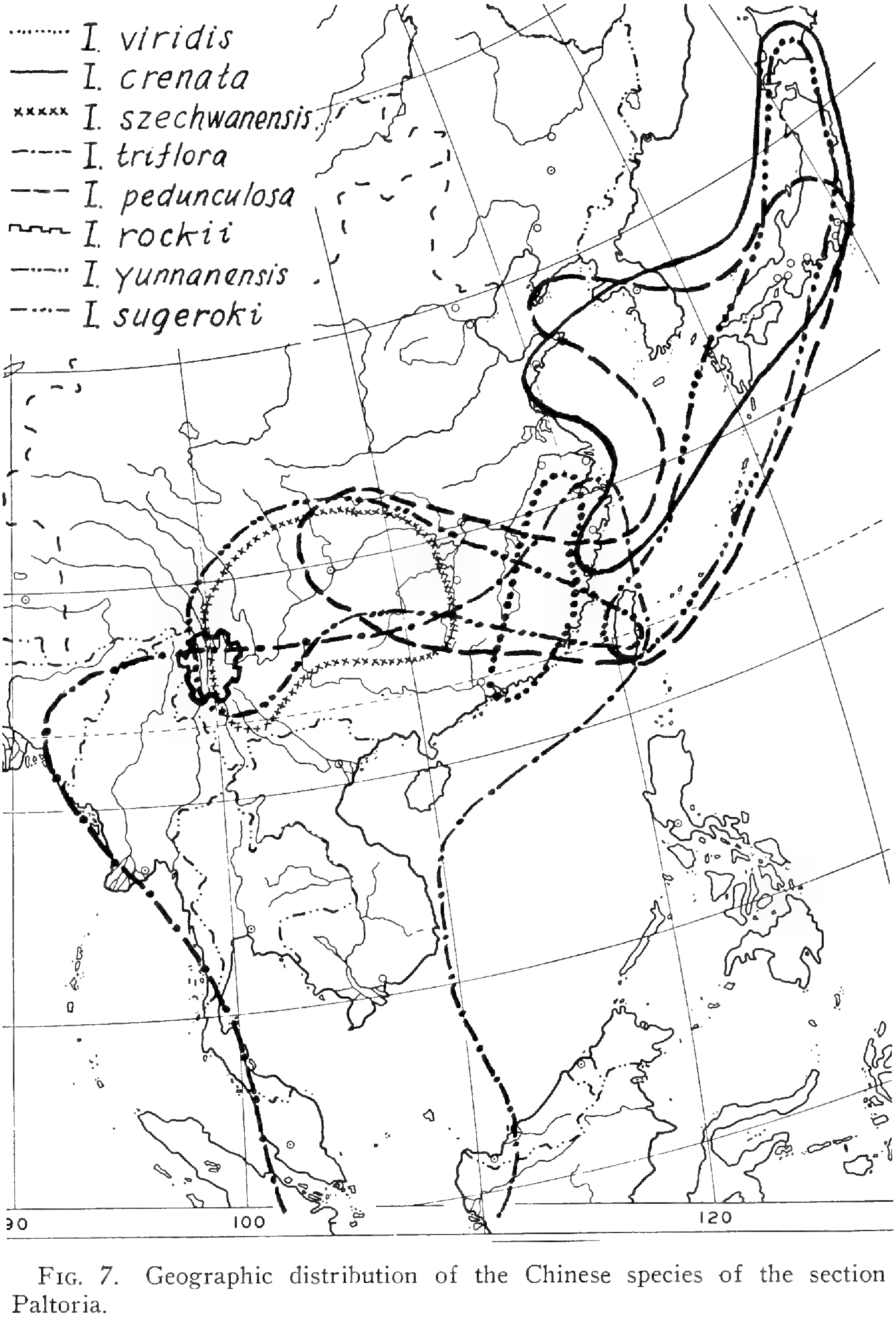

FIG. 7. Geographic distribution of the Chinese species of the section Paltoria.

folia epunctata, videntur *I. triflora* Bl. et *I. szechwanensis* Loes." Examination of an isotype shows that the leaves are distinctly glandular, but that the glands are obscured by the indumentum.

Fleury 32126 (HOLOTYPE for *Ilex fleuryana* Tardieu) is a normal staminate branch of *Ilex triflora*. Its pyramidal rudimentary ovary is very characteristic of the species.

Ilex triflora is manifestly closely related to *Ilex crenata* Thunb., which differs in having smaller and fewer-nerved leaves, solitary fruits, and peduncles of the staminate cymes longer than the pedicels; yet Loesener placed the former species in [Sect.] Aquifolium and the latter in [Sect.] Paltoria.

In an attempt to find tangible differences I have studied intensively all of the specimens cited. I have made use of high magnification, and have examined the plants not once, but several times. I have tried to distinguish entities according to the density of the indumentum, the pattern of the inflorescences, the length of the pedicels, the form and size of the stigmas, the characters of the calyces, the form of the rudimentary ovaries, and the size and pattern of the pyrenes. In none of these could I find a constant character strong enough to warrant their separation. An attempt to distinguish them on the basis of their geographical location was no more successful. Specimens from widely separated areas, such as Hainan (*Lau 28047*), Kwangsi (*Ching 7879* and *8210*), Yunnan (*Henry 12018C* and *12018D* and *Wang 80178A*), and Indo-China (*Tsang 29800*) all impress me as being exactly like the Javan specimens. It is not logical to take certain plans and name them *Ilex triflora* Blume, and at the same time to put their next-door neighbors into another species, when morphologically there is no ground for doing so. My study led me to believe that what I had was a somewhat variable collective species whose center of origin was the region about the China-Indo-China border, where it flourishes, and that from there it had spread southward through the Malay Peninsula to Sumatra, Borneo, and Java, westward to Assam and Bengal, and northward and eastward into China.

In certain parts of China and in Taiwan forms which appear to be intermediate between *Ilex triflora* Blume and *Ilex crenata* Thunb. occur. These might be interpreted as weak species or as varieties of either of the two species. A good illustration of this is *Ilex crenata* Thunb. var. *scoriarum* W. W. Sm. Its staminate inflorescences are essentially those of *Ilex crenata,* and the leaves are those of *Ilex triflora* in form and size. Smith placed the variety under the former species, while Comber interpreted it as the latter. The form discussed immediately below falls in this same intermediate category.

32a. **Ilex triflora** Blume var. **kanehirai** (Yamamoto), comb. nov.

Ilex crenata Thunb. var. *kanehirai* Yamamoto, Suppl. Ic. Pl. Formos. **1:** 31, *fig. 11.* 1925.

Ilex kanehirai (Yamamoto) Koidz. in Bot. Mag. (Tokyo) **43:** 389. 1929; Kanehira, Formos. Trees 375. 1936.

Ilex kanehirai var. *glabra* Kanehira l.c. *fig. 330.* 1936.

An evergreen shrub with puberulous branchlets; leaves coriaceous or subcoriaceous, oblong, obovate or oblong-elliptic, the apex rounded, obtuse or rarely acute, never acuminate; inflorescences fasciculate, the staminate fascicles composed of 1–3-flowered cymes, the pedicels 2–4 mm. long, peduncles of 3-flowered cymes 1–2 mm. long, shorter than the pedicels; infructescences fasciculate, fruits globose, 5–6 mm. in diameter, the persistent calyx explanate, 3 mm. across, ciliate; stigma small, elevated, distinctly 4-lobed.

CHINA: Fukien: near the Chekiang border, *R. C. Ching 2225* (B, LU, US). Kwangtung: Loh-fau-shan, *C. O. Levine* (CCC) *1597* (US); *F. P. Metcalf 17507* (LU). Taiwan: *R. Kanehira* (photo of type of *Ilex crenata* var. *kanehirai*, TU); *E. H. Wilson 10150* (A). Hainan: Five Finger Mt., *F. A. McClure* (CCC) *9394* (A).

Ilex triflora var. ***kanehirai*** is intermediate between *Ilex triflora* and *Ilex crenata* Thunb. It resembles the former in having fasciculate infructescences on the second year's growth and peduncles of the staminate cymes shorter than the pedicels. It resembles the latter only in its oblong-obovate leaves rounded or obtuse at the apex. Since *Ilex crenata* is characterized by solitary fruits found only on the current year's growth, it seems preferable to place this as a variety of *Ilex triflora.*

Series 2. CASSINOIDES (Loes.), comb. nov.

Ilex subgen. ***Euilex,*** ser. A. *Lioprinus,* sect. 2. *Cassinoides* Loes. in Engler & Prantl, Nat. Pflanzenfam. Nachtr, 218. 1897, et in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. 78: 131 (Monog. Aquif. 1: 131). 1901.

Branchlets puberulous; leaves coriaceous or subcoriaceous, serrate or subentire, rarely entire; inflorescences solitary, axillary, on current year's growth only, staminate ones cymose, 3–9-flowered, pistillate ones usually uniflorous, rarely 3-flowered, the pedicels of the fruit 1–5.5 cm. long, rarely shorter; flowers 4–6-merous; calyx usually ciliate, the petals well united, the stamens shorter than the petals, the rudimentary ovary globose; fruit red, globose; pyrenes 4–6, smooth, neither striate nor sulcate, the endocarp thickly coriaceous or sublignescent.

Key to the Species

A. Leaves 5–8 cm. long, usually entire, sometimes serrate, the midribs plane or slightly impressed; leaf-apices acuminate; pedicels of the fruit 25–55 mm. long. (Central China and Japan) ....33. *I. pedunculosa.*

AA. Leaves less than 4 cm. long, serrate or rarely subentire, the midrib elevated and pubescent above; leaf-apices acute, obtuse or rounded; pedicels of the fruit 6–15 mm. long.

B. Leaves ovate-oblong, 15–30 mm. long, 12–18 mm. wide; petioles 8–9 mm. long, one-fourth to one-third the length of the lamina; flowers 4- or 5-merous. (Taiwan) ....33a. *I. pedunculosa* var. *taiwanensis.*

BB. Leaves ovate, ovate-lanceolate or elliptic; petioles 2–5 mm. long, one-fourteenth to one-fifth the length of the lamina.
C. Fruiting pedicels less than 4 mm. long; leaves obovate or oblong; the apex rounded. (Alpine Yunnan) . . . . . 34. *I. rockii.*
CC. Fruiting pedicels 10–15 mm. long (6 mm. long in a variety of *I. yunnanensis*); leaves ovate or ovate-elliptic, rarely lanceolate.
D. Pyrenes 4; branchlets thickly ferruginous-pubescent; leaves aristate-serrate nearly to the base (except in one variety). (Western and Central China and Taiwan) . . . . 35. *I. yunnanensis.*
DD. Pyrenes 4–6; branchlets puberulous; leaves serrate or crenate, the lower half entire. (Japan and Taiwan) . . . . 36. *I. sugeroki.*

33. **Ilex pedunculosa** Miq. in Versl. Med. Kon. Akad. Wet. II, **2**: 83. 1868 [1866] (Repr. 19. 1866), et in Ann. Mus. Bot. Lugd.-Bat. **3**: 106. 1867; Franch. & Sav. Enum. Pl. Jap. **1**: 77. 1873; Maxim. in Mém. Acad. Sci. St. Pétersb. VII, **29** (3): 25, 37. 1881; Loes. ex Diels in Bot. Jahrb. **29**: 435. 1900, et Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. 78: 108 (Monog. Aquif. 1: 108). 1901; Kia, Pl. Sin. Ill. 492, *fig. 832.* 1937; Makino, Ill. Fl. Nip. 367, *fig. 1100.* 1940.

Ilex pedunculosa f. *genuina* Loes. op. cit. 110; Chien in Contr. Biol. Sci. Soc. China **3**: 58. 1927; Hand.-Mzt. Symb. Sin. **7**: 655. 1933. *Syn. nov.*

Ilex pedunculosa f. *continentalis* Loes. ex Diels in Bot. Jahrb. **29**: 435. 1900, nom. nud., et in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. **78**: 110 (Monog. Aquif. **1**: 110). 1901, descr., et in Sarg. Pl. Wils. **1**: 76. 1913; Chien in Contr. Biol. Sci. Soc. China **3**: 58. 1927; Rehd. in Jour. Arnold Arb. **7**: 156. 1927, **14**: 240. 1933; Masamune Fl. Kainant. [Hainan] 174. 1943. *Syn. nov.*

Ilex purpurea Hassk. var. *leveilleana* Loes. in Léveillé, Fl. Kouy-Tchéou 201. 1914.

Ilex morii Yamamoto, Suppl. Ic. Pl. Form. **1**: 38, *fig. 18.* 1925.

Ilex impressivena Yamamoto, Suppl. Ic. Pl. Form. **1**: 34, *fig. 15.* 1925; Kanehira, Form. Trees 373, *fig. 329.* 1936. *Syn. nov.*

An evergreen shrub up to 5 m. high with ovate subentire acuminate leaves, long slender fruit-stalks, and smooth esulcate and estriate pyrenes.

Branchlets straight, subterete; second year's growth 4–5 mm. thick, plicate-striate, the bark cinereous, the lenticels minute, circular, inconspicuous, the leaf-scars semi-orbicular; current year's growth 2–3 mm. in diameter, angular, brunneous-nigrescent, minutely puberulent especially below the nodes. Leaves occurring even on the third year's growth, 3–5 mm. apart; stipules deltoid, falcate-acute, 1 mm. long, persistent; petioles slender, 12–17 mm. long, one-fifth to one-third the length of the lamina, minutely puberulent, narrowly and deeply canaliculate above, plicate-rugose beneath; lamina thinly coriaceous, castaneous-nigrescent above, brunneous beneath, ovate to oblong-elliptic, 5–8 cm. long, 2–3 cm. wide; base rounded, rarely obtuse; apex acuminate, the acumen 5–10 mm. long;

margin entire, plane, slightly revolute near the base, often obscurely serrate near the apex; midrib slightly impressed above, puberulent or rarely glabrous, the lateral nerves very obscure on both surfaces. Inflorescences cymose, solitary, axillary, only on current year's growth, minutely puberulent; flowers 4- or 5-merous. Staminate inflorescences: cymes 3–9-flowered; peduncles 25 mm. long, the secondary axes sometimes 3 mm. long, the pedicels 2–4 mm. long, the bracteoles 1–1.5 mm. long, lanceolate, puberulent especially on the adaxial surfaces; calyx 1.5 mm. in diameter, patelliform, 4- or 5-lobed, the lobes deltoid, very acute, glabrous, sometimes sparsely ciliate; corolla rotate, 3 mm. across, the petals 1.8 mm. long, ovate, one-eighth connate at the base; stamens shorter than the petals, the anthers ovoid; rudimentary ovary subglobose, 0.5 mm. in diameter. Pistillate inflorescences: flowers solitary, very rarely 3-flowered cymose, the pedicels 4–4.5 cm. long, very slender, with 2 subulate supermedian prophylla 1 mm. long; calyx 3 mm. in diameter, 4- or 5-lobed, the lobes ciliate; corolla 5 mm. across, the petals 2 mm. long, ovate; staminodes shorter than the petals, the sterile anthers ovate; ovary broad-conic, 2 mm. in diameter, the stigma mammiform. Fruit globose, 7–8 mm. in diameter, red, when dry reddish brown, smooth, the stigma prominent, subpyramidal. Pyrenes 5 (4 ex Miquel, often 5 or 6 ex Loesener), elliptic in outline, trigonous in cross-section, 6 mm. long, 2.5 mm. wide, smooth, unistriate along the dorsal median line; the endocarp coriaceous.

CHINA: Launing: Dairen, Man-shu No-san Sho-kai Inc. (A); *C. Wilford* (G). Anhwei: *S. Chen 2630* (A); Chien-shen-hsien, *C. S. Fan & Y. Y. Li 187* (A); Wang-shan, *W. C. Chong 4131* (US); *R. C. Ching 3017* (A, LU), *A. N. Steward 7158* (A, US); Chu-hwa-shan, *R. C. Ching 2816* (A); *S. C. Sun 1467*. Chekiang: Tien-mo-shan, *R. C. Ching 5189* (A). Kiangsi: Lu-shan, *A. N. Steward 2643* (A); *E. H. Wilson 1609* (A). Hupei (Hupeh): *A. Henry 1702* (ISOTYPES of *Ilex pedunculosa* var. *continentalis*, A, NY), *4913* (NY), *5168* (G), *5910* (G), *6614* (ISOTYPE of var. *continentalis*, G, US); *E. H. Wilson 477* (A, US), *1305* (A), *1325* (A, NY, US), *1976* (A), *1976A* (NY), *2257* (A, K, NY, US), *2698* (A, K, NY, US), *3095* (A, US), *2699* (K, NY), *2700* (K, NY), *2700B* (K). Hunan: Mo-fou-shan, *Y. K. Hsiung 5898* (A). Szechuan: Kiang-yu-hsien, *F. T. Wang 22271* (A). Kweichow: Pin-fa, *J. Cavalerie 1066* (TYPE of *Ilex purpurea* var. *leveilleana*, fragment and photo, A); Yin-kiang, *Y. Tsiang 7976* (NY). Kwangsi: San-chiang-hsien, *Steward & Cheo 982* (A, NY). Taiwan: *R. Kanehira 21177* (A); *T. Suzuki 11728* (TU).

JAPAN: *K. Beattie & Y. Kurihara 10149* (A); *Buerger* (ISOTYPE, G); Sci. Col. Imp. Univ. Jap. (A); *U. Faurie 6895* (A); *J. G. Jack* in 1905 (A, G); *H. Mayer* in 1886 (A), *Maximowicz* in 1863 (G, NY); *Siebold* (A); *K. Shiota* (A); *C. S. Sargent* (A); *K. Uno* (A); *E. H. Wilson 6024* (A), *6235* (A), *7479* (A), *7756* (A).

This species was first described on the basis of Japanese specimens, collected by Buerger, as a glabrous, entire-leaved, long-pedunculate and tetramerous species. A duplicate of the type collection is in the Gray Herbarium. The branchlets, petioles, and peduncles are shortly puberulent. Additional material from Japan shows that even the calyx-lobes are sparsely ciliate (*Maximowicz,* in 1863). Similar specimens have been collected from many provinces in China.

This species occurs in cultivation in England and in the United States.

When Loesener differentiated two forms of *Ilex pedunculosa* he distinguished the continental from the Japanese form by the size of the leaves and the ciliate calyx. For f. *genuina* he says, "foliis tantum usque 9 cm. longis," and for f. *continentalis,* "foliis longioribus usque 12 cm. longis." With numerous Chinese specimens before me, including isotypes of f. *continentalis,* I find no leaves longer than 9 cm. The presence or absence of cilia and their density when present vary similarly in both Chinese and Japanese specimens. I see no reason for distinguishing two forms here.

33a. **Ilex pedunculosa** var. **taiwanensis,** var. nov.

Frutex; foliis subcoriaceis, integerrimis, suborbiculo-oblongis, 1.5–3 cm. longis, 1–1.6 cm. latis, basi rotundatis, apice acutis; costa supra plana et pubescente, nervis lateralibus utrinque 6 vel 7, subtus evidentibus; petiolis 7–9 mm. longis, quam laminis ¼–½ brevioribus; floribus femineis solitariis, axillaribus; pedicellis 11–14 mm. longis, floribus 4-meris vel raro calycibus 5-meris; corolla rotata, 6 mm. diametro; ovario ovoideo; stigmate discoideo, stylo evidente.

CHINA: Taiwan: Tai-ho-ku-syû, *T. Suzuki 18333* (TYPE, TU).

This variety is very closely related to *Ilex sugeroki* var. *brevipedunculata,* but the latter has plane pedicels 3–7 mm. long which are one-tenth to one-seventh the length of the lamina. Because of the proportionally long and canaliculate petioles, I think it is preferable to place this plant as a small-leaved variety of *Ilex pedunculosa.*

34. **Ilex rockii,** sp. nov.

Ilex intricata sensu Hand.-Mzt. Symb. Sin. **7**: 658. 1933, pro parte; non Hook. f.

Frutex; ramulis pubescentibus; foliis obovato-oblongis, 1–2.5 cm. longis, 6–14 mm. latis, basi cuneatis, apice rotundatis obtusis vel raro subacutis, margine crenulato-serratis; costa supra elevata, pubescente, subtus obscura, glabra, nervis lateralibus utrinque 2–4, obscuris; inflorescentiis solitariis, raro subfasciculatis; pedicellis 2–4 mm. longis; floribus rubris, 5-meris, raro 4- vel 6-meris; calycibus patelliformibus, 3–4 mm. diametro, glabris, ciliatis; corolla rotata, 7 mm. diametro; petalis basi connatis, lobis 3 mm. longis; staminibus 5; staminodiis quam petalis brevioribus; ovario conico-ovoideo; stigmate capitato; fructibus globosis, 5–7 mm. diametro; stylo evidente; pyrenis 5, 5 mm. longis, 3 mm. latis, laevibus, estriatis et esulcatis; endocarpio coriaceo.

A small shrub 1–2 m. high with distinctly pubescent branchlets, obovate-oblong serrate leaves, cuneate at the base, rounded, obtuse or rarely subacute at the apex, solitary pistillate flowers at the base of the current year's growth, and very short pedicels.

Branchlets stout, when dry castaneous or smoky; fourth year's growth

4 mm. in diameter, longitudinally rimulose, the lenticels lacking; third year's growth 2–3 mm. in diameter, smooth, densely puberulous; second year's growth tomentose, plicate-rugose, 1.5–2 mm. in diameter; current year's growth 1–1.5 mm. in diameter, castaneous, hirsute. Leaves occurring even on the fourth year's growth, 2–5 mm. apart; stipules minute, callose, deltoid, often persistent; petioles flattened, 2 mm. long, one-tenth to one-fifth the length of the lamina, plane above, pilose; lamina coriaceous, olivaceous-brunneous, shiny above, paler beneath, epunctate, obovate-oblong, 10–25 mm. long, 6–14 mm. wide; base cuneate; apex rounded, obtuse or rarely subacute; margins crenulate-serrate, the teeth prominent, 3–6 on each side, the lower half entire; midrib prominent, elevated, hirsute above, obscure and glabrous beneath, the lateral nerves 2–4 pairs, obscure above and beneath. Pistillate inflorescence: flowers solitary, axillary to scales at the base of the current year's growth; bracts coriaceous, caducous, ovate, 1–2.5 mm. long, ciliate; pedicels short and thick, 2–4 mm. long, glabrous or sparsely puberulous; prophylla none; flowers red (ex Rock), rather large for the genus, 7 mm. across, 5-merous or rarely 4- or 6-merous; calyx patelliform, 3–4 mm. in diameter, glabrous, rugose, the lobes normally 5, imbricate, deltoid, 1.5 mm. long and wide, rounded, obtuse or acute, erose and ciliate; corolla rotate, the petals ovate-oblong, 3 mm. long, 1.5 mm. wide, one-fifth connate at the base; staminodes one-half the length of the petals, the sterile anthers very minute, cordiform; ovary large, 2.5 mm. long and wide at the base, conic-ovoid, stigma capitate, distinctly 5-lobed. Staminate inflorescence: fasciculate, the stamens 5; only buds seen. Fruits globose, 5–7 mm. in diameter, the persistent stigma elevated, discoid, the style short, pedicels 2–4 mm. long. Pyrenes 5 (sometimes 3 or 4), 5 mm. long, 3 mm. wide, smooth, estriate, esulcate, the endocarp coriaceous.

CHINA: Yunnan: Mekong-Salwin Divide, *Handel-Mazzetti 9617* (A); Kun-shan, Solola, *J. F. Rock 22299* (TYPE, A; ISOTYPES NY, US), *22651* (A); *C. W. Wang 66727* (A); Salwin-Kiukiang Divide, *T. T. Yu 20228* (A), *20241* (A), *23150* (A).

The description of the fruit is drawn from *Yu 20241*.

Ilex rockii is a low alpine shrub occurring at altitudes of 4100–4330 m. in the high mountains of northwestern Yunnan. The red pistillate and pink staminate flowers appear in May and June, and its fruits turn red in September.

The plant is closely related to *Ilex crenata* Thunb., *Ilex luzonica* Rolfe, *Ilex yunnanensis* Franch., and *Ilex intricata* Hook. f. Superficially its leaves suggest those of *Ilex crenata*. That species, however, differs in having punctate lower leaf-surfaces, impressed midribs, 4-merous flowers, longer pedicels and striate pyrenes. *Ilex rockii* resembles *Ilex luzonica* in its 5-merous flowers, but differs in its lack of greatly elevated leaf-scars and punctate leaves with retuse tips. In the thick indumentum of the branchlets, elevated hairy midribs, flattened petioles, and smooth pyrenes, it resembles *Ilex yunnanensis,* which differs in having 4-merous flowers, ovate or ovate-elliptic leaves with slightly produced acute apices, longer pedicels, and cymose staminate inflorescences. In its short pedicels and 5-merous flowers, it resembles *Ilex intricata,* which differs in its completely glabrous and peculiarly warty branchlets, impressed venation, and striate-sulcate pyrenes.

35. **Ilex yunnanensis** Franch. Pl. Delav. 2: 128. 1889; Loes. in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. 78: 131 (Monog. Aquif. 1: 131). 1901, et in Sarg. Pl. Wils. 1: 76. 1911; Rehd. & Wils. in Sarg. Pl. Wils. 3: 425. 1917; Rehd. in Jour. Arnold Arb. 7: 199. 1926; Anon. in Notes Bot. Gard. Edinb. 17: 29, 38, 48. 1929, 262, 381. 1930; Hand.-Mzt. Symb. Sin. 7: 655. 1933; Chen, Ill. Man. Chin. Trees 656. 1937; S. Y. Hu in Ic. Pl. Omei. 2: *pl. 158.* 1946.

Ilex sugeroki Maxim. forma *brevipedunculata* sensu Loes. l.c. 134. 1901; non (Maxim.) Hu.

A shrub or a small tree up to 12 m. high with ferrugineous-villose branchlets, small coriaceous ovate or ovate-lanceolate leaves, elevated and pubescent midribs, aristate-crenulate-serrate margins, cymose staminate inflorescences, solitary pistillate flowers on the current year's growth, 4-merous flowers, globose fruits, elevated discoid stigmas, and smooth coriaceous pyrenes.

Branchlets straight, fourth year's growth 3–4 mm. in diameter, cinereous, pubescent, smooth, minutely and longitudinally rimose, the lenticels lacking; second year's growth 1–2 mm. in diameter, ferrugineous-villose; current year's growth 1 mm. in diameter, densely villose, hairs golden, the terminal buds well developed, ovoid, acute, ferrugineous-villose. Leaves occurring even on the fourth year's growth, 3–10 mm. apart; stipules callose, buried in the indumentum, persistent; petioles 2–5 mm. long, one-fifteenth to one-seventh the length of the lamina, pubescent, slightly grooved above, flattened beneath; lamina coriaceous or thick-coriaceous, brunneous, usually shiny above, paler beneath, when young villose, especially near the base and along the margin, becoming glabrescent, ovate or ovate-lanceolate, rarely elliptic, 2–3.5 cm. long, 1–2 cm. wide; base rounded, obtuse or rarely narrowly subacute; apex acute, mucronate, sometimes ciliate; margin recurved, crenulate-serrate, teeth often aristate; midrib elevated and pubescent above, plane or slightly elevated, usually villose beneath, the lateral nerves obscure. Inflorescences cymose, solitary, axillary to leaves or scales of current year's growth, pubescent. Staminate inflorescences: cymes 1–3, usually 3-flowered, peduncles 8–14 mm. long, the pedicels 2–4 mm. long; flowers small, normally white, those from high altitudes pink or red, 4-merous; calyx subpatelliform, 2 mm. across, deeply 4-lobed, the lobes deltoid, acute or obtuse, ciliate; corolla rotate, the petals ovate, obtuse, 2 mm. long, 1.5 mm. wide, one-fourth connate at the base; stamens shorter than the petals, the anthers broadly ovoid; rudimentary ovary conic, the apex obtuse. Pistillate inflorescences: flowers solitary, very rarely 2- or 3-flowered cymose, the pedicels 8–14 mm. long with 1 or 2 supermedian prophylla; calyx as in the staminate flowers; corolla suberect, the petals 1.5 mm. long, one-third connate at the base;

staminodes one-half the length of the petals, the sterile anthers sagittate; ovary globose, 1 mm. in diameter, with 4 longitudinal grooves, style distinct, 0.5 mm. long, the stigma discoid, 4-lobed. Fruits red, globose, 5–6 mm. in diameter, the persistent calyx explanate, quadrangular in outline, ciliate, the stigma elevated, discoid. Pyrenes 4, oblong-oval in outline, subtriangular in cross-section, 5 mm. long, 3 mm. wide, estriate, esulcate, the endocarp smooth, thickly coriaceous.

CHINA: Szechuan: Mt. Omei, *H. C. Chow 8361* (A), *12291* (A); *W. P. Fang 11609* (Sz), *16912* (Sz), *23387* (A); *A. Henry 7144* (NY); *S. C. Sun & K. Chang 148* (A); O-pien, *C. L. Sun 841* (Sz), *1133* (Sz); without precise locality, *C. W. Yao 3774* (SS), *3872* (SS), *4284* (SS), *4328* (SS); Wen-chuan, *E. H. Wilson 1024* (A, US), *3092* (US), *3094* (A, US); Kwan-hsien, *E. H. Wilson 3093* (A, US). Sikang: Pao-shien (Mu-ping), *K. L. Chu 3726* (SS), *3097* (SS); Lu-ting (Ta-chien-lu), *W. P. Fang 3755* (A); *E. H. Wilson 4135* (A); Tien-tsian, *Y. S. Liu 1815* (A). Yund-shi Mountains (southeastern Tibet), *J. F. Rock 23151* (A), *23654* (A, NY). Yunnan: Li-kiang, *R. C. Ching 20637* (A); S. Chung-tien, *K. M. Feng 3254* (A); western Yunnan, *G. Forrest 4193* (K), *10247* (A), *13932* (US), *14174* (A), *19074* (A), *19459* (A, US); *Handel-Mazzetti 8497* (A, US), *9141* (A, US); *J. F. Rock 4196* (A, US), *8945* (A, NY, US), *9283* (A, US); Wei-si, *H. T. Tsai 57995* (A), *59809* (A), *59911* (A), *63045* (A); *C. W. Wang 63544* (A), *64002* (A), *64061* (A), *67868* (A); A-tun-tse, *T. T. Yu 7864* (A); Ne-wah-lung, *T. T. Yu 19230* (A); Tseh-chung, *T. T. Yu 19018* (A).

UPPER BURMA: Nam Tamai Valley, *Kingdon Ward 13296* (B).

Ilex yunnanensis is a large hardy shrub common in the high mountains of western China. There it grows at altitudes from 1500 to 3100 m. The fragrant flowers appear in June. They are usually white, but on the snow range of northwestern Yunnan they are said to be pink or even red in color. Several varieties of the species have been proposed. These can be distinguished by the following key.

A. Leaves ovate or oblong, the apex obtuse, the margin crenate; staminate flowers 4–6-merous. (Shensi, Hupei and N. E. Kweichow) . . . . 35a. var. *gentilis*.
AA. Leaves ovate, oblong or lanceolate, the apex acute, the margin serrate, the teeth often aristate; flowers always 4-merous.
  B. Fruiting pedicels less than 7 mm. long, the fruit nodding. (Border of Szechuan, Sikang and Yunnan) . . . . 35b. var. *brevipedunculata*.
  BB. Fruiting pedicels 8–15 mm. long, the fruit erect.
    C. Calyx ciliate.
      D. Leaves entire or 1–3-toothed on each side (teeth spinose), thickly coriaceous, 2–3 cm. long, 1–1.5 cm. wide. (Yunnan) . . . . 35c. var. *paucidentata*.
      DD. Leaves serrate, the teeth aristate; coriaceous, 1.2–2 cm. long, 0.5–0.7 cm. wide. (Taiwan) . . . . 35d. var. *parvifolia*.
    CC. Calyx eciliate . . . . 35e. var. *eciliata*.

35a. **Ilex yunnanensis** var. **gentilis** (Franch.) Loes. ex Diels in Bot. Jahrb. **29**: 435. 1900, nom. nud. et in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. **78**: 132 (Monog. Aquif. **1**: 132). 1901, descr., et in Sarg. Pl. Wils. 3: 425. 1917; Chen, Ill. Man. Chin. Trees 656. 1937.

Ilex gentilis Franch. ex Loes. in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. **78**: 133 (Monog. Aquif. **1**: 133). 1901, in syn.

Leaves thin-coriaceous, ovate or oblong, the apex obtuse or rarely subacute, the base round, the margin crenate; staminate inflorescence cymose, the flowers 4-, rarely 5- or 6-merous.

CHINA: Shensi: Tai-pei-shan, *W. Purdon 1114* (A). Hupei (Hupeh): *W. Y. Chun 4214* (A); *A. Henry 6901* (A, US); *E. H. Wilson* (Veitch Exp.) *2344* (A, NY, US), *4458* (A). Szechuan: Mt. Omei, *Y. S. Liu 1195* (A); Wen-chuan, *E. H. Wilson 4195* (A, US). Taiwan: Arisan, *E. H. Wilson 9781* (A, US).

Several flowers (staminate) of *Wilson 2344* are 5- or 6-merous. In this respect the plant more or less resembles *Ilex sugeroki* Maxim. var. *brevipedunculata* (Maxim.) S. Y. Hu. Because of the leaf-form and size, the indumentum and the geographic range, I think it is better to place it as a variety of *Ilex yunnanensis* rather than to transfer it to *Ilex sugeroki* Maxim. *Farges 129,* from Tschen-kéou-tin, Szechuan, is within the range of the distribution of this variety, and I suspect that it belongs here.

I have examined several specimens collected by Prof. A. Rehder in the Arnold Arboretum from plants grown from seeds obtained by Wilson in Hupei Province. The pubescence on the twigs of these cultivated forms is shorter and thinner than that found on the specimens of the wild *Ilex yunnanensis*. The venation of the leaves is more prominent than on the normal form. In appearance it looks more like *Ilex crenata* Thunb. than *Ilex yunnanensis*. Perhaps this is a demonstration of how environmental factors can affect the appearance and characters of the species.

35b. **Ilex yunnanensis** var. **brevipedunculata** S. Y. Hu in Ic. Pl. Omei. 2: *pl. 158*. 1946.

Leaves oval, ovate or elliptic, 2–3.5 cm. long, 1–2 cm. wide; fruiting pedicels 3–6, rarely up to 7 mm. long, the fruit nodding.

CHINA: Kweichow: Fan-chin-shan, *Steward, Chiao & Cheo 842* (A, NY, US). Szechuan: Mt. Omei, *T. C. Lee 6449* (Sz); O-pien, *C. W. Yao 2834* (SS). Yunnan: Lap-ping, *H. T. Tsai 54016* (A); Shang-pa, *H. T. Tsai 54484* (A); Wei-si, *H. T. Tsai 57918* (A), *59870* (A); *C. W. Wang 63808* (A), *67842* (A), *68710* (A), *70457* (A); Ta-li, *C. W. Wang 63344* (A), *63345* (A).

This variety occurs only at higher altitudes, 2600–3600 m. Its purplish red flowers appear in May and June. Its fruits are red by November.

35c. **Ilex yunnanensis** var. **paucidentata**, var. nov.

Arbor, 5 m. alta; foliis crasse coriaceis, ovato-lanceolatis, 2–3.5 cm. longis, 1–1.5 cm. latis, supra nitidis, basi rotundis vel obtusis, apice acutis spinosisque, margine integris vel 1–3-denticulato-serrulatis; pedicellis 12 mm. longis; fructibus globosis, 4–5 mm. diametro, calycibus ciliatis, stylis perspicuis, stigmate discoideo, 4-lobato.

CHINA: Yunnan: Wei-si, *C. W. Wang 67855* (TYPE, A).

The leaves of this variety are much thicker and more rigid than the typical *Ilex yunnanensis*. The leaf-tips terminate in a weak spine. More material may show it to be worthy of specific rank.

35d. **Ilex yunnanensis** var. **parvifolia** (Hayata), comb. nov.

Ilex parvifolia Hayata in Jour. Coll. Sci. Univ. Tokyo **30:** 57. 1911, et Ic. Pl. Form. **1:** 134, *fig. 19.* 1911; Kanehira, Form. Trees 378, *fig. 336.* 1936. *Syn. nov.*

Leaves coriaceous, oblong-lanceolate, small, 11–20 mm. long, 6 mm. wide, serrate, teeth aristate.

CHINA: Taiwan: Arisan, *Faurie 914* (A), *1377* (A); *E. H. Wilson 9470* (A, US), *10917* (A, US); *Kamiyama* (TU).

In the nature and density of the indumentum, the texture and form of the leaves, the venation, the inflorescences, the fruits, and the pyrenes, the Taiwan and Yunnan specimens are alike. The only difference I have noted between them is that the Taiwan form has somewhat smaller leaves. I judge it to be worthy of varietal rank only.

35e. **Ilex yunnanensis** var. **eciliata**, var. nov.

Frutex, 1–3 m. altus; foliis tenuiter coriaceis, ellipticis, raro ovatis, 1–2.8 cm. longis, 4–12 mm. latis, basi acutis, raro obtusis, apice acutis vel obtusis; floribus 4–6-meris; calycibus patelliformibus, 2–3 mm. diametro, glabris, lobis 4–6, raro usque ad 9, deltoideis, acutis, eciliatis.

CHINA: Szechuan: Wen-chuan, *E. H. Wilson 3092* (A); Hong-ya, Wa-wu-shan, *C. W. Yao 2379* (SS), *2377* (SS), *3872* (SS); Mt. Omei, *S. N. Hsu 16* (SS), *F. T. Wang 23390* (A); O-pien, *C. W. Yao 4328* (TYPE, SS). Sikang: Pao-shien (Mu-ping), *K. L. Chu 2960* (SS), *2957* (SS); Tien-chuan, *C. L. Wu 7225* (SS, UN), *12254* (SS, UN); *K. L. Chu 2623* (SS).

The local name reported is "Shui-cha-tze," which means "water tea" or "the tea growing by the water." The leaves are collected by natives of the Sino-Tibetan Border and used as a substitute for tea. It is of interest to note that species of *Ilex* belonging to the same section have been used in a similar way by Indians of both North and South America.

Ilex yunnanensis is closely related to *Ilex sugeroki* Maxim. var. *brevipedunculata* (Maxim.) S. Y. Hu. The typical forms of the former have densely ferrugineous-villose branchlets, 4-merous flowers, 4 pyrenes, aristately crenulate-serrate leaves and acute apices. The variety of *Ilex sugeroki* has puberulous branchlets, 4–6-merous flowers, 5 or 6 pyrenes, and leaves coarsely serrate only on the distal half and obtuse at the apex. The former occurs in western China and the latter is found in Japan. In Taiwan the two elements meet. Sometimes it is difficult to decide to which species the Taiwan specimens belong.

36. **Ilex sugeroki** Maxim. in Mém. Acad. Sci. St. Pétersb. VII, **29** (3): 35, *pl. 1, fig. 7 e.* 1881; Loes. in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. **78**: 133 (Monog. Aquif. **1**: 133). 1901; Makino, Ill. Fl. Nip. 367, *fig. 1101.* 1940.

Ilex sugeroki forma *longipedunculata* Maxim. l.c. 36. 1881; Loes. l.c. 134. 1901. *Syn. nov.*

Ilex sugeroki subsp. *longipedunculata* (Maxim.) Makino in Bot. Mag. (Tokyo) **27**: 78. 1913. *Syn. nov.*

An evergreen shrub up to 5 m. high with puberulous branchlets, coriaceous ovate or ovate-elliptic leaves with the margin serrate on the apical half, solitary axillary inflorescences, long-pedicellate (2–3.5 cm.) fruits, elevated discoid stigmas, and 4–6 smooth estriate esulcate pyrenes.

Branchlets puberulous, brunneous, older growth roughened by many elevated leaf-scars; third and second year's growth 2 mm. in diameter, the lenticels lacking; current year's growth 2 mm. in diameter, angular, pubescent, the terminal buds well developed, ovoid, 3 mm. long, 2 mm. wide, acute, with sparsely puberulous and ciliate scales. Leaves occurring even on the fourth year's growth, 5–10 mm. apart; stipules minute, callose, deltoid, persistent; petioles 4–7 mm. long, one-tenth to one-seventh the length of the lamina, pubescent, plane above; lamina thin-coriaceous, olivaceous, shiny above, opaque beneath, ovate or ovate-elliptic, 2–4 cm. long, 1–2.8 cm. wide; base rounded or obtuse; apex acute or shortly acuminate, the acumen 2–5 mm. long; margin serrate only on the distal half, midrib elevated and puberulous above, plane and glabrous beneath, the lateral nerves 6 or 7 pairs, obscure on both surfaces. Inflorescences solitary, axillary, on current year's growth only, puberulous; flowers 4-, 5-, or 6-merous. Staminate inflorescences: cymes 2–7-flowered, the peduncles 12–18 mm. long, the secondary axis 1–2 mm. long, the pedicels 2–5 mm. long, the bracteoles linear, 2 mm. long, puberulous; calyx patelliform, 2.5 mm. across, deeply 4–6-lobed, the lobes deltoid, densely long-ciliate; corolla white, rotate, 5–6 mm. across, the petals oblong, eciliate, one-sixth connate at the base; stamens shorter than the petals, the anthers oblong; rudimentary ovary ovoid, acute or shortly rostellate. Pistillate inflorescences: flowers solitary, the pedicels slender, erect, 3.5 cm. long, with 1 or 2 prophylla above the middle; calyx and corolla as in the staminate flowers; staminodes three-fourths the length of the petals, the sterile anthers oblong-sagittate, obtuse at the apex; ovary ovoid, 1.5 mm. long, glabrous, stigma elevated, discoid, plane and explanate. Fruits globose, 5–6 mm. in diameter, persistent calyx explanate, 3 mm. across, ciliate, stigma elevated, discoid. Pyrenes 4–6, oblong in outline, 3.5 mm. long, 2 mm. wide, neither striate nor sulcate, the ends obtuse, endocarp smooth, coriaceous.

JAPAN: Fujiyama region, *P. H. Dorsett & W. J. Morse 384* (A). Hondo: Mino, *K. Shiota 77* (A), *4363* (A), *6785* (A); *E. H. Wilson* (A).

Ilex sugeroki is endemic to the Fujiyama region of Japan. There it grows as a shrub at altitudes of 1000–1500 m. Its white flowers appear in June. The fruit turns red in October and remains on the plants until the flowers appear the following June.

Maximowicz named two forms, distinguishing them by the length of the peduncles and the position of the fruits. He cited no specimens under these forms. Since the plant he illustrated as *Ilex sugeroki* is the large-leaved, long-pedicellate form, I am accepting it as typical of the species in the strict sense. According to this illustration, the leaves of the species are essentially ovate with a rounded base. However, most of our specimens have neither ovate leaves nor rounded leaf-bases. The fruiting pedicels of these latter are less than 2 cm. long. I interpret them as representing *Ilex sugeroki* Maxim. var. *brevipedunculata* (Maxim.) S. Y. Hu.

36a. **Ilex sugeroki var. brevipedunculata** (Maxim.), comb. nov.

Ilex sugeroki forma *brevipedunculata* Maxim. in Mém. Acad. Sci. St. Pétersb. VII, **29**(3): 36, *pl. 1, fig. d.* 1881; Loes. in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. **78**: 134 (Monog. Aquif. **1**: 134). 1901. *Syn. nov.*

Ilex sugeroki subsp. *brevipedunculata* Makino in Bot. Mag. (Tokyo) **27**: 78. 1913. *Syn. nov.*

Ilex sugeroki sensu Hara in Bot. Mag. (Tokyo) **50**: 188. 1936, non Maxim.

Ilex taisanensis Hayata in Jour. Coll. Sci. Imp. Univ. Tokyo **30**: 57. 1911, et Ic. Pl. Form. **1**: 134. 1911; Kanehira, Form. Trees 382, *fig. 339.* 1936. *Syn. nov.*

A much-branched shrub up to 3 m. high with puberulous branchlets; leaves elliptic or ovate-elliptic, 2–3.5 cm. long, 1–1.5 cm. wide, cuneate or obtuse at the base, acute or obtuse at the apex, the margin serrate only in the apical half, the midrib elevated and puberulous above, plane or slightly elevated underneath, the petiole 3–8 mm. long, one-tenth to one-fourth the length of the lamina; inflorescences solitary, axillary, staminate 3-flowered, cymose, the peduncles 10 mm. long, the pedicels 1–5 mm. long, the prophyllum none or 1 near the calyx, puberulous; pistillate flowers solitary, pedicels 12–15 mm. long, prophylla 1 or 2, supermedian; calyx deeply 4–6-lobed, long-ciliate; fruit globose, 8 mm. in diameter, the stigma elevated, discoid.

CHINA: Taiwan: Bioritsu, *T. Kawakami & U. Mori* in 1908 (TYPE of *Ilex taisanensis*, photo and fragment, A; fragment, TU); Taihoku, *S. Suzuki* in Aug. 1928 (A, TU); Mt. Taiheizan, *S. Suzuki* in Aug. 1928 (TU).

JAPAN: Mt. Hakusan, (Herb. Sci. Coll. Imp. Univ. Jap.) (A); Shiribeshi, *T. Ishikawa* in 1893 (A); Oshima, *K. Miyabe & Y. Fukubuchi* in 1890 (A); Mt. Hakkoda, *C. S Sargent* in 1892 (A); Mt. Nasu, *K. Sakurai* in 1909 (A); Echizen, *K. Shiota 3453* (A); Mino, *K. Shiota 5932* (A), *6393* (A); *E. H. Wilson 7100* (A), *7183* (A), *7285* (A), *7632* (A), *7723* (A); Kitamifuji, Hokkaido, *K. Uno 1581* (A), *1698* (A).

The color of the dry Taiwan specimen cited above is brunneous-nigrescent. This is probably due to the methods of preparation. At sight, specimens of this variety might easily be mistaken for *Ilex yun-*

nanensis Franch., but the latter has densely ferrugineous-villose branchlets and its leaves are serrate or crenulate to near the rounded or obtuse base, while *Ilex sugeroki* var. *brevipedúnculata* has puberulous branchlets and leaves which are serrate only on the upper half.

To be Continued

JOHN GEORGE JACK

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JOHN GEORGE JACK. 1861–1949.

With portrait.

ON MAY 20, John George Jack, Assistant Professor of Dendrology, *Emeritus,* at the Arnold Arboretum, died at the age of eighty-eight years at his home, "Folly Farm," in East Walpole. He had been confined to his bed since August of the preceding year, having broken his hip while working in his orchard.

John George Jack was born in Chateauguay, Quebec, Canada, on April 15, 1861. His mother, Mrs. Annie L. Jack, originally a school-teacher, was a well-known horticulturist. She produced a series of articles under the title of "Garden Talks" and wrote a handbook on "The Canadian Garden." Undoubtedly his mother's influence was responsible for Professor Jack's early interest in horticulture. Although Professor Jack's formal education did not extend beyond high school he acquired a thorough knowledge of plants from practical experience and long study. He was outstanding as a field worker in detecting variations and species-hybrids.

In 1886, Professor Jack first came to the Arnold Arboretum to work and study under Professor C. S. Sargent and in 1891 he was appointed Lecturer at the Arnold Arboretum. He served as Instructor in Forestry at Harvard from 1903 to 1908, and as Lecturer in Forestry at the Massachusetts Institute of Technology from 1899 to 1908. He was made an Assistant Professor of Dendrology in 1908. Although Professor Jack spent most of his time at the Arnold Arboretum where he was a staff member from 1891 until he was retired in 1935, he was also on the staff both of the Bussey Institution and the Harvard Forest.

Even though most of Professor Jack's time was spent on the Arnold Arboretum grounds checking identifications of the trees and shrubs, lecturing to field classes, and supervising the plantings, he made many collecting trips to various parts of the world. The early trips were financed by funds obtained by Professor Jack himself from outside sources since at first the Arnold Arboretum had little money for exploration and Professor Jack's salary was only $500.00 per year. In 1891 he visited the botanic gardens and nurseries in France, Germany, Italy, Denmark and

England and in 1904 with Professor Alfred Rehder he made extensive collections in the western United States and Canada. In 1905 he went to Japan, Korea and China, where he studied both native and cultivated ornamental plants sending seeds and cuttings back to the Arnold Arboretum. Nearly every year from 1926 to 1936 Professor Jack went to the Atkins Botanical Garden in Cuba for a few months where he worked with the collections in the garden and collected native species in the vicinity of Soledad.

In 1907 Professor Jack married Cerise Emily Agnes Carmen, daughter of Elbert S. Carmen, who published the "Rural New Yorker." They adopted two children. Mrs. Jack died in 1935. Their daughter, Betty Wirth, and her husband lived with Professor Jack in his later years at "Folly Farm" in East Walpole.

Professor Jack was especially interested in trees, but like all old-time naturalists his interests covered the entire range of biology. His knowledge of plants, his spontaneous enthusiasm and sincerity, made him an outstanding teacher of field classes. He made many friends for himself and for the Arnold Arboretum.

Taxonomists are a hardy race, but few could keep up with Professor Jack. While spending a month with him at the Atkins Garden in 1936, I discovered that although he was 75 years old Professor Jack was up at 6 A.M., worked all day, often traveling into the surrounding country on horseback, and continued to work until 11 or 12 o'clock at night. Later I visited him at his farm on his 85th birthday where I found him spraying his orchard. He complained that he couldn't work after supper as formerly when he was younger.

Professor Jack published several hundred papers beginning in 1888. Most of these were notes on various plants grown in the Arnold Arboretum and descriptions of field work. His earlier contributions were published in "Garden and Forest" and in various horticultural journals. Many of his later publications appeared in the *Bulletin of Popular Information* published by the Arnold Arboretum.

In recognition of his work in taxonomy the following species were named for Professor Jack: —

Sinojackia Hu, a new genus with two species from China.
Alnus Jackii Hu (= *A. trabeculosa* Hand.-Mazz.).
× *Amelasorbus Jackii* Rehd.
× *Betula Jackii* Schneid.
Crataegus Jackii Sarg.
Juniperus communis var. *Jackii* Rehd.
× *Populus Jackii* Sarg.
× *Quercus Jackiana* Schneid.
Rosa Maximowiczii var. *Jackii* (Rehd.) Rehd. (*R. Jackii* Rehd.).
× *Sorbaronia Jackii* Rehd. (*Pyrus Jackii* [Rehd.] Fernald).
× *Viburnum Jackii* Rehd.

The hybrids (×) were discovered by Professor Jack.

A Selected Bibliography of the Writings of John George Jack.

1888–1889. Notes from the Arnold Arboretum. (Garden and Forest, vol. 1 & 2.)

1890–1892. Notes on shrubs. (Garden and Forest, vol. 3 & 5.)

1891–1893. Notes of a summer journey in Europe, I-XXIV. (Garden and Forest, vol. 4.)

1891. Notes on some hardy wild roses, I-V. (Garden and Forest, vol. 4.)

1894. Notes on some injurious insects. (Trans. Mass. Hort. Soc. **1:** 1–20.)

1894. Notes on trees and shrubs. (Garden and Forest, vol. 7.)

—— Native trees and shrubs about Montreal, Canada, I-V. (Garden and Forest, vol. 7.)

1897. The fructification of Juniperus. (Bot. Gaz. **18:** 369–375.)

—— Notes on the Eastern American Spruces. (Garden and Forest, vol. 10.)

1900. The Pikes Peak, Plum Creek, and South Platte forest reserves. (20th Annual Rept. U. S. Geol. Survey 1898–99: pt. 5.)

1904. The Arnold Arboretum, a lecture delivered before the Massachusetts Horticultural Society. (Trans. Mass. Hort. Soc. **1:** 59–75.)

1911. Trees and other woody plants found in the Harvard Forest, Petersham, Massachusetts. (Bull. Harvard Forestry Club **1:** 10–26.)

1930. Planting trees in autumn. (Bull. Pop. Inf. ser. 3, **4:** 65–68. illustr.)

1931. Forsythias. (Bull. Pop. Inf. ser. 3, **5:** 9–12. illustr.)

—— Flowering cherries. (Bull. Pop. Inf. ser. 3, **5:** 13–16. illustr.)

1935. Winter injuries among trees and shrubs. (Scientific Monthly, **40:** 332–338.)

1936. Arboreta, old and new. (Scientific Monthly, **41:** 541–550.)

Professor Jack was a member of the Society of Foresters, Botanical Society of America, Massachusetts Horticultural Society, American Academy, Boston Society of Natural History, and Deutsche Dendrologische Gesellschaft.

With the passing of Professor Jack, the era of the old-time naturalist is drawing to a close. Largely self taught, with enthusiastic interest in all phases of nature, and with apparently unlimited energy, these early botanists made the contact between botanical science and the horticultural public which led to the establishment and maintenance of so many of our botanic gardens and parks.

Karl Sax

THE GENUS ILEX IN CHINA, II

SHIU-YING HU

Continued from page 344

SECTION VII. AQUIFOLIUM GRAY

Ilex § **Aquifolium** Gray, Man. Bot. N. U. S. 276. 1848; Maxim. in Mém. Acad. Sci. St. Pétersb. VII. 29(3): 26. 1881; Rehd. Bibliog. Cult. Trees Shrubs 399. 1949.

Ilex subgen. *Euilex* Loes. series C. *Aquifolium* (Maxim.) Loes. in Verh. Bot. Ver. Brand. **33:** 26. 1891, in Engler & Prantl, Nat. Pflanzenfam. Nachtr. 219. 1897, et in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. **78:** 227 (Monog. Aquif. **1:** 227). 1901.

Evergreen trees or shrubs with fasciculate inflorescences in the axil of the leaves of the second year's or even older growth, the pyrenes 4, rarely less, with stony or woody striate and sulcate or rugose and pitted endocarps.

Forty-seven species in five series occur in China. Most of the species are locally endemic. The range of the five series is as illustrated in figure 8.

KEY TO THE SERIES

A. Leaves spinose or entire with the apex ending in a spine (except *Ilex hylonoma*).
- B. Pyrenes stony, irregularly wrinkled and pitted; fruit always containing 4 pyrenes....................... Series 1. *Aquifolioides.*
- BB. Pyrenes woody, palmately striate; fruit containing 2 pyrenes.... .... Series 2. *Dipyrenae.*

AA. Leaves entire, serrate or crenate, those from the mature plant never spinose.
- B. Pyrenes irregularly wrinkled and pitted, the endocarp stony; fruit 8–12 mm. in diameter; stigma navel-like, rarely discoid......... .... Series 3. *Denticulatae.*
- BB. Pyrenes palmately striate and sulcate; fruit 4–6 rarely up to 8 mm. in diameter; stigma discoid, capitate, rarely navel-like.
  - C. Leaves chartaceous or subcoriaceous, when dry brunneous, with impressed veinlets on the upper surfaces; fruiting pedicels 4–7 mm. long.................. Series 4. *Hookerianae.*
  - CC. Leaves thick coriaceous, coriaceous, rarely subcoriaceous, the veinlets obscure or plane above, never impressed; fruiting pedicels 2–4 mm. long.................. Series 5. *Repandae.*

Series 1. AQUIFOLIOIDES (Loes.), stat. nov.

Ilex subgen. III. *Euilex* Loes. ser. C. *Aquifolium* (Gray) Loes. sect. 2. *Aquifolioides* Loes. in Engler & Prantl, Nat. Pflanzenfam. Nachtr. 219. 1897, et in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. **78**: 244 (Monog. Aquif. **1**: 244). 1901.

Trees or shrubs with spinose or coarsely serrate leaves, fasciculate inflorescences, the individual branches of the staminate fascicles 1–3-flowered, those of the pistillate fascicles uniflorous, the flowers 4-merous, the fruiting pedicels 2–12 mm. long, the fruit large, 6–12 mm. in diameter, the pyrenes wrinkled and pitted, the dorsal surfaces convex, and the endocarp stony.

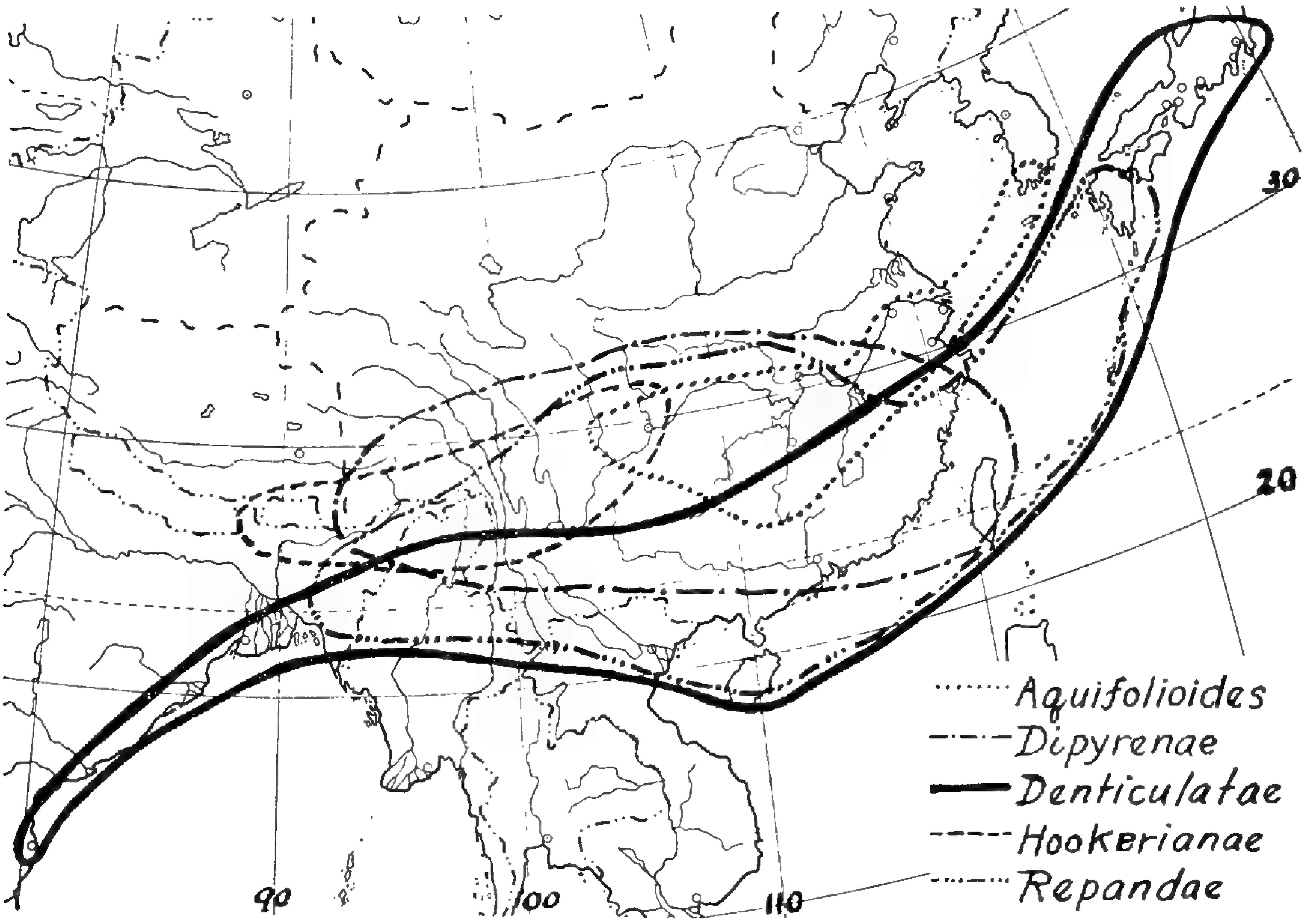

Fig. 8. Geographic distribution of the Chinese representatives of the five series of the section Aquifolium.

Key to the Species

A. Fruiting pedicels 2 mm. long; leaves oblong-elliptic or elliptic-lanceolate, the margin spinosely dentate or coarsely serrate.

B. Individual branches of the staminate fascicles 3-flowered; leaves 6–12.5 cm. long, 2.4–4.5 cm. wide, the margin coarsely serrate, sometimes the teeth ending in weak spines; fruit 10–12 mm. in diameter with a discoid or mammiform stigma. (Szechuan, Kweichow, and Kwangsi) .... 37. *I. hylonoma.*

BB. Individual branches of the staminate fascicles uniflorous; leaves 6–7 cm. long, 1.5–2.8 cm. wide, the margin 4–10 spinose-dentate; fruit 6–7 mm. in diameter, with a thin-discoid stigma. (Hupei-Szechuan border) .... 38. *I. centrochinensis.*

AA. Fruiting pedicels 5–18 mm. long; leaves quadrangular-oblong, rarely ovate, the margin entire or sinuate with 1–3 rigid spines on each side. (East and Central China) .... 39. *I. cornuta.*

37. **Ilex hylonoma** Hu & Tang in Bull. Fan. Mem. Inst. Biol. Bot. **9**: 250. 1940.

Ilex intermedia sensu S. Y. Hu in Ic. Pl. Omei. **2**: *pl. 164.* 1946, non Loes.

An evergreen tree up to 10 m. high with glabrescent or glabrous branchlets, elliptic or oblong-elliptic, coarsely and sharply serrate, slightly acuminate leaves, large (10–12 mm. in diameter) ellipsoid fruits, and 4 large (7–9 mm. long) bony wrinkled and pitted pyrenes, each with a median longitudinal ridge.

Branchlets straight, castaneous; second year's growth subterete, 3 mm. in diameter, plicate; current year's growth 2 mm. in diameter, slightly angular, striate and sulcate, the terminal buds slender, acute, conic, glabrous, with ciliate bud-scales. Leaves occurring also on second year's growth (3–)25(–37) mm. apart; stipules minute, deltoid, 1 mm. long, acute; petiole 8–14 mm. long, one-eleventh to one-seventh the length of the lamina, canaliculate and minutely puberulent above, rugose beneath; lamina thin-coriaceous, elliptic or oblong-elliptic, 6–12.5 cm. long, 2.4–4.5 cm. wide, acute or obtuse, rarely cuneate at the base, shortly acuminate at the apex, the very tip mucronate; margin coarsely and sharply serrate, sometimes the teeth ending in weak spines; the midrib impressed above, pilose or glabrescent above, elevated and prominent beneath, the lateral nerves 9 pairs, obscurely impressed above, elevated and prominent beneath, branched and anastomosing near the margin, the reticulations of the veinlets evident above, rather obscure beneath. Inflorescences fasciculate, axillary on second year's growth, the bracts deltoid, acute, glabrous and ciliate; flowers 4-merous. Staminate inflorescences: individual branches of the fascicle 3-flowered, sparsely puberulent; peduncles 1 mm. long, the pedicel 3 mm. long, with 2 ciliate basal prophylla; calyx patelliform, 1.8 mm. in diameter, glabrous, the lobes broadly deltoid, obtuse, ciliate, 0.5 mm. long, 0.5–1 mm. wide; corolla rotate, the petals obovate-elliptic, 3.3–3.5 mm. long, 1.8 mm. wide, one-eighth connate at the base; stamens slightly longer than the petals, the anthers ovoid; rudimentary ovary subglobose. Pistillate flower not seen. Infructescences paucifasciculate, the pedicels 2 mm. long, with 2 sub-basal prophylla. Fruit ellipsoid-subglobose, 10–12 mm. in diameter, quite wrinkled when dry, the persistent calyx explanate, 3 mm. across, the stigma prominent, thickly discoid or almost mammiform. Pyrenes 4, obovate in outline, trigonous in cross-section, the apical end obliquely retuse, 7–9 mm. long, 3–4 mm. wide, the dorsal surface irregularly wrinkled and pitted, with a median longitudinal ridge, the endocarp bony.

CHINA: Szechuan: Mt. Omei, *H. C. Chow 11831* (A); *W. P. Fang 12579* (A, Sz), *14971* (Sz), *15296* (Sz), *15517* (Sz), *16496* (Sz), *18229* (Sz), *18540* (Sz); *S. N. Hsu 678* (SS); *T. C. Lee 3710* (Sz), *4438* (Sz); *W. W. Ma 2691* (Sz), *2339* (Sz), *2762* (Sz), *2771* (Sz); *G. L. Sun 135*

(Sz), *149* (Sz); *T. H. Tu 397* (ISOTYPE, SS); without precise locality, *C. W. Yao 3659* (SS). Kweichow: Wong-Mou, Chen-feng, *S. W. Tseng 90969* (A), *90969B* (A).

Ilex hylonoma was first reported from Mount Omei, the sacred mountain in West China. There it grows as a small tree 3–4 m. high in thickets at altitudes of 950–1200 m., or as a big tree 10 m. high in mixed forests at altitudes of 1300–1700 m. Its yellowish flowers appear in March. The large fruits become brown in October and red in November (ex Fang).

Ilex hylonoma is closely related to *Ilex centrochinensis*. In the thin-coriaceous texture of the leaves, the fasciculate inflorescences, the very shortly pedicellate fruits, and in the sculpturing of the pyrenes, they are almost alike. They differ in that *Ilex centrochinensis* has smaller spinose leaves, uniflorous branches of the staminate fascicles, and smaller pyrenes.

37a. **Ilex hylonoma var. glabra,** var. nov.

Arbor glabra; foliis coriaceis vel crasse coriaceis, lanceolatis, oblanceolatis, ovato-lanceolatis vel ellipticis, 6–10 cm. longis, 1.8–4.2 cm. latis, margine serratis vel tenuiter spinosis; fructibus ellipsoideis vel subglobosis, 8–10 mm. diametro, pedicellis 2–3 mm. longis; pyrenis 4, oblongis, trigonis, apice oblique retusis, 6–8 mm. longis, endocarpio lapideo.

Branchlets, terminal buds, pedicels, midrib and petioles all glabrous; leaves coriaceous or thickly coriaceous, lanceolate, oblanceolate, ovate-lanceolate or elliptic, 6–10 cm. long, 1.8–4.2 cm. wide, coarsely serrate or weakly spinose; fruits ellipsoid or subglobose, 8–10 mm. in diameter; pedicels 2–3 mm. long, prophylla 2, median, ciliate; pyrenes 4, oblong-trigonous in outline, 6–8 mm. long, with 1 median longitudinal ridge along the back, the apical end obliquely retuse, the endocarp bony.

CHINA: Chekiang: Chu-an-hsien, *Y. L. Keng 726* (A). Hunan: Chang-sa, *Handel-Mazzetti 11501* (A, LU). Kwangsi: Hu-chen, *R. C. Ching 5386* (NY); Ling-wun, *S. K. Lau 28662* (A); Kwei-lin, *W. T. Tsang 27796* (TYPE, A; US), *27998* (A, US), *28063* (A, US); Hing-on, *Z. S. Chung* (T. S. Tsoong) *83691*.

Geographically this variety ranges over a wider area than does the typical West China species. It extends from the coastal provinces, Chekiang, westward to the Great Lake Province, Hunan, and southward to Kwangsi. It is a large tree 10 m. high.

This variety differs from the typical West China species in having glabrous branchlets and midrib. The leaves are thicker in texture.

38. **Ilex centrochinensis,** nom. nov.

Ilex aquifolium L. var. *chinensis* Loes. ex Diels in Bot. Jahrb. **29**: 435. 1900, nom. nud., in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. **78**: 236 (Monog. Aquif. **1**: 236). 1901, descr., et in Sarg. Pl. Wils. **1**: 78. 1913; Hand.-Mzt. Symb. Sin. **7**: 655. 1933; Chen, Ill. Man. Chin. Trees 658. 1937.

Ilex aquifolium sensu Franch. in Bull. Soc. Bot. France **33**: 453. 1886; sensu Hemsl. in Gard. & Forest **2**: 124. 1889, non L.

Ilex dipyrena Wall. var. *leptacantha* Loes. ll.cc. 436. 1900, nom. nud., 278. 1901, descr. *Syn. nov.*

An evergreen shrub up to 3 m. high, with slender angular and ridged sparsely puberulent or glabrescent branchlets, lanceolate spinose leaves, fasciculate inflorescences, short-pedicellate fruits, and 4 wrinkled-pitted and median longitudinally ridged pyrenes.

Branchlets slender, longitudinally ridged and rugose, brown or nigrescent; third year's growth 3 mm. in diameter, the lenticels lacking, the leaf-scars deltoid; second year's growth 2–2.5 mm. in diameter, ridged; current year's growth angular, 1.5 mm. in diameter, puberulent or glabrescent, sharply ridged from the stipules downward, the terminal buds thin, acute-conic, puberulent or glabrescent with ciliate bud-scales. Leaves occurring also on the second year's growth, 5–15 mm. apart; stipules deltoid or obliquely deltoid; petioles 5–8 mm. long, one-eleventh to one-ninth the length of the lamina, very shallowly impressed above; lamina coriaceous, brown, shiny above, less so beneath, elliptic-lanceolate, rarely ovate-elliptic, 5–9 (usually 6–7) cm. long; 1.5–2.8 cm. wide; obtuse or rarely rounded at the base; acuminate at the apex, the acumen deltoid, 6–12 mm. long, terminating in a spine; margin spinose-dentate, the spines 4–10 on each side, 2–4 mm. long, the tips nigrescent; midrib shallowly impressed above, puberulent near the base, elevated beneath, the lateral nerves 6–8 pairs, obscure, rarely evident above, obscure or rarely prominent beneath. Inflorescences fasciculate, axillary on the second year's growth; the bud-scars often persistent, broadly ovate, cartilaginous, puberulent or glabrescent, the individual branches of the fascicles uniflowered, the bracts ovate-lanceolate, pubescent, ciliate; flowers 4-merous. Staminate flowers: pedicels 1–2 mm. long, puberulent, with 2 median ciliate prophylla reaching the calyx; calyx patelliform, 2.5 mm. across, deeply lobed, the lobes ovate, deltoid, ciliate and often puberulent; corolla rotate, 6 mm. across, the petals oblong, 3 mm. long, the distal half ciliate, one-eighth connate at the base; stamens longer than the petals, the anthers oblong-ovate; rudimentary ovary subglobose, the apex rounded. Pistillate flower not known. Infructescences paucifasciculate, the fascicles with 1–3 fruits, the pedicels 2 mm. long, puberulent, with 2 sub-basal ciliate prophylla; persistent calyx explanate, quadrangular in outline, 2 mm. across, the lobes ciliate. Fruit globose, 6–7 mm. in diameter, the stigma thin-discoid, 4-lobed. Pyrenes 4, oblong-trigonous in outline, ca. 6 mm. long, 3 mm. wide at the back, wrinkled and pitted all over, the dorsal surfaces with a median longitudinal ridge, the ends obtuse, the endocarp stony.

CHINA: Hupei (Hupeh): Chien-shih-hsien, *H. C. Chow 1523* (A, NY); Nan-yang-ho, western Hupei, *W. Y. Chun 3857* (A); Ichang, *A. Henry 1084* (TYPE, fruit, G), *3299* (A, G, US); *4239* (TYPE of *Ilex dipyrena* var. *leptacantha*, A); *E. H. Wilson 108* (A, NY), *295B* (A), *3100* (A, US). Szechuan: *E. Faber 87* (NY); Wu-shan-hsien, *E. H. Wilson 1028* (A); *W. Y. Chun 4098* (A).

This species is endemic to the Hupei-Szechuan border where the Yangtze River cuts through the limestone mountains forming the famous huge deep gorges. It is in this area that *Metasequoia* has recently been discovered. There *Ilex centrochinensis* grows as a shrub along the roadside, margin of the woods or by small streams at altitudes of 500–700 m. The flowers appear in March and April, and the fruit turns purplish red in middle August (ex Chun) or is still green in September (ex Chow).

In indumentum and leaf characters, *Ilex centrochinensis* is most closely allied with *Ilex aquifolium* Linn., but the latter has 3-flowered branches in the staminate inflorescences, fruiting pedicels as long as or longer than the diameter of the mature fruits, reticulately striate and sulcate pyrenes which lack a distinct median longitudinal ridge on the back. Moreover, *Ilex aquifolium* Linn. does not occur in any part of China unless cultivated. In the color and texture of the dry leaves, the nature of the inflorescences, the short fruiting pedicels, and in the character of the pyrenes, *Ilex centrochinensis* is very closely related to *Ilex hylonoma* Hu and Tang, but the latter has larger (up to 12 cm. × 4 cm.) serrate leaves, and much larger fruits (up to 12 mm. in diameter).

Loesener with the specimen *A. Henry 4239* created the variety *Ilex dipyrena* Wall. var. *leptacantha,* basing it upon *Ilex leptacantha* Lindl. & Paxt. But the specimen he examined does not belong to the species as he supposed. It is a fruiting specimen. Each fruit has 4 stony, wrinkled-pitted, longitudinally ridged pyrenes which are typical of *Ilex centrochinensis.* It is apparently a branch from a vigorously growing plant. The leaves are larger and thinner, and the lateral nerves are more evident above than in the other Henry specimens. But this variation is very common in any growing shrub.

39. **Ilex cornuta** Lindl. & Paxt. Flow. Gard. 1: 43, fig. 27. 1850, in Gard. Chron. **1850**: 311. 1850; Loud. Encyc. Pl. Suppl. **2**: 1302. 1855; Hook. in Bot. Mag. **14**: pl. 5059. 1858; Moore in Jour. Bot. **16**: 137. 1878; Maxim. in Mém. Acad. Sci. St. Pétersb. VII, 29(3): 44. 1881; Forbes & Hemsl. in Jour. Linn. Soc. Bot. **23**: 115. 1886; Loes. ex Diels in Bot. Jahrb. **29**: 436. 1900, in Nov. Act. Acad. Caes. Leop.-Carol. **78**: 280 (Monog. Aquif. **1**: 280). 1901, et in Sarg. Pl. Wils. **1**: 78. 1911; Schneid. Ill. Hand. Laubh. **2**: 164. 1912; H. Lévl. in Mém. Real Acad. Cien. y Art. **12**: 13. 1916; Gee in Sci. [China] **6**: 212. 1921; Chung in Mem. Sci. Soc. China **1**: 139. 1924; Liu in Bull. Pek. Soc. Nat. Hist. **2**: 126. 1928; Belval, Mus. Heude Not. Bot. Chin. **2**: 21. 1933; Hand.-Mzt. Symb. Sin. **7**: 656. 1933; Cheng in Contr. Biol. Lab. Sci. Soc. China **9**: 171. 1934; Chen, Ill. Man. Chin. Trees 657. 1937.

Ilex cornuta forma *typica* Loes. op. cit. 281. 1901. *Syn. nov.*
Ilex cornuta forma *gaëtana* Loes. l.c. *Syn. nov.*
Ilex furcata Lindl. in hortis: Göppert in Gartenfl. **1853**: 322. 1854.
Ilex burfordii S. R. Howell, Descr. Cat. Howell Nurs. 19. 1935, *nom. nud.*
Ilex cornuta var. *burfordii* De France in Nat. Hort. Mag. **13**: 193. 1934; Clarke in Jour. Hort. Soc. **6**: 284. 1945.
Ilex cornuta forma *burfordii* (De France) Rehd. in Bibl. Cult. Trees Shrubs 400. 1949. *Syn. nov.*

An evergreen shrub or small tree with firm thick-coriaceous dimorphic leaves varying from cordate or oblong-entire to quadrangular and sinuate-spinose, fasciculate inflorescences, globose drupes, and 4 wrinkled-pitted stony pyrenes, entirely or half-grooved along the dorsal longitudinal line.

Branchlets stout, subterete, cinereous when dry; third year's growth 5 mm. in diameter, longitudinally minutely rimulose, the nodes prominent with elevated leaf-scars, the lenticels lacking; second year's growth 4 mm. in diameter, ochraceous or brown; longitudinally striate-rugose; current year's growth 2–3 mm. long, longitudinally ridged, minutely puberulent in the grooves or glabrescent, the terminal bud small, thin-conical, puberulent or glabrescent. Leaves occurring even on the third year's growth, 5–10 mm. apart; stipules broadly deltoid, callose, ca. 0.4 mm. long, 0.5 mm. wide; petioles 4–8 mm. long, one-seventeenth to one-ninth the length of the lamina, puberulent, narrowly impressed above; lamina thick-coriaceous, olivaceous, shiny above, opaque beneath, quadrangular-oblong, rarely ovate, (3–)5–6(–8) cm. long, (2–)2.5–3(–4) cm. wide; round or truncate at the base; acute or shortly acuminate at the apex, the very tip always terminating in a strong spine; margin entire or sinuate with 1–3 spines on each side, rigid, thickened and of lighter color than the lamina; midrib very slightly impressed (almost plane on the distal half) above, prominent and elevated beneath, the lateral nerves 5 or 6 pairs, anastomosing near the margin, obscure above, evident beneath, the reticulation of the veinlets obscure on both surfaces. Inflorescences fasciculate, sessile, axillary, on second year's growth, the persistent scales suborbicular, cartilaginous, ciliate and sparsely puberulent, 1.5 mm. long, the individual branches of the fascicles uniflowered, the bracts ovate, pubescent, ciliate, obtuse or mucronate, with 2 subulate basal appendages; flowers 4-merous. Staminate inflorescences: pedicels 5–6 mm. long, glabrous, with 1 or 2 sub-basal minute broadly deltoid prophylla; calyx patelliform, 2.5 mm. across, the lobes membranaceous, broadly deltoid, sparsely puberulent, ciliate, 0.75 mm. long, 1.5 mm. wide; corolla rotate, 7 mm. across, the petals oblong-ovate, 3.5 mm. long, with the apical ends very sparsely ciliate, one-tenth connate at the base; stamens subequaling or slightly longer than the petals, the anthers ovoid-oblong, 1 mm. long; rudimentary ovary subglobose, the apex obtuse or rounded, indistinctly 4-lobed. Pistillate inflorescences: pedicels 8–9 mm. long, glabrous, after fruiting 13–14 mm. long with minute broad deltoid basal prophylla; calyx patelliform, the lobes obtuse, sparsely puberulent and ciliate; corolla rotate, 7 mm. across, choripetalous, the petals oblong-ovate, 3.5 mm. long, sparsely ciliate; staminodes four-fifths the length of the petals, slightly longer than the ovary, the sterile anthers ovate-sagittate; ovary oblong-ovoid, 3–4 mm. long, 2 mm. wide, the stigma discoid. Fruit globose (ellipsoid before reaching maturity), 8–10 mm. in diameter, the persistent calyx quadrangular in outline, the stigma discoid, distinctly 4-lobed. Pyrenes 4, obovate or elliptic in outline, the ends acute, 7–8 mm. long, 5 mm. wide at the back, wrinkled-pitted, rugose all over, the dorsal surface entirely or partly canaliculate along the median longitudinal line, the endocarp bony.

CHINA: Kiangsu: Nanking, *Chen & Teng 3960* (A, US), *3961* (NY); *W. C. Cheng 383* (SS); *W. P. Fang 10416* (SS), *61108* (SS). Soochow: *H. F. Feng* in 1925 (G); *Y. L. Keng 1692* (A, NY); *E. Faber* (NY); Chiu-yong, *K. King 2175* (G); *A. N. Steward* (ex Herb. Univ. Nanking *1959*) (A), *7261* (NY, US); *Y. Z. Sun 1067* (SS); *Tso 28* and *210* (A). Chekiang: Moh-kan-san, *S. P. Barchet* (US); Tien-mu-shan, *W. C. Cheng 3624* (US); Tih-tai-shan, *R. C. Ching 1374* (A, US); Hangchow, *C. Y. Chiao* (ex Herb. Univ. Nanking *7966*) (US); Nin-po, *C. K. Chao* in 1935, (CUB); *S. S. Liu* in 1935 (CUB); Tsing-yun-hsien, *Y. L. Keng 449* (A, SS); Chang-hwa-hsien, *Y. L. Keng 574* (A); Chun-an-hsien, *Y. L. Keng 712* (A); Lin-an-hsien, *H. H. Hu 1562* (A); locality not given, *D. Macgregor* in 1908 (A); Tang-si, *F. H. Meyer 229* (A); Tien-mo-shan, *T. Tang & W. Y. Hsia 428* (A). Anhwei: Hwang-shan, *S. S. Chien 1336* (SS); Bau-hua-shan, *W. C. Cheng 434* (SS, US), *5897* (SS); *C. Pei 2439* (SS). Kiangsi: Nan-chang, *H. H. Chung 658* (LU); *J. N. Hsiung 504* (A); Kian, *F. A. McClure 3421* (LU); Kao-ping, *Y. Tsiang 9893* (NY); Kiu-kiang, *E. H. Wilson 1608* (A, SS). Hupei (Hupeh): Wu-chang, *S. C. Sun 1078* (A, NY); Ichang, *A. Henry 3292A* (G); *E. H. Wilson 3101A* (A, US). Hunan: Tsing-tschou (Chang-sa), *Handel-Mazzetti 364, 637, 442* (A).

KOREA: Senra, *Taquet 2721* (A); same province, *E. H. Wilson 11242* (A).

CULTIVATED: I have seen specimens from the gardens of Kew, England, Hannover and Dahlem, Germany, Locarno, Switzerland, and from gardens and nurseries of Virginia, Tennessee, and Georgia in the United States.

Ilex cornuta is endemic to the hilly regions of the lower Yangtze provinces from the sea up to western Hupei. There its yellow flowers appear in April and the fruit turns red in November.

Ilex cornuta was first introduced to England from the vicinity of Shanghai by R. Fortune in 1846. The first published record of it appeared in 1850. From the very beginning Lindley and Paxton had clearly stated the variation in leaf forms, "Foliis . . . in plantâ vegetiore grossè sinuato-dentatis spinosis in adultâ 3-cornibus integrisque." In 1908 Dallimore commented on Fortune's specimen deposited in Kew, saying, "it appears that the upper leaves on mature trees vary in shape, sometimes being spineless and sometimes bearing but one or two spines." This is correct.

Ilex cornuta is like many other Asiatic spinose species of *Ilex* in that maturity in the plant and aridity in the environment are associated with the reduction of the number of spines on the leaves, often even with entire leaves. Such a dimorphism in leaves is very common with wild *Ilex cornuta*. It has been reported from Chekiang by Keng, from Anhwei by Ching, and in Nanking I have personally seen trees about 5 m. high with some branches bearing entire leaves and others bearing spinose leaves. The type or parent plant of *Ilex cornuta* var. *burfordii* De France in the West View Cemetery, Atlanta, Georgia, must have been propagated from such an entire-leaved shoot. De France admitted, "When seeds of *Ilex cornuta* var. *Burfordii* germinate they produce seedlings similar to Ilex cornuta . . ." Therefore, his variety may be considered as a horticultural clone, but not a taxonomic form or variety.

The branchlets of *Ilex cornuta* are rather flexible. In China they are used by farmers to make nose-rings for cattle. The bark and the leafy shoots are used as medicine. The plant is believed to be an excellent remedy for diseases of the kidney and is commonly administered as a tonic. It is also widely cultivated as an ornamental shrub.

39a. **Ilex cornuta var. fortunei** (Lindl.), comb. nov.

Ilex fortunei Lindl. in Gard. Chron. **1857:** 868. 1857; Chung in Mem. Sci. Soc. China **1:** 140. 1924.

Ilex cornuta sensu Rehd. in Jour. Arnold Arb. **8:** 156. 1927, pro parte.

Branchlets minutely puberulent or glabrescent; leaves thick-coriaceous, oblong, obovate-oblong, or quadrangular, the margin entire, occasionally with 2 or 3 strong spines on each side, rigidly thickened; inflorescences fasciculate or in the staminate inflorescence pseudopaniculate with a rachis up to 10 mm. long; individual branches of the staminate fascicles 1–3-flowered, the pedicels 5–15 mm. long, when 3-flowered the peduncles 1–2 mm. long; individual branches of the pistillate fascicles uniflorous, the pedicels 12 mm. long, after fruiting up to 18 mm. long; fruit globose, 10–11 mm. in diameter, the stigma plane-discoid or almost capitate.

CHINA: Kiangsu: Nanking, *E. D. Merrill 11371* (A). Honan: Ki-Kiang-shan, *A. N. Steward 5239* (US), *9838* (A, US). Anhwei: Chu-wha-shan, *R. C. Ching 2719* (A, LU); Liu-chu-wan, *R. C. Ching 2736* (A, US); Chien-shan-hsien, *C. S. Fan & Y. Y. Li 72* (A). Chekiang: Tung-yang-hsien, *Y. L. Keng 912* (A). Hupei: Ichang, *A. Henry 3292* (A, G, US); *E. H. Wilson 3101* (A, SS); without precise locality, *F. B. Forbes 854* (A).

Wilson 3101 is a mixture of staminate flowers and young fruits. The former have long pedicels, often with 3-flowered branches. The latter have short pedicels. In the Arnold Arboretum, I have numbered the latter *3101A*.

Cultivated: I have seen specimens collected from La Mortola, Italy, by A. Rehder and also by C. Schneider; from United States National Botanic Gardens by P. Russell, and from Australia by J. F. Bailey.

Geographically, there is no clear demarcation between this variety and the typical *Ilex cornuta*. However, so far as is known, the variety has not been reported in those coastal areas beyond Long. 120°E. It commonly occurs in the hilly high lands on both sides of the Yangtze River from Kiangsu west to Hupei. The flowers appear in April and the fruit becomes red in November, persisting for a long time on the branches.

This variety differs from typical *Ilex cornuta* in having 3-flowered branches of the staminate inflorescences and longer fruiting pedicels (12–18 mm.). It was first collected by Fortune in Hwuy-chow, S. Anhwei.

His specimen was from an old plant with entire leaves. About it Lindley wrote, "In its young state it is much like *I. cornuta,* but in the adult condition it acquires quite another appearance, resembling a very broad-leaved entire-leaved European Holly . . . in the axil of each leaf a sessile umbel of from 6–10 stalks [of fruits] each about three-quarters of an inch long . . ." In S. Anhwei it was again collected by *R. C. Ching* (*2719* with entire leaves only and *2736* with both entire and spinose leaves). Merrill's specimen from Purple Mountain in Nanking and Henry's and Wilson's specimens from western Hupei both possess spinose leaves only. It is obvious that in nature leaf dimorphism is as common in this long-pedicellate variety as in the typical *Ilex cornuta.*

Series 2. DIPYRENAE, ser. nov.

Arbor vel frutex, ramulis puberulis; foliis coriaceis, rigidis, juvenilibus spinosis, in maturitate interdum partim integris; inflorescentiis paucifasciculatis, fasciculis 1–5-floris; fructus pedicellis 1–3 mm. longis; fructibus ellipsoideis vel depresso-globosis, saepe in paribus; pyrenis 1–4, plerumque 2, palmatim striatis et sulcatis, endocarpio crasso, lignescente.

Key to the Species

A. Trees; leaves comparatively large, 6–9 cm. long, often entire; petioles 4–5 mm. long. (India-Yunnan) . . . . 40. *I. dipyrena.*

AA. Shrubs; leaves 2–4.5 cm. long; petioles less than 3 mm. long.

B. Pyrenes 4; leaves ovate.

C. Leaves 3–4.8 cm. long, the margin sinuate, with 3–7 spines on each side; pyrenes suborbicular in outline, 4.5 mm. wide, broadly grooved on the dorsal surface. (Chekiang) . . . . 41. *I. wenchowensis.*

CC. Leaves 1.3–2.5, rarely up to 3 cm. long, the margin with 1 or 2, rarely 3 spines; pyrenes obovate or oblong, less than 4 mm. wide, impressed only at the broader end. (West and northwest China) . . . . 42. *I. pernyi.*

BB. Pyrenes usually 2, rarely 1; leaves lanceolate, elliptic, rhomboid, quadrangular, rarely ovate, usually over 4 cm. long (except *I. perryana*).

C. Leaves lanceolate, with numerous spines; fruit obovoid-ellipsoid, 5–6 mm. in diameter. (Yunnan) . . . . 43. *I. georgei.*

CC. Leaves elliptic, rhomboid, or quadrangular, rarely ovate; fruit ellipsoid or subglobose, 8–10 mm. in diameter.

D. Erect shrubs over 1 m. high; leaves elliptic or ovate, truncate or rounded at the base, acuminate at the apex; the veinlets indistinct above; pyrenes 2, palmately striate and sulcate.

E. Leaves elliptic or ovate; margin with 4–6 weak spines on each side; pedicels of fruits pubescent. (Szechuan) . . . . 44. *I. ciliospinosa.*

EE. Leaves ovate or quadrangular, margin with 2–3 strong spines on each side; pedicels of fruits glabrous. (Yunnan to Taiwan) . . . . . 45. *I. bioritsensis.*

DD. Prostrate shrubs less than 30 cm. high; leaves subrhomboid, rugose, obtuse at the base, broadly deltoid and acute at the apex, the upper surface with deeply impressed veinlets; pyrene 1, palmately striate and esulcate. (Yunnan, high altitude) .... 46. *I. perryana.*

40. **Ilex dipyrena** Wall. in Roxb. Fl. Ind. ed. Carey, **1**: 473. 1820; D. Don, Prod. Fl. Nep. 188. 1825; Wall. List, 4327. 1830, et Pl. As. Rar. 3: *pl. 292.* 1832; Walp. Rep. **1**: 540. 1842; Loud. Encyc. Pl. Suppl. **2**: 1302. 1855; Brandis, For. Flor. 76. 1874; Hook. f. Fl. Br. Ind. **1**: 599. 1875; Franch. Pl. Delav. 127. 1889; Loes. in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. **78**: 276 (Monog. Aquif. **1**: 276). 1901; Chung in Mem. Sci. Soc. China **1**: 140. 1924; Hand.-Mzt. Symb. Sin. **7**: 656. 1933; Comber in Notes Bot. Gard. Edinb. **18**: 44. 1933; Chen, Ill. Man. Chin. Trees 659. 1937.

Ilex dipyrena var. *connexiva* W. W. Sm. in Notes Bot. Gard. Edinb. **10**: 41. 1917; Comber op. cit. 61. 1933. *Syn. nov.*

Ilex dentonii Hort. ex Loud. l. c.

Ilex dipyrena var. *paucispinosa* Loes. op. cit. **89**: 283. 1908; Comber op. cit. **18**: 45. 1933. *Syn. nov.*

Ilex monopyrena Watt. ex Loes. op. cit. 275. 1901; Hu and Tang in Bull. Fan Mem. Inst. Biol. Bot. **9**: 252. 1940. *Syn. nov.*

Ilex bioritsensis Hayata var. *integra* Comber op. cit. 43. 1933. *Syn. nov.*

A puberulent evergreen tree up to 14 m. high with coriaceous elliptic-oblong, rarely ovate or lanceolate, spinose (or entire with an apical spine) leaves, fasciculate inflorescences, globose or ellipsoid fruits, 1–4 pyrenes with thick woody palmately striate and sulcate endocarp.

Branchlets straight, stout; third year's growth 4–6 mm. in diameter, cinereous, minutely longitudinally rimulose, the lenticels lacking or obscure, the leaf-scars semi-orbicular, not elevated; current year's growth subangular, longitudinally striate rugose or smooth, minutely puberulent or glabrescent, cinereous or cinnamon, the terminal buds conic, acute, puberulent. Leaves occurring also on second year's growth, 5–20 mm. apart; stipules callose, broadly deltoid, sometimes obscure; petioles 4–6 mm. long, one-twentieth to one-thirteenth the length of the lamina, shallowly canaliculate above, puberulent; lamina thick-coriaceous, shiny above or opaque on both surfaces, olivaceous, brown or even yellow, elliptic-oblong or rarely ovate, 4–10 cm. long, 2–4 cm. wide; base rounded; apex shortly acuminate, the acumen 3–10 mm. long, terminated by a sharp spine 2 mm. long; margin entire or subentire with few spines or spinose with up to 14 spines on each side; midrib sulcate, puberulent or glabrescent above, elevated beneath; lateral nerves 7–9 pairs, impressed above, elevated beneath, the reticulation of the veinlets obscure. Inflorescences fasciculate, axillary on second year's growth, the individual branch of the fascicles uniflorous; the bracts ovate-lanceolate, long-ciliate, the outer ones cuspidate, the inner ones obtuse, the basal appendages subulate, flowers 2–4-merous. Staminate flowers: pedicels 2–3 mm. long, sparsely and minutely puberulent or glabrescent, with 2 sub-basal lanceolate acute prophylla, 1.5 mm. long, which reach the calyx; the calyx patelliform, 3 mm. across, deeply lobed, the lobes membranous, ovate-deltoid, obtuse or subacute, sparsely ciliate; corolla rotate, 7 mm. across, the petals ovate, 3 mm. long, ciliate, one-fifth connate at the base; stamens 4, longer than the petals, the anthers oblong-ovoid, 0.75 mm. long; the rudimentary ovary subglobose-ovoid, 1.5 mm. in diameter, the apex truncate or obtuse. Pistillate flowers: pedicels 1–3 mm. long; calyx and corolla as in the staminate flowers; staminodes slightly shorter than the petals, the sterile anthers ovate; ovary ovoid, the stigma discoid, plane, distinctly lobed. Fruit red, globose, 6–9 mm. in diameter, appearing subsessile, the persistent calyx explanate, quadrangular, the stigma 2–4-lobed, discoid. Pyrenes 1–4, often 2; when two, oblong-elliptic or subcircular in outline, dorso-ventrally compressed, the ends obtuse or rounded, the back convex, longitudinally and subpalmately striate and sulcate, 5–7 mm. long, 5 mm. wide, the ventral side also striate-sulcate; when four, oblong in outline, 3.5 mm. wide at the back; the endocarp thick and woody.

CHINA: Yunnan: Li-kiang, *R. C. Ching 20243* (A), *21576* (A); *K. M. Feng 3101* (A), *3179* (A); *J. F. Rock 3427* (A, US); *C. Schneider 2845* (A); *T. T. Yu 14921* (A); Hokin near Sung-kwei, *K. M. Feng 6921* (A); western Yunnan, *G. Forrest 10171* (A), *10224* (A), *10426* (A), *11071* (A), *12528* (TYPE of *Ilex dipyrena* var. *connexiva*, fragment in A), *19817* (A, US), *20096* (A, US), *20101* (A, US), *21023* (ISOTYPE of *I. bioritsensis* var. *integra*, A), *25362* (A); Cai-pou, *E. E. Maire 125* (A); west of Ta-li, *J. F. Rock 6781* (A, US); mountain of Londjre, *J. F. Rock 8906* (A, US); Wei-hsi, *J. F. Rock 11701* (A, US); locality not given, *H. T. Tsai 57186* (A), *57360* (A), *57339* (A); Wei-si, *C. W. Wang 67917* (A), *70400* (A); Atungtze, *T. T. Yu 5773* (A), *7826* (A), *7831* (A), *8486* (A), *10610* (A), *11171* (A). Sikang: Zayul, *Kingdon Ward 10990* (B).

INDIA: East Himalaya, *Griffith 2011* (NY); Simlah, *Griffith* (NY); Chakrata, *M. A. Hamid* (NY); Ramilchet, *G. Kasilingarn* (NY); Punjab, *W. Koelz 1990* (NY); Chamba, *W. Koelz 8857* (NY); Mussoorie, *R. R. Steward 14895* (NY); Kumson, *R. Strachey & J. E. Winterbottom 3* (G); *Wallich 4327* (TYPE, fragments in A).

UPPER BURMA: *F. K. Ward 342* (NY).

CULTIVATED: Many specimens from botanical gardens of America and Europe have been examined.

Ilex dipyrena was first described from Nepal, where it is called "caulah." According to Wallich, it "blossoms from April to July." Now, as our knowledge of the flora of southwestern China has increased, we know that it is a common and wide-spreading species in Yunnan Province, where it grows as a tree (sometimes as a shrub, after cutting by fuel-gatherers) in mixed forests, in ravines, or on slopes of mountains at an altitude of 2000–3000 m. The fruit is greenish yellow in October and red in December.

As Wallich remarked, "This species varies considerably in the shape and serratures of the leaves. Generally they are oblong and remotely serrate; sometimes, however, they are of a more ovate form, rounded at the base, the margins sinuated and marked with pretty strong unequal spinous serratures." This statement is true; varieties based on differences in leaf margin are not worthy of taxonomic recognition. *Rock 11701* serves as a good example. On that sheet, there are subentire leaves which resemble *Ilex dipyrena* var. *connexiva,* less spinose leaves which resemble *Ilex dipyrena* var. *paucispinosa,* and very spinose leaves. In specimens collected from Yunnan, the pyrenes vary from one to four. In the double-pyrened fruits there are often one or two small globose masses of stone-cells which may indicate aborted pyrenes. The fruits of *H. T. Tsai 57360* contain three or four pyrenes. Yet its vegetative characters show it to be an example of *Ilex dipyrena.*

41. **Ilex wenchowensis,** sp. nov.

Frutex parvus; ramulis pubescentibus, foliis spinosis, coriaceis, ovatis, 3–4.8 cm. longis, 1.2–2.5 cm. latis; petiolo 1–2 mm. longo; costa supra impressa et puberulente; nervis lateralibus utrinque 4 vel 5, supra evidentibus, subtus obscuris; inflorescentiis fasciculatis, unifloribus; pedicellis 1 mm. longis, prophyllis ciliatis; calycibus 4-lobis, ciliatis; corolla rotata, 6–7 mm. diametro, petalis oblongis, 3 mm. longis, 2.5 mm. latis, ciliatis, one-fifth connatis; staminibus 4, quam petalos aequilongis; ovario abortu turbinato, 1 mm. longo, apice obtuso; fructibus depresso-globosis, 5–6 mm. longis, 8 mm. diametro, calycibus 2.5 mm. diametro donatis; stigmate umbilicato vel discoideo; pyrenis 4, suborbicularibus, 5 mm. longis, 4.5 mm. latis, dorso palmatim striatis et depressis, lateralibus striatis et sulcatis.

An evergreen shrub up to 2 mm. high with pubescent branchlets, spinose ovate leaves, fasciculate inflorescences, depressed globose fruits and 4 palmately striate and dorsally depressed pyrenes.

Branchlets pubescent, castaneous; third year's growth 3.5 mm. in diameter, the lenticels lacking, the leaf-scars suborbicular, not elevated; current year's growth 3 mm. in diameter, angular and pubescent, the terminal buds narrowly conic, pubescent, unfolding after anthesis. Leaves occurring even on the third year's growth, 5–10 mm. apart; stipules minute, obscure; petioles 2 mm. long, one-twenty-fifth to one-eighteenth the length of the lamina, puberulous; lamina coriaceous, olivaceous, slightly shiny above, ovate, 3–4.8 cm. long, 1.2–2.5 cm. wide, truncate or rounded at the base, acuminate and spinose at the apex; margin sinuate, with 3–7 spines on each side, the midrib slightly impressed and pubescent above, slightly elevated beneath, the lateral nerves 4–5 pairs, evident above, obscure below. Inflorescence fasciculate, axillary on second year's growth, the individual branches of the fascicles all uniflorous; flowers all 4-merous. Staminate flowers: pedicels 1 mm. long, puberulous, with 2 large ciliate basal prophylla extending to the calyx; calyx patelliform, 2 mm. in diameter, deeply 4-lobed, the lobes deltoid, obtuse, ciliate; corolla rotate, 6–7 mm. across, the petals oblong, 3 mm. long, 2.5 mm. wide, sparsely ciliate, one-fifth connate at the base; stamens 4, equaling the petals in length, the anthers ovoid; rudimentary ovary conic, 1 mm. long, the apex obtuse. Pistillate flowers not seen. Infructescences fasciculate, the pedicels 4–5 mm. long, puberulous, with 2 sub-basal ovate ciliate prophylla, the persistent calyx explanate, 2.5 mm. in diameter. Fruit (immature) depressed-globose, longitudinally grooved, 5–6 mm. long, 8 mm. in diameter, the stigma thin-discoid or navel-like. Pyrenes 4, suborbicular in outline, 5 mm. long, 4.5 mm. wide, the dorsal surface palmately striate, esulcate and longitudinally depressed, the sides reticulately striate and sulcate, the endocarp woody.

CHINA: Chekiang: Wenchow, *R. C. Ching 1819* (TYPE, A; US), *1820* (fruit, A; staminate flowers, US).

Ilex wenchowensis is localized in southeastern Chekiang, where it occurs on bushy slopes at an altitude of 600 m. There it flowers in May. It is closely related to *Ilex pernyi* Franch. which differs in having smaller leaves (1.3–2.5, rarely 3 mm. long) with one or two spines on each side and oblong or obovate pyrenes, impressed only at the broader ends. From *Ilex bioritsensis* Hayata it differs in having 4 pyrenes. From *Ilex centrochinensis* S. Y. Hu it differs in its very short petioles and median longitudinally impressed pyrenes.

42. **Ilex pernyi** Franch. in Nouv. Arch. Mus. Hist. Nat. II, **5**: 221. 1883, Pl. Dav. **1**: 69. 1884; Oliv. in Hook. Ic. Pl. III, **6**: *pl. 1539*. 1886; Forbes & Hemsl. in Jour. Linn. Soc. Bot. **23**: 117. 1886; Loes. ex Diels in Bot. Jahrb. **29**: 436. 1900, in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. 78: 278 (Monog. Aquif. **1**: 278). 1901, et in Sarg. Pl. Wils. **1**: 78. 1911; Farrer in Jour. Roy. Hort. Soc. **42**: 77. 1916; Chun, Chin. Econ. Trees 223. 1921; Chung, Mem. Sci. Soc. China **1**: 141. 1924; Rehd. in Jour. Arnold Arb. **7**: 199. 1926, **8**: 156. 1927; Comber in Notes Bot. Gard. Edinb. **18**: 75. 1933; Chen, Ill. Man. Chin. Trees 658, *fig. 550*. 1937; S. Y. Hu in Ic. Pl. Omei. **2**: *pl. 162*. 1946.

An evergreen shrub or small tree up to 8 m. high with pubescent branchlets, very short petioles, small coriaceous ovate-lanceolate spinose leaves, fasciculate inflorescences, rather large globose drupes up to 8 mm. in diameter, and 4 palmately striate and sulcate pyrenes.

Branchlets straight, terete or subterete; third year's growth 4 mm. in diameter, apricot-colored, covered with a dirty gray pubescence, minutely rimulose, the lenticels lacking; second year's growth 3 mm. in diameter, dirty gray, densely pubescent; current year's growth 2 mm. in diameter, angular, pubescent, fulvous, the terminal buds ovoid-conic, acute, pubescent. Leaves occurring even on the fifth year's growth, crowded together, appearing sessile; stipules callose, deltoid, acute, 0.75 mm. long, 0.5 mm. wide; petioles very short, 2 mm. long, one-twelfth to one-eighth the length of the lamina, pubescent; lamina coriaceous, olivaceous, ovate or ovate-lanceolate, 1.3–2.5 cm., rarely 3 cm. long, 5–14 mm. wide, broadest between the two anterior spines; base rounded or truncate; apex triangularly acuminate, the acumen 12–14 mm. long, terminated by a strong spine 3 mm. long; margin sinuate-dentate, 1–3 spines (usually 2) on each side, the two anterior ones strongest; midrib slightly impressed above, puberulent near the base, gradually becoming obscure toward the apex, elevated beneath, the lateral nerves 1–3 pairs, obscure beneath. Inflorescence fasciculate, axillary, on second year's growth; individual branches of the fascicles all uniflorous, the bracts lanceolate, membranous; pedicels sparsely puberulent, ciliate; flowers all 4-merous. Staminate inflorescence: pedicels 1 mm. long, glabrous, with 2 suborbicular ciliate super-median prophylla; the calyx 2 mm. across, deeply 4-lobed, the lobes broad-deltoid or semi-orbicular, ciliate; the corolla rotate, 7 mm. across, the petals 3 mm. long, broad-elliptic, the apical half ciliate; stamens slightly longer than the petals, the anthers 1 mm. long; the rudimentary ovary conic-ovoid, 1.5 mm. long, the apex obtuse. Pistillate inflorescence: pedicels 2 mm. long; calyx as in the staminate flowers; corolla choripetalous, erect, the petals ovate, 2.5 mm. long; the staminode two-thirds as long as the petals, the sterile anthers ovate; the ovary ovoid, the stigma discoid. Fruit globose or depressed-globose, 7–8 mm. in diameter, the persistent calyx quadrangular in outline, 2.5 mm. across, ciliate, the stigma thick-discoid, distinctly 4-lobed. Pyrenes 4, obovate or oblong in outline, 4.5–5.5 mm. long, 3–3.5 mm. wide, impressed on the back at the wider end, palmately striate and sulcate on the back, reticularly striate and sulcate along the sides, the endocarp thick, woody.

CHINA: Anhwei: Wu-yuan, *R. C. Ching 3245* (A). Kiangsi: Hwang-lung-shan, *Y. K. Hsiung 5627* (A). Hupei (Hupeh): Pa-tung-hsien, *H. C. Chow 337* (A, NY); W. Hupei, *W. Y. Chun 3808* (A), *4172* (A), *4153* (US); *A. Henry 5298* (US), *5298A* (A, NY); Ichang, *E. H. Wilson 119* (staminate, A, US), *119A* (fruit, A, US), *271* (A, NY, US). Kweichow: *Perny* (ex Franchet). Kansu: Feng-s'an-ling, *Farrer 16*. Shensi: Tsing-ling, *David*. Szechuan: Mt. Uo-mi San [Mt. Omei], *Fr. Hugh* in 1899 (B); Kwang-yun-hsien, *F. T. Wang 22595*. Sikang: Pau-hsien-hsien (Mu-pin), *K. L. Chu 2456* (SS), *3090* (SS); Tien-chuan, *Y. S. Liu 1313* (A).

CULTIVATED: I have seen cultivated specimens from the Royal Botanic Gardens at Kew, England, from J. A. Havemeyer, and from the Arnold Arboretum.

Ilex pernyi is endemic to the Tsing-ling Range, the climatic barrier in central China responsible for the very different aspects of the floras of North and South China. *Ilex pernyi* is found on both sides of this range, from Kansu down to the foothills of Hwang-shan in Anhwei. On the western limit of its area of distribution, the plant, as Farrer reported, grows as an "ugly and graceless little dumpy shrub . . . woodland of the drier ranges." On the eastern and southern sections of its area of distribution it is a shrub or small tree in forests growing at an altitude of 1800 m. (ex Chun). It flowers in April and May, and the fruit becomes red in October.

On the field notes attached to the specimen labeled *W. Y. Chun 4172*, the collector is erroneously recorded as "*R. C. Ching*."

The fruits of *Y. S. Liu 1313* contain either two or three pyrenes. This may indicate that the two-pyrened *Ilex bioritsensis* Hayata is nothing but a variety of *Ilex pernyi*. The small ovate-lanceolate shiny leaves and the palmately striate-sulcate, thickly woody endocarp of *Ilex pernyi* closely relate it to *Ilex georgei* Comber, which differs in having only two pyrenes.

43. **Ilex georgei** Comber in Notes Bot. Gard. Edinb. **18**: 50. 1933; Hand.-Mzt. Symb. Sin. 7: 656. 1933; Merr. in Brittonia 4: 100. 1941.

Ilex pernyi Franch. var. *manipurensis* Loes. in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. **78**: *279* (Monog. Aquif. **1**: *279*). 1901.
Ilex pernyi sensu Loes. in Sarg. Pl. Wils. **1**: *78*. 1911, in part.

A spinose-leaved evergreen shrub up to 6 m. high with pubescent branchlets, lanceolate (rarely ovate) leaves, fasciculate inflorescences, obovoid-ellipsoid red fruits each with 1 or 2 pyrenes.

Branchlets rather stout, pubescent, cinereous or light brown; third year's growth 4 mm. in diameter, hirsute, the lenticels lacking; second year's growth 3.5 mm. in diameter; current year's growth subterete, 2–2.5 mm. in diameter, longitudinally shallowly striate-sulcate, densely pubescent, the terminal bud conic, pubescent. Leaves occurring even on the fourth year's growth, 2–5 mm. apart; stipules broadly ovate, acute; petioles 1–2 mm. long, one-twentieth to one-fifteenth the length of the lamina, pubescent, often covered by the decurrent base of the leaf; lamina thickly coriaceous, olivaceous, shiny above, opaque beneath, lanceolate, ovate-lanceolate or rarely ovate, 2–4.5 mm. long, 7–15 mm. wide; rounded or cordate at the base; acuminate at the apex, the acumen 10 mm. long, terminating in a spine 3 mm. long; margin thickened, recurved, subentire, with 4–7 spines on each side; midrib pubescent, shallowly impressed above, elevated beneath, the lateral nerves 5–7 on each side, indistinct above, evident beneath, the reticulation of the veinlets obscure on both surfaces. Inflorescences fasciculate, axillary on second year's growth. Staminate inflorescences: individual branches of the fascicles 1–3-flowered, the uniflorous pedicels 2–4 mm. long, when 3-flowered the peduncles 1 mm. long, both sparsely and minutely pubescent, the bracts membranous, ovate, obtuse, ciliate, the prophylla 2, membranous, submedian, pubescent; flowers 4-merous, calyx 1.5–2 mm. across, 4-lobed, lobes ovate, obtuse or rounded, ciliate; corolla rotate, 4–5 mm. across, the petals 2 mm. long, minutely and sparsely ciliate, one-tenth connate at the base; stamens longer than the petals, the anthers oblong; rudimentary ovary subglobose or ovoid, obtuse at the apex, sometimes obscurely 2-lobed. Pistillate flowers not seen. Fruit usually paired, obovoid-ellipsoid, 4–6 mm. long, 3–4 mm. thick, the pedicels 2 mm. long, pubescent, the persistent calyx ciliate, the stigma discoid. Pyrenes 1 or 2, obovoid-oblong, rarely suborbicular in outline, slightly dorso-ventrally compressed, flattened on one side, 4.5 mm. long, 2.5–3 mm. wide, longitudinally (almost palmately) 7–9-striate and shallowly sulcate on the back, the ends obtuse, the endocarp thickly woody.

CHINA: Yunnan: Tengyueh, *G. Forrest 7577* (A), *9608* (A), *9712* (A), *16061* (fruit, ISOTYPE, A), *26251* (staminate flowers, ISOTYPE, A), *26254*

(US); *J. F. Rock 7677* (A, NY, US); San-ying-pa, *C. Schneider 394* (A); without precise locality, *H. T. Tsai 57247* (A); Mien-ning, *T. T. Yu 17967* (A). Sikang: Ta-chien-lu, *E. H. Wilson 119B* (A).

NORTH BURMA: *F. K. Ward 463* (A, NY).

Ilex georgei is confined to western and southwestern Yunnan and adjacent Burma, where it grows as a shrub in dense thickets, on dry slopes, or in side valleys at altitudes of 1800–2700 m. Its greenish staminate flowers appear in late March and on into May, and the fruit becomes red in October.

E. H. Wilson 119 is a mixture of material collected in Hupei and Sikang. The Hupei material has 4 pyrenes, while the Sikang (Ta-chien-lu) material has a much prolonged leaf-apex, as well as smaller fruits maturing only 2 pyrenes each. I have distinguished this latter material in the Arnold Arboretum herbarium as *119B*.

The indumentum and the lack of uniformity in the number of pyrenes of *Ilex georgei* closely relates it to *Ilex ciliospinosa* Loes., but in the latter the leaves are less coriaceous and ovate or ovate-elliptic in shape, with a less prominent apex. The fruit is larger (8–10 mm. long), as are the pyrenes.

44. **Ilex ciliospinosa** Loes. in Sarg. Pl. Wils. **1**: 78. 1911; S. Y. Hu in Ic. Pl. Omei. **2**: *pl. 161*. 1946.

Ilex bioritsensis Hayata var. *ciliospinosa* (Loes.) Comber in Notes Bot. Gard. Edinb. **18**: 43. 1933.

An evergreen shrub or small tree up to 7 m. high, with densely pubescent branchlets, elliptic or ovate-elliptic weakly spinose leaves, fasciculate inflorescences, ellipsoid drupes 8 mm. long, and 1–3 palmately striate and sulcate pyrenes.

Branchlets terete, dirty-gray, pubescent; fourth year's growth 4 mm. in diameter, reticulately rimulose, pubescent, the lenticels lacking, the leaf-scars broadly deltoid; second year's growth 3 mm. in diameter, densely pubescent, rugose; current year's growth subterete, longitudinally striate, light brown, densely pubescent, the terminal buds ovoid, pubescent, the apex cuspidate. Leaves occurring even on the fourth year's growth, 2–8 mm. apart; stipules callose, often tricuspidate; petioles 2–3 mm. long, one-fifteenth to one-tenth the length of the lamina, pubescent and rugose; lamina coriaceous, olivaceous, elliptic or ovate-elliptic, 2.5–4.5 cm. long, 1–2.5 cm. wide; round or rarely obtuse at the base; shortly acuminate or acute at the apex, the acumen 3–5 mm. long, terminating in a weak spine; margin serrate, with 4–6 spines on each side; midrib impressed and pubescent above, elevated and glabrous beneath, the lateral nerves 4–6 on each side, indistinct above, evident beneath, arching upward, near the margin reticulate. Inflorescences paucifasciculate, fascicles 2–5-flowered, axillary on last year's growth, the bud-scales persistent, ovate, acute, sparsely pubescent, ciliate, the bracts lanceolate, ciliate; the prophylla 2, median or submedian, not reaching the calyx, individual branches of the fascicles all uniflorous, the pedicels 2–3.5 mm. long, pubescent or glabrescent; flowers 4-merous. Staminate flowers: calyx 3 mm. broad, deeply lobed, the lobes ovate, deltoid, ciliate, obtuse or rounded at the apex; corolla rotate, 6 mm. broad, the petals ovate, 3 mm. long, 2 mm. wide, minutely ciliate at the apex, one-eighth connate at the base; stamens longer than the petals, the anthers oblong; rudimentary ovary ovoid, 1 mm. in diameter, the apical end indistinctly sulcate. Pistillate flowers: calyx as in the staminate flowers; corolla erect, choripetalous, 2.5 mm. long; staminodes about equaling the petals in length, the sterile anthers sagittate; ovary oblong, 2 mm. in diameter, truncate at the apex, the stigma discoid. Fruit solitary or paired, seldom 3 in a fascicle, ellipsoid, 8 mm. long, the pedicels 2–4 mm. long, pubescent or glabrescent, the persistent calyx 2–3 mm. across, quadrangular in outline, ciliate; the stigma thinly discoid. Pyrenes 1–3; obovoid in outline, palmately striate and sulcate, when 1, suggestive of a wheat-grain with a narrow shallow groove on the ventral side, when 2, (developing) dorso-ventrally compressed, slightly convex on the back, flat on the ventral side, when 3, obovoid, 6 mm. long, 4 mm. wide, the endocarp thick-woody.

CHINA: Szechuan: Mt. Omei, *W. C. Cheng 6591* (Sz); *C. Y. Chiao & C. S. Fan 871* (A); *W. P. Fang 14800* (Sz); *Y. S. Liu 1447* (A); *T. H. Tu 720* (SS); *E. H. Wilson 3316* (A); Opien-hsien, *W. C. Cheng 6216* (Sz), *6456* (Sz); *S. N. Hsu 69* (Sz); *C. Y. Yao 2808* (SS), *4279* (SS), *Y. S. Liu 2058* (A); *T. T. Yu 639* (A), *663* (A), *835* (A); Chien-shi-hsien, *E. H. Wilson 996* (ISOTYPE, A), Wa-shan, *E. H. Wilson 996A* (A); locality not clear, *E. H. Wilson 3319* (A). Yunnan: Mengtze, *A. Henry 11169* (A).

CULTIVATED: I have seen a specimen from Upper Bank Nurseries, located at Media, Pennsylvania.

Ilex ciliospinosa is endemic to western Szechuan, where it grows as a shrub or small tree in bamboo forests or in thickets at an altitude of 1700–2300 m. The greenish flowers appear in early May, and the fruit becomes red in September.

Comber, presuming that Wilson's specimens were juvenile forms, reduced *Ilex ciliospinosa* to a variety of *Ilex bioritsensis* Hayata. But Wilson's specimens were not juvenile forms, since most of the branchlets show plainly five years of growth. The leaves on the four-years' growth are the same in shape, texture, and margin as those on the current year's twigs. Furthermore, the specimen *T. T. Yu 663* was collected from a tree 20 feet high. The spines of the leaves of this specimen are as weak as those on a 5-foot shrub. In this spinose group of *Ilex,* the "species" show much intergradation in the size and dentation of the leaves, in the indumentum, and in the number of pyrenes. Hence the reduction of any of them to varieties would result, consistently, in further reductions. Probably all would end up as varieties of *Ilex dipyrena* Wall., the oldest binomial of the group. Morphologically there is just as much resemblance and just as much difference between *Ilex ciliospinosa* Loes. and *Ilex bioritsensis* Hayata as between *Ilex bioritsensis* and *Ilex dipyrena.* Until cytological and genetic techniques can be applied to this group, it is better to keep all the members in specific rank.

In its weak and more numerous spines and in the inconsistent number of its pyrenes (1–3), *Ilex ciliospinosa* is very closely related to *Ilex dipyrena,* which differs in having large (6–10 cm. long) leaves and glabrescent branchlets.

45. **Ilex bioritsensis** Hayata in Jour. Coll. Sci. Tokyo 30: 53. 1911; Comber in Notes Bot. Gard. Edinb. 18: 42. 1933; Kanehira, Formosan Trees 371, *fig. 325.* 1936.

Ilex veitchii Veitch, New Hard. Pl. W. China 4, 1912, nomen subnudum; Anon. in Gard. Chron. III. **52:** 289. 1912.

Ilex pernyi Franch. var. *veitchii* Bean, Trees Shrubs Hardy Brit. Isles **1:** 650. 1914, nomen nudum; Rehd. in Mitteil. Deutsch. Dendr. Ges. **23:** 263. 1914, descr.

Ilex diplosperma S. Y. Hu in Ic. Pl. Omei. **2:** *pl. 163.* 1946.

An evergreen shrub or small tree up to 10 m. high, with glabrescent or sparsely puberulent branchlets, ovate or quadrangular strongly spinose leaves, fasciculate inflorescences, large fruits (8–10 mm. in diameter) and two dorso-ventrally compressed, palmately striate and sulcate, thick-woody pyrenes.

Branchlets glabrescent or sparsely puberulent; third year's growth subterete, cinereous, 3–4 mm. in diameter, smooth, the lenticels lacking; second year's growth 2.5 mm. in diameter, longitudinally striate rugose; current year's growth 2 mm. in diameter, striate and ridged, the terminal buds puberulent, conic, acute at the apex, the scales ciliate. Leaves occurring even on the fourth year's growth, 5–15 mm. apart; stipules callose, ovate, 0.8 mm. long, acute, constricted near the base; petioles 3 mm. long, one-fifteenth to one-twelfth the length of the lamina, pubescent; lamina thick-coriaceous, olivaceous or ochraceous, shiny above, opaque beneath, ovate-quadrangular, 2.5–6 cm. long (usually 3 cm. long), 1.5–3.5 cm. (usually 2 cm.) wide; base rounded or truncate; apex acuminate, the acumen 5–15 mm. long, terminated by a spine 3 mm. long; margin sinuate, with 3 or 4 strong spines on each side; midrib sulcate above, puberulent, elevated beneath, the lateral nerves 4–6 pairs, evidently impressed above, obscure or slightly elevated beneath; reticulation of the veinlets obscure on both surfaces. Inflorescences fasciculate, axillary on the second year's growth, the individual branches of the fascicles all uniflorous, the bracts ovate, ciliate, 1.75 mm. long; flowers 2–4-merous. Staminate flowers: pedicels 2 mm. long, glabrous, with 2 large ovate ciliate prophylla extending to the calyx; the calyx patelliform, 3 mm. across, the lobes broadly deltoid, obtuse, sparsely ciliate; corolla rotate, the petals broad-elliptic, 3 mm. long, one-eighth connate at the base; stamens longer than the petals, the anthers oblong; rudimentary ovary ovoid, 1 mm. in diameter. Pistillate flowers: pedicels 2 mm. long, glabrous, with 2 basal prophylla; calyx as in the staminate flowers; corolla choripetalous; staminodes half the length of the petals, the sterile anthers cordate; ovary oblong-ovoid, 2–3 mm. long, the stigma thin-discoid. Fruit ellipsoid, 8–10 mm. long; the stigma discoid. Pyrenes 2, dorso-ventrally compressed, ovate or suborbicular in outline, 5–6 mm. long, 4–5 mm. wide, palmately 8–10-striate and sulcate on the dorsal surface, 5-striate on the ventral surface, the endocarp woody.

CHINA: Kweichow: Fan-ching-san, *Steward, Chiao & Cheo 390* (A, US), *774* (A, NY, US); *P. C. Tsoong 1041* (SS); Yin-kiang, *Y. Tsiang 7736* (NY), *7965* (NY). Szechuan: Nan-chuan-hsien, *W. T. Fang 640* (SS), *976* (A, SS); Mt. Omei, *W. P. Fang 3097* (A, NY), *12879* (A, Sz, US), *16431* (Sz); O-pien-hsien, *T. S. Chao 604* (SS); Muli, *J. F. Rock 5211* (A, US), *17368* (A, US); Ning-yuan-fu, *C. Schneider 942* (A); Lang-pa (Lolo-lang), *C. Schneider 1070* (A), *1523* (A); Wu-shan, *E. H. Wilson 1028* (A, NY, US); Yung-ching-hsien, Wa-wu-shan, *C. W. Yao 2224* (SS); without precise locality, *H. C. Chow 10005* (Sz). Yunnan: Li-kiang, *K. M. Feng 622* (A); Chung-tien, *K. M. Feng 966* (A); Yung-ning, *G. Forrest 20644* (US); Che-kia, *E. E. Maire 525* (A); Ho-kia-keou, *E. Maire 3330* (NY, US); Yi-liang-hsien, *H. T. Tsai 52130* (A); without precise locality, *T. T. Yu 5446* (A). Taiwan: *N. Fukuyama & T. Suzuki 15207* (TU); *E. Matuda 1208* (TU); *R. Kanehira & S. Sasaki 21807* (US); *E. H. Wilson 10058* (A, US).

CULTIVATED: I have seen sterile specimens of juvenile plants from Kew and the Arnold Arboretum under the name *Ilex pernyi* var. *veitchii* Rehd.

This plant was first recorded from Bioritsu, Taiwan. Additional material has been collected from Kweichow, Szechuan, and Yunnan. Both on the Island and on the mainland it grows in forests as a small tree up to 10 m. high. It flowers in late April.

All the spinose-leaved *Ilex* characterized by medium-sized leaves with rather strong spines and two-pyrened fruits have been placed under this species. There is great variation in its leaf-form and indumentum. The stems of some specimens are almost glabrous, but others are as pubescent as those of *Ilex pernyi* Franch.

46. **Ilex perryana**, sp. nov.

Ilex pernyi sensu Marquand in Jour. Linn. Soc. Bot. **48**: 168. 1929; sensu F. K. Ward in Gard. Chron. III, **92**: 232. 1932, non Franch.

Ilex pernyi Franch. forma, Anon. in Notes Bot. Gard. Edinb. **17**: 270. 1930.

Ilex pernyi Franch. var., Anon. in Notes Bot. Gard. Edinb. **17**: 304. 1930.

Ilex georgei Comber var. *rugosa* Comber in Notes Bot. Gard. Edinb. **18**: 51. 1933; Merrill in Brittonia **4**: 100. 1941.

Frutex prostratus; ramulis brevissime pubescentibus; foliis spinosis, crasse coriaceis, supra nitidis et rugosis, subrhomboideis, raro ellipticis, 1–3 cm. longis, 7–15 mm. latis, basi obtusis, raro rotundatis, costa supra impressa, subtus obscura; inflorescentiis paucifasciculatis, axillaribus; ♂ unifloribus, pedicellis 2–3.5 mm. longis, calycibus ciliatis, corolla rotata, petalis 1.5 mm. longis, eciliatis, staminibus quam petalis aequilongis vel longioribus; ♀ unifloribus, pedicellis 3–4 mm. longis, ovario ovoideo, 1.5 mm. longo; fructibus subgloboso-ellipsoideis, 6–7 mm. diametro; pyrena 1, subglobosa, dorso-ventraliter compressa, 5 mm. diametro, dorso palmatim striata et esulcata, ventro canaliculato, endocarpio lignescente.

A prostrate evergreen spinose shrub 20–30 cm. high with stout puberulent branchlets, small hexangularly subrhomboid rugose leaves, paucifasciculate inflorescences, small subglobose fruits, and a single palmately striate esulcate subglobose pyrene in each fruit.

Branchlets stout, straight, tuberculate with elevated leaf-scars, normal annual growth 2–3 mm. long, the third year's growth and the current year's growth almost alike in thickness and texture, 3–4 mm. in diameter, minutely puberulent, the lenticels lacking, the terminal buds ovoid, puberulent, well protected by crowded leaves or petioles. Leaves occurring even on sixth year's growth, 2–3 mm. apart; stipules callose, ovate, ca. 0.6 mm. long, acute, slightly constricted at the base; petioles 1–2 mm. long, one-fifteenth to one-tenth as long as the lamina, glabrous or minutely puberulent, dorso-ventrally flattened; lamina thick-coriaceous, olivaceous or brunneous-olivaceous, very shiny and rugose above, opaque and smooth beneath, hexangular-subrhomboid, rarely elliptic, 1–3 cm. long, 7–15 mm. wide; obtuse, rarely rounded at the base; broadly deltoid at the apex, the tip acute, terminated by a spine 2 mm. long; margin subentire-sinuate, with 2 or 3 spines on each side; midrib deeply impressed above, glabrous, slightly elevated beneath, the lateral nerves 3 or 4 pairs, deeply impressed above, obscure beneath, the reticulation of the veinlets impressed above, inconspicuous beneath. Inflorescence paucifasciculate, axillary on second year's growth; fascicles with 2–4 flowers, the bud-scales persistent, cartilaginous, suborbicular, glabrescent; flowers all 4-merous. Staminate inflorescences: individual branches of the fascicles uniflorous, the bracts ovate, obtuse, sparsely puberulent, ciliate; pedicels 2–3.5 mm. long, glabrous, with 2 submedian or basal glabrous ciliate prophylla; calyx patelliform, 3 mm. across, deeply 4-lobed, lobes ovate, 0.9 mm. long, 0.75 mm. wide at the base, glabrous, minutely ciliate; corolla rotate, 4–5 mm. across, the petals ovate, 1.5 mm. long, eciliate, one-sixth connate at the base; stamens equaling or slightly longer than the petals, the anthers ovoid-oblong, 0.75 mm. long; rudimentary ovary pulvinate, obscurely lobed. Pistillate inflorescences: individual branches of the fascicles uniflorous, the calyx and corolla as in the staminate; ovary ovoid, 1.5 mm. long, constricted below the discoid stigma. Fruit subglobose-ellipsoid, 6–7 mm. in diameter, the fruiting pedicels 3–4 mm. long, the stigma discoid, orbicular. Pyrene 1, subglobose, slightly dorso-ventrally compressed, 5 mm. in diameter, palmately striate and esulcate on the back, canaliculate on the ventral side, the endocarp thickly woody.

CHINA: Yunnan: *G. Forrest 17538* (A), *18006* (A); Newahlung, *T. T. Yu 19330* (A); Barcuhwang, *T. T. Yu 20942* (TYPE, A).

NORTH BURMA: *F. K. Ward 224* (A), *9873* (A).

Ilex perryana is a prostrate dwarf shrub confined to the alpine flora of eastern Himalaya, where it grows on open rocky slopes at altitudes of 3000–3650 m. The flowers appear in June and the fruit turns red in November.

In its small leaves, few spines, and subglobose pyrenes this alpine *Ilex* is closely related to *Ilex pernyi* Franch., which differs in having leaves with a smooth surface, prolonged apex, and truncate base, and fruits which are consistently 4-pyrened. It can easily be distinguished from all the other spinose species of *Ilex* by its prostrate habit, and its striate esulcate pyrenes.

The descriptions of the staminate and pistillate flowers were drawn respectively from *Ward 9873* and *Yu 19330*.

This species is named in honor of Dr. Lily M. Perry of the Arnold Arboretum, whose assistance and advice has been of great value.

Series 3. DENTICULATAE, ser. nov.

Arbor vel frutex; foliis crasse coriaceis, raro subcoriaceis, crenulato-serratis, serratis vel raro integris; inflorescentiis fasciculatis, pseudopaniculatis vel pseudoracemosis; floribus 4-meris; corolla ♂ basi connata, ♀ choripetala; fructibus globosis, stigmate umbilicato; pyrenis rugosis et caveatibus, raro palmatim striatis; endocarpio lapidoso.

Key to the Species

A. Ovary and fruit pubescent.
- B. Fruiting pedicels ca. 4 mm. long; leaves elliptic or ovate-elliptic, 3–7 cm. long, 1.3–2.5 cm. wide, the lower surface pubescent; petioles 3–6 mm. long. (Hainan and Indo-China) . . 47. *I. pubilimba.*
- BB. Fruiting pedicels ca. 8 mm. long; leaves oblong or oblong-elliptic, 10–15 cm. long, 4.5–7.5 cm. wide, the lower surface glabrous; petioles 20–22 mm. long. (Hainan) . . . . 48. *I. kaushue.*

AA. Ovary and fruit glabrous.
- B. Branchlets, leaves and inflorescences densely hirsute. (Kwangsi) . . . . 49. *I. nanningensis.*
- BB. Branchlets and inflorescences glabrous, glabrescent or puberulous, the leaves always glabrous.
  - C. Leaves thick-coriaceous, 10–17 cm. long, 4.5–7.5 cm. wide; individual branchlets of the staminate inflorescences 3–9-flowered. (East China and Japan) . . . . 50. *I. latifolia.*
  - CC. Leaves coriaceous or subcoriaceous, rarely up to 10 cm. long; individual branchlets of the staminate inflorescence 1–3-flowered.
    - D. Leaves entire; fruits 5 mm. in diameter, smooth when dry. (Taiwan) . . . . 51. *I. suzukii.*
    - DD. Leaves crenulate-serrulate, serrate or rarely subentire; fruits 6–15 mm. in diameter, when dry usually wrinkled.
      - E. Fruits 5–7 mm. in diameter; pyrenes 4–5 mm. long.
        - F. Leaves coriaceous, the apex obtuse or rarely abruptly and shortly acuminate; fruiting pedicels 4–8 mm. long.
          - G. Branchlets glabrous; margin of leaves densely and often irregularly serrate; infructescences pseudoracemose or fasciculate; fruiting pedicels 6–8 mm. long. (India and Southwest China) . . . . . . 52. *I. denticulata.*

GG. Branchlets puberulous; margin of leaves remotely serrate; infructescences fasciculate, the fruiting pedicels ca. 4 mm. long. (Hongkong and vicinity) ...... 53. *I. graciliflora.*

FF. Leaves subcoriaceous, the apex long-acuminate, the acumen 10–16 mm. long; fruiting pedicels 10–12 mm. long. (Kwangtung) .. 54. *I. tsangii.*

EE. Fruit 10–15 mm. in diameter; pyrenes 7–12 mm. long.

F. Mature fruit solitary; fruiting pedicels 2–4 mm. long; pyrenes obovate in outline, 10–12 mm. long. (Kwangsi) .... 55. *I. chingiana.*

FF. Mature fruits fasciculate; fruiting pedicels 6–10 mm. long; pyrenes 7–9 mm. long.

G. Leaves elliptic or obovate; reticulation of the veinlets prominent on both surfaces; pyrenes oblong in outline, both ends obtuse or one end emarginate. (Taiwan) .... 56. *I. uraiensis.*

GG. Leaves oblong, ovate-elliptic or oblanceolate; reticulation of the veinlets obscure above; pyrenes broad-elliptic in outline, the ends pointed.

H. Branchlets castaneous or nigrescent; leaves shiny above with caudate apex, the acumen 7–16 mm. long; the base obtuse or rounded. (South China) .... 57. *I. subficoidea.*

HH. Branchlets cinereous; leaves opaque on both surfaces, with acuminate apex, the acumen 5–10 mm. long; base cuneate. (Hainan) .... 58. *I. nuculicava.*

47. **Ilex pubilimba** Merr. & Chun in Sunyat. **5**: 109. 1940.

Ilex hirsuticarpa Tardieu-Blot in Not. Syst. XII. **15**: 120. 1945, et in Fl. Gén. Indo-Chine Suppl. **1**: 776. 1948. *Syn. nov.*

A densely pubescent evergreen tree up to 15 m. high with coriaceous, elliptic, shortly acuminate, crenate-serrate leaves, fasciculate inflorescences, pubescent ovary, short fruiting pedicels (2–4 mm.), and depressed globose fruits 7 mm. in diameter.

Branchlets straight, subterete, fuscous when dry; third year's growth 4 mm. in diameter, pubescent, longitudinally rimulose, the lenticels obscure, the leaf-scars semi-orbicular; second year's growth pubescent; current year's growth 2–2.5 mm. in diameter, subterete, very densely pubescent, the indumentum fuscous; terminal buds small, naked, pubescent. Leaves occurring also on the second year's growth, 2–12 mm. apart; stipules callose, deltoid, pubescent at the base; petioles 3–6 mm. long, one-twentieth to one-twelfth the length of the lamina, densely pubescent, canaliculate above; lamina thick-coriaceous, when dry cinereous-olivaceous and shiny above, paler with over-all pubescence beneath, elliptic, rarely ovate-elliptic or lanceolate, 3–7 cm. long, 1.3–2.5 cm. wide; base rounded, obtuse or cuneate; apex shortly acuminate, the acumen 3–10 mm. long, the tip obtuse; margin crenate-serrate, slightly recurved when dry; midrib impressed and pubescent above, elevated beneath, lateral nerves obscure. Inflorescence fasciculate, axillary, on last year's growth, short-pedicellate; bracts ovate to semi-orbicular, densely pubescent; flowers 4-merous. Staminate flowers: individual branches of the fascicles 1–3-flowered, 3-flowered branches cymose, the peduncle 0.5–1 mm. long, the pedicels 2–3 mm. long, with 2 basal prophylla; calyx patelliform, 1.5–2 mm. in diameter, rugose, 4-lobed, the lobes rounded, ciliate; corolla rotate, 6 mm. in diameter, the petals oblong, 2.5 mm. long, ciliate, one-ninth connate at the base; stamens slightly shorter than the petals, the anthers ovoid, 0.75 mm. long; rudimentary ovary conical, 1 mm. in diameter, the apex obtuse. Pistillate flowers: individual branches of the fascicles uniflorous, the calyx and corolla as in the staminate flowers; staminodes one-third the length of the petals, the sterile anthers ovate; ovary subglobose, 1.75 mm. in diameter, sparsely but distinctly pubescent, the stigma discoid, convex. Fruit depressed globose, 7 mm. in diameter, the fruiting pedicel 3–4 mm. long, pubescent, the persistent calyx explanate, orbicular in outline, 2 mm. across, shallowly 4-lobed, the lobes ciliate, the stigma thinly discoid, orbicular. Pyrenes 4, suborbicular or oblong in outline, 4–5 mm. long, 3.5–4 mm. wide, rugose, flattened or slightly impressed on the back, the endocarp woody.

CHINA: Hainan: Kan-en, *S. K. Lau 5974* (A); Bak-sa, *S. K. Lau 25742* (material for the description of the staminate flower) (A); *S. K. Lau 26069* (material upon which description of the pistillate flower is drawn) (A); Yai-chow, *H. Y. Liang 62579* (A, K, NY, US), *62624* (TYPE, A; K, NY, US); without precise locality, *H. Y. Liang 63624* (A, NY); *C. Wang 35188* (A, NY).

INDO-CHINA: Tonkin: *W. T. Tsang 30339* (A); Annam: *Poilane 8235* (A, ISOTYPE of *I. hirsuticarpa*).

Ilex pubilimba Merr. & Chun has been recorded from Hainan Island and Indo-China, where it grows as a big tree in mixed forests. The whitish yellow flowers appear in March.

The vegetative characters, especially the indumentum, and the leaf form of *Ilex pubilimba* are very similar to those of the very closely allied species *Ilex nanningensis* Hand.-Mzt. Professor Merrill has written on the type specimen and on other Hainan material "= *Ilex nanningensis* Hand.-Mzt." On closer examination, however, these two species can easily be distinguished from each other by the size of their fruits, the length of the petioles and fruiting pedicels, and the indumentum of the ovary. In *Ilex nanningensis* the fruits are 10 mm. in diameter, the petioles one-tenth to one-sixth as long as the lamina, the fruiting pedicels 6–8 mm. long, and the ovary glabrous. In *Ilex pubilimba* the fruits are 7 mm. in diameter, the petioles one-twentieth to one-twelfth as long as the lamina, the fruiting pedicels 3–4 mm. long, and the ovary pubescent.

48. **Ilex kaushue,** sp. nov.

Arbor; ramulis pubescentibus; foliis oblongis vel oblongo-ellipticis, 10–15 cm. longis, 4.5–7.5 cm. latis, basi obtusis vel cuneatis, apice acutis vel breviter acuminatis, margine serratis vel biserratis; costa supra impressa pubescente, subtus elevata, nervis lateralibus 14 vel 15 paribus; inflorescentiis fasciculatis vel pseudoracemosis, pedicellis 8 mm. longis, pubescentibus; fructibus subglobosis, 11 mm. longis, 9–10 mm. diametro; pubescentibus; calycibus persistentibus ciliatis, stigmate umbilicato; pyrenis 4, ca. 7.5 mm. longis, 4.5–5 mm. latis, endocarpio lapidoso.

An evergreen tree with densely puberulent branchlets, large oblong thin-coriaceous serrate or double-serrate leaves, fasciculate infructescence, large subglobose puberulent fruits, and 4 reticulately striate sulcate wrinkled and pitted pyrenes.

Branchlets straight, subterete, brown, longitudinally ridged and canaliculate; second year's growth 4 mm. in diameter, the lenticels lacking, the leaf-scars deltoid-semi-orbicular; current year's growth angular, longitudinally plicate, 3.5 mm. in diameter; densely puberulent especially in the grooves; terminal buds acute-conic, pubescent. Leaves occurring also on second year's growth, 10–18 mm. apart; stipules callose, often hidden; petioles pubescent, slender, 20–22 mm. long, one-sixth to one-fifth the length of the lamina, subterete and angular, very narrowly canaliculate above; lamina thin-coriaceous, brunneous-olivaceous, shiny above, paler and opaque beneath; oblong or oblong-elliptic, 10–18 cm. long, 4.5–7.5 cm. wide; base obtuse or cuneate; apex acute or very shortly acuminate, the acumen 3–6 mm. long; margin serrate or double-serrate; midrib impressed, sparsely and minutely puberulent above, prominent, elevated and keeled beneath, the lateral nerves in 14 or 15 pairs, prominent on both surfaces; the reticulation of the veinlets dense and evident on both surfaces. Infructescences fasciculate or pseudoracemose, the rachis up to 9 mm. long, densely puberulent; bracts caducous, the lower persistent ones cartilaginous, broad-deltoid, obtuse, coarsely ciliate, the basal appendages acute, pubescent; pedicels 8 mm. long, pubescent; persistent calyx explanate, ca. 5 mm. across, puberulent, 4-lobed, the lobes broad-deltoid, very acute or cuspidate, sparsely ciliate. Fruit subglobose or ellipsoid, ca. 11 mm. long, 9–10 mm. in diameter, the exocarp densely puberulent, the stigma navel-like. Pyrenes 4, oblong in outline, ca. 7.5 mm. long, 4.5–5 mm. wide, reticulately striate and sulcate, wrinkled and pitted, the endocarp stony.

CHINA: Hainan: Taam-chau, *W. T. Tsang 864* (LU 16363) (TYPE, A; LU, US).

This species is endemic to Hainan Island. The local name is "kaushue." In September the fruits become yellow.

The large leaves, the pseudoracemose infructescences, and the wrinkled and pitted pyrenes of *Ilex kaushue* suggest a relationship with *Ilex latifolia* Thunb., but the latter has smaller glabrous fruits, glabrous branchlets, and thick-coriaceous leaves with no evident reticulations of the veinlets.

On the labels distributed by the Herbarium of Lingnan University, the notation "flowers yellow" is given. Since the specimens at hand show no evidence of the flowering stage, I assume that there may have been a mechanical error in the preparation of the labels. The color yellow as given undoubtedly refers to the fruit, since the specimen was collected in September.

49. **Ilex nanningensis** Hand.-Mzt. in Sinensia 5: 2. 1934; Chun in Sunyat. 4: 225. 1940.

A densely pubescent evergreen tree up to 20 m. high with coriaceous elliptic or lanceolate, shortly acuminate crenate-serrate leaves, fasciculate inflorescences, large subglobose fruits, 10 mm. in diameter, and long fruiting pedicels (8 mm. long).

Branchlets straight, fuscous when dry; third year's growth 4 mm. in diameter, pubescent, smooth, inconspicuously longitudinally rimulose, the lenticels lacking, the leaf-scars semi-orbicular; second year's growth densely pubescent; current year's growth subterete or angular, 2.5 mm. in diameter, fuscously and densely pubescent, the terminal buds naked, small, pubescent. Leaves occurring even on the fourth year's growth, 3–10, sometimes up to 15 mm. apart; stipules callose, deltoid, falcate, very acute, pubescent at the base; petioles 7–10 mm. long, one-tenth to one-sixth the length of the lamina, pubescent, the distal half narrowly winged by the decurrent leaf-base, canaliculate above; lamina thick-coriaceous, cinereous-olivaceous when dry, shiny above, dusty brown beneath, elliptic, very rarely lanceolate or ovate-elliptic, 5–8 cm. long, 1.5–3.5 cm. wide; obtuse or cuneate at the base; very shortly and gradually acuminate at the apex, the acumen broad-deltoid, 5–12 mm. long, often nigrescent; margin crenate-serrate, slightly recurvate when dry; midrib impressed and pubescent above, elevated beneath, the lateral nerves 7 or 8 pairs, obscure above, evident beneath, the reticulation of the veinlets sometimes evident beneath. Inflorescence fasciculate, axillary, on the second year's growth, fascicle 2–5-flowered, the bracts ovate-reniform, mucronate, or cuspidate, ciliate; flowers 4-merous. Pistillate flowers: individual branches of the fascicles uniflorous, the pedicels 6–8 mm. long, pubescent, with 2 submedian long-deltoid pubescent prophylla; calyx patelliform, 3 mm. across, the lobes shallow, rounded, 0.5 mm. long, 1.5 mm. wide, rugose, very sparsely and minutely puberulent, ciliate; corolla rotate, 8 mm. in diameter, the petals 3 mm. long, 2 mm. wide, the apical portion ciliate; staminodes slightly shorter than the petals, the sterile anthers sagittate; ovary large, ovoid, 3 mm. long, 2.5 mm. wide, the apical end truncate, the stigma discoid. Staminate flowers not seen. Fruit subglobose, 8 mm. long, 10 mm. in diameter, the stigma flat, orbicular, 2 mm. across, the persistent calyx explanate, orbicular, 3 mm. across, ciliate; the fruiting pedicels 8 mm. long, the exocarp thin, the mesocarp fleshy, abundant. Pyrenes 4, oblong in outline, 6.5 mm. long, 5.5 mm. wide, rugose, reticulately striate, flattened and broadly depressed on the dorsal surface, the endocarp woody.

CHINA: Kwangtung: Sin-fung, *Y. W. Taam 271* (A). Kwangsi: Seh-feng-dar-shan, *R. C. Ching 8082* (ISOTYPES LU, NY; fragments, A); Sup-man-ta-shan, *H. Y. Liang 69851* (A); Shap-man-taai-shan, *W. T. Tsang 22073* (A). Hainan: Ba-tung, *S. K. Lau 28238* (A).

Ilex nanningensis was first described from a specimen collected in the high mountains south of Nanning, Kwangsi Province. From the material at hand, it appears to be endemic to the mountain range between Kwangsi and Indo-China. There it grows as a big tree in woods or mixed forests at an altitude of 600 m. The fragrant yellow flowers appear in April and the fruit turns bright red in October.

It should be noticed that the Kwangsi localities all refer to one mountain range, the name of which is variously transliterated by persons speaking different dialects. The preferred spelling is "Shih-wan-ta-shan."

The large fruit, the big rugose pyrenes, and the form and shape of the leaves of this species ally it closely to *Ilex subficoidea* S. Y. Hu, which differs in having glabrous branchlets and leaves.

50. **Ilex latifolia** Thunb., Fl. Jap. 79. 1784; Willd. Sp. Pl. 1(2): 708. 1797; Persoon Syst. Veg. 174, 1797, et Syn. Pl. 1: 151. 1805; Poir. in Lam. Encycl. Suppl. 3: 66. 1813; Roem. & Schult., Syst. 3: 488. 1818; DC. Prodr. 2: 16. 1825; Spreng. Syst. 1: 494. 1825; Dietr. Syn. Pl. 1: 556. 1839; Sieb. & Zucc. in Abh. Bay. Ak. Wiss. IV, 2: 148 (Fl. Jap.). 1845; Regel in Gartenfl. 13: 38. 1864; Hook. in Bot. Mag. 22: *pl. 5597*. 1866; Miq. in Ann. Mus. Bot. Lugd.-Bat. 3: 105. 1867; Maxim. in Mém. Acad. St. Pétersb. VII, 29(3): 29, 43, *pl. 1, fig. 2*. 1881; Loes. in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. 78: 289 (Monog. Aquif. 1: 289). 1901; Moore, Holly Yew Box 127. 1908; Chung in Mem. Sci. Soc. China 1: 140. 1924; Chien in Contr. Biol. Lab. Sci. Soc. China 3(1): 58. 1927; Rehd. in Jour. Arnold Arb. 8: 157. 1927; Hand.-Mzt., Symb. Sin. 7: 656. 1933; Belval, Mus. Heud. Nat. Bot. Chin. 2: 21. 1933; Kia, Pl. Sin. Ill. 491, *fig. 830*. 1937; Chen, Ill. Man. China Trees 660, *fig. 552*. 1937.

Ilex macrophylla Blume Bijdr. 1150. 1825; Dietr., Syn. Pl. 1: 556. 1839; Walp. Rep. 1: 540. 1842.

Ilex tarajo Hort. Göpp. in Gartenfl. 3: 325. 1854.

Ilex terago Anon. in Gard. Chron. 1859: 508, 972. 1859.

A very large, entirely glabrous evergreen tree up to 20 m. high, trunk 60 cm. in diameter (ex Ching) with large thick-coriaceous oblong serrate leaves, axillary paniculate staminate and racemose pistillate inflorescences, globose fruit with thick exocarp, and 4 bony wrinkled pyrenes.

Branchlets straight, stout, ochraceous or brown; second year's growth 5–7 mm. in diameter, longitudinally plicate, often rimose, the lenticels lacking or sparse, the leaf-scars elevated, broad-deltoid or semi-orbicular; current year's growth 4–5 mm. in diameter, striate, sulcate and angular, smooth and glabrous, tuberculate under a lens. Leaves occurring even on the third year's growth, 8–17 mm. apart; stipules very minute and callose, broad-deltoid, acute; petioles thick, short, rugose, 15–20 mm. long, one-eighth to one-seventh the length of the lamina, 3 mm. in diameter, subcylindrical, slightly impressed above, glabrous; lamina thick-coriaceous, olivaceous, shiny above, opaque beneath, oblong or ovate-oblong, 8–17 cm. long, 4.5–7.5 cm. wide; base rounded; apex obtuse or very shortly acuminate, the acumen 3–6 mm. long; margin serrate, the teeth nigrescent; midrib impressed above, strongly elevated beneath, the lateral nerves 15–17 pairs, obscure on both surfaces. Inflorescences pseudopaniculate, sessile, axillary, on the second year's growth; rachis 1–2 cm. long, 2–3 mm. thick, the bud scales persistent, imbricate, the outer ones cartilaginous, rounded, ca. 3 mm. long, 5 mm. wide, the inner ones membranous, larger; flowers 4-merous. Staminate inflorescence: individual branches of the pseudopanicles 3–9-flowered, cymose, the bracts ovate, 5–7 mm. long, 3–5 mm. wide, the peduncles 2 mm. long, the bracteoles hyaline, ovate or lanceolate, 2–3 mm. long, the pedicels 6–8 mm. long, with 1 or 2 sheath-like, broad-deltoid basal prophylla; calyx subcupuliform, 3.5 mm. in diameter, shallowly 4-lobed, the lobes rounded, ca. 0.75 mm. long, 1.75 mm. wide; corolla rotate, reflexed, ca. 9 mm. across, the petals ovate-oblong, ca. 3.5 mm. long, 2.5 mm. wide, one-eighth connate at the base; stamens equaling the petals in length, the anthers ovoid-oblong, ca. 1.25 mm. long, the filament twice as long; rudimentary ovary subglobose, ca. 1 mm. in diameter, the apex introrse, 4-lobed. Pistillate inflorescence: individual branches of the pseudopanicles 1–3-flowered, the peduncles of the 3-flowered cymes 2 mm. long, the pedicels of the uniflorous ones 5–8 mm. long, with 1 or 2 basal prophylla; calyx patelliform, ca. 3 mm. across; corolla erect, ca. 5 mm. across, the petals ovate, ca. 3 mm. long, 2 mm. wide; staminodes one-third the length of the petals, the sterile anthers minute, ovate; ovary ovoid, ca. 2 mm. wide at the base, the stigma 4-lobed discoid. Fruit globose, ca. 7 mm. in diameter, brown or reddish when dry, the stigma thinly discoid, explanate, the exocarp thick, smooth, minutely tuberculate under a lens, the persistent calyx explanate, 3–4 mm. across. Pyrenes 4, oblong-elliptic in outline, ca. 5 mm. long, 2.5 mm. wide, irregularly wrinkled and pitted, the dorsal surface with 3 distinct longitudinal ridges, the endocarps bony.

CHINA: Kiangsu: I-shing, *Ching & Tso 630* (A); *K. Ling 12377* (NY). Anhwei: Chu-wha-shan, *R. C. Ching 2626* (A, LU); Chi-men, *R. C. Ching 3155* (A); Wang-shan, *A. N. Steward 7140* (A, US). Chekiang: Tien-tai-shan, *R. C. Ching 1436* (A, US); Chen-chion, *R. C. Ching 1780* (A, LU, US); Tien-mo-shan, *R. C. Ching 5113* (A); Ning-po, *E. Faber* (NY). Fukien: *Dunn 2474* (A).

JAPAN: Honshu, *R. K. Beattie & Y. Kurihara 1014* (A); *U. Faurie 6122* (A); Nagasaki, *Maximowicz* in 1863 (G, NY); Yokohama, *Maximowicz* in 1862 (NY); *K. Sakurai* in 1901 (A), in 1913 (A); Hondo, *K. Shiota 7421* (A); *Siebold* (A); Mt. Kirishima, *E. H. Wilson 6253* (A), *10340* (A); Tokyo, *E. H. Wilson 6378* (A); *C. S. Sargent* (A); *K. Watanabe* in 1889 (G).

CULTIVATED: I have seen specimens from various botanical gardens of Europe and America.

Ilex latifolia was first recorded from Japan. Specimens have been collected from a few of the coastal provinces of China. It has been reported as common in central Chekiang Province. It grows in woods at an altitude of 100–700 m. and the flowers, which appear in April, are yellowish green. The fruits turn red in October.

In Chekiang and Fukien provinces the wood of this species is used for rolling-pins and other turned work. The bark is used for making birdlime and the leaves are used as a substitute for tea.

The large thick glossy leaves of *Ilex latifolia* are very characteristic. There is no other species of Chinese *Ilex* that has the like. In the structure of the inflorescence and flowers it is closely related to *Ilex denticulata* (Wall.) Wight, which differs in having smaller leaves and fruits.

51. **Ilex suzukii**, sp. nov.

Frutex; ramulis glabris; foliis coriaceis, ellipticis, 2.5–4 cm. longis, 1.5–2.2 cm. latis, integris, basi acutis vel cuneatis, apice breviter acuminatis vel obtusis, acuminibus 3 mm. longis, costa supra plana, subtus elevata, nervis lateralibus utrinque 5 vel 6, subtus prominentibus; inflorescentiis fructiferis paucifasciculatis, axillaribus, pedicellis 4 mm. longis, glabris; fructibus globosis, 5 mm. diametro, stigmate umbilicato, pyrenis 4, 3 mm. longis, 2 mm. latis, palmatim striatis, esulcatis, lignescentibus.

An evergreen shrub with glabrous branches, small elliptic entire leaves, fasciculate infructescences, globose fruit with a navel-like stigma and palmately striate, esulcate pyrenes.

Branchlets nigrescent, glabrous; third year's growth terete, 2.5 mm. in diameter, the lenticels lacking, the leaf-scars semi-orbicular, slightly elevated; current year's growth 1.5 mm. in diameter, longitudinally ridged, angular, the axillary buds large, globose, the terminal bud acute-conic, glabrous, the scales densely ciliate. Leaves occurring even on the fourth year's growth, 2–6 mm. apart; stipules very minute, often obscure; petioles 5–7 mm. long, one-eighth to one-fifth as long as the lamina, narrowly canaliculate above, glabrous; lamina coriaceous, brunneous-olivaceous when dry, somewhat shiny above, opaque beneath, elliptic, 2.5–4 cm. long, 1.5–2.2 cm. wide, acute or cuneate at the base, obtuse or very shortly acuminate at the apex, the acumen 3 mm. long; margin entire; midrib plane above, slightly elevated beneath, the lateral nerves 5 or 6 pairs, obscure above, prominent beneath, the reticulation of the veinlets obscure above, prominent beneath. Flowers not seen. Infructescences paucifasciculate, axillary, on the second year's growth, the fascicles with 2 or 3 fruits, the individual branches of the fascicles uniflorous, the bracts suborbicular or ovate, ciliate; fruiting pedicels 4 mm. long, glabrous, with 2 minute deltoid ciliate prophylla at the base. Fruit globose, 5 mm. in diameter, castaneous, smooth and shiny when dry, the persistent calyx explanate, orbicular in outline, 2.5 mm. in diameter, shallowly 4-lobed, the lobes rounded, ciliate, the stigma navel-like, 4-lobed. Pyrenes 4, oblong-obovate in outline, the ends obtuse, 3 mm. long, 2 mm. wide, palmately striate and esulcate, the striae slightly elevated, the endocarp woody.

CHINA: Taiwan: Taheizan, *S. Suzuki* in 1928 (TYPE, A; ISOTYPE, TU).

The entire leaves, the prominent venation, the striate and esulcate pyrenes of *Ilex suzukii,* indicate close relationship with *Ilex mertensii* Maxim. However, the latter species has large thick-coriaceous leaves 5–9(–16) cm. long and, also, large fruits 8–9 mm. in diameter. This species has been mistakenly identified as *Ilex hanceana* Maxim. in the past. This last species can readily be distinguished by the pubescent branchlets, the short petioles (2–5 mm. long), the obscure veins, the fruiting pedicels 1–1.5 mm. long, and the smaller fruits.

52. **Ilex denticulata** Wall. List 4333. 1830, nom. nud.; Wight, Ill. Ind. Bot. 2: 147, *pl. 149.* 1850; Beddome, Fl. Sylv. 1: 142. 1869; Hooker f., Fl. Br. Ind. 1: 600. 1875; Maxim. in Mém. Acad. St. Pétersb. VII, 29(3): 29. 1881; Loes. in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. 78: 320 (Monog. Aquif. 1: 320). 1901.

Ilex nilagirica Miq. ex Hook. f., l. c.

A glabrous evergreen tree with coriaceous ovate-elliptic, elliptic, or oblong leaves, obtuse or shortly acuminate apices, serrate margins, pseudo-paniculate staminate and pseudoracemose pistillate inflorescences, globose fruits, and stony, irregularly striate, sulcate and wrinkled pyrenes.

Branchlets straight, glabrous, brunneous, second year's growth subterete, 3–5 mm. in diameter, minutely rimulose, the lenticels lacking, the leaf-scars deltoid, not elevated; current year's growth subangular, striate, 3 mm. in diameter; terminal buds narrowly conic, the scales cartilaginous, eciliate. Leaves occurring also on second year's growth, 1–2 cm. apart; stipules lacking or very minute, callose and nigrescent; petioles rather stout, 10–13 mm. long, one-fifth to one-seventh the length of the lamina, glabrous, narrowly or not at all sulcate above, rugose beneath; lamina coriaceous, olivaceous or cinereous-olivaceous, ovate-elliptic or elliptic-oblong, 5–10 cm. long, 2.5–3.7 cm. wide; base obtuse or cuneate; apex very shortly and abruptly acuminate or obtuse, the acumen 3–8 mm. long; margin densely and often irregularly denticulate-serrate, the teeth nigrescently apiculate; midrib glabrous, narrowly impressed above, elevated beneath, the lateral nerves 6–9 pairs, obscure above, prominent beneath, the reticulations obscure above, evident beneath. Staminate inflorescences: pseudo-paniculate, axillary, sessile, only on the second year's growth, the rachis 4–14 mm. long, the individual branches 1–3-flowered, the bracts obovate, acute, 4 mm. long, 2–5 mm. wide; 3-flowered cymes with peduncles 2 mm. long, the pedicels 2–3 mm. long, the uniflowered pedicels 5 mm. long, glabrous, with 2 submedian deltoid prophylla; flowers 4-merous; calyx patelliform, 2.5 mm. across, glabrous, the lobes deltoid, ca. 0.57 mm. long, 1 mm. wide, acute or acuminate, entire, eciliate; corolla rotate, 7 mm. across, the petals oblong, reflex, 3 mm. long, 1.5 mm. wide, one-tenth connate at the base; stamens equaling the petals in length, the anthers small, ovoid, ca. 0.75 mm. long; rudimentary ovary globose, the apex rounded and slightly depressed. Infructescences fasciculate or pseudoracemose, the central axis 5–10 mm. long, the individual branches uniflorous, the fruiting pedicels 6–10 mm. long, glabrous or sparsely puberulous. Fruits globose or depressed globose, 6–7 mm. in diameter, brown and smooth, the persistent calyx explanate, 3 mm. in diameter, the stigma navel-like, often depressed, 4-lobed. Pyrenes 4, oblong or elliptic in outline, irregularly striate, sulcate, wrinkled and pitted, ca. 4–5 mm. long, 3 mm. wide, the endocarp stony.

CHINA: Yunnan: Fo-hai, *C. W. Wang 77406* (A).

INDIA: Madras, *D. Brandis 666;* Nilghiri, *Ed. Hohenacker 1455* (A), *1456* (fragment, A); Culgherris, *Perrottet* (A); Nilghiri Hills, *E. H. Wilson; Wight 437* (ISOTYPE, G, NY), *438* (NY), *490* (fragment, A).

Ilex denticulata was first recorded from Nilghiri Hills of India as a large tree up to 12 m. high. Specimens collected from the type locality vary in the degree of their pubescence. Some of them (*Wight 437, 490; Hohenacker 1455*) are entirely glabrous, and others (*Hohenacker 1456*) are with slightly pubescent pedicels. In the form, size, and margin of the leaves, pubescence of the inflorescences, size of the fruit, and number and nature of the pyrenes, the Chinese specimens collected from southwestern Yunnan match the Indian type very well, with the exception of the more pubescent pedicels. In Yunnan, the plant grows to be a big tree up to 12 m. high. It occurs in mixed forests at an altitude of 2000 m.

In its irregularly wrinkled and pitted stony pyrenes and the navel-like stigma, *Ilex denticulata* is closely related to *Ilex latifolia* Thunb., but the latter has thick-coriaceous larger (8–17 cm. long, 4.5–7.5 cm. wide) leaves and 3–9-flowered individual branches in the staminate pseudopanicles. The leaves of *Ilex denticulata* resemble superficially those of *Ilex chieniana* S. Y. Hu, but the latter has palmately striate and sulcate pyrenes, thickly discoid or capitate stigmata, and ciliate calyx-lobes.

53. **Ilex graciliflora** Champ. in Jour. Bot. Kew Gard. Miscel. 4: 328. 1852; Walp. Ann. 4: 429. 1857; Benth. Fl. Hongk. 65. 1861; Maxim. in Mém. Acad. Sci. St. Pétersb. VII, 29(3): 43. 1881; Forbes & Hemsl. in Jour. Linn. Soc. Bot. 1: 116. 1886; Loes. in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. 78: 338 (Monog. Aquif. 1: 338). 1901; Dunn & Tutcher in Kew Bull. Misc. Inf. Add. Ser. 10: 60. 1912.

An evergreen tree up to 6–9 m. high with rather stout branchlets, obovate or oblong-elliptic leaves, minutely and loosely serrulate or subentire leaves, fasciculate inflorescences, globose fruit with plane and thin-discoid stigmata and 4 wrinkled and rugose, irregularly striate-sulcate pyrenes.

Branchlets subterete, castaneous or rarely brunneous when dry; third year's growth 3–4 mm. in diameter, longitudinally rimulose, the lenticels lacking, the leaf-scars deltoid, not elevated; second year's growth 2.5 mm. in diameter, longitudinally plicate, rugose, glabrous; current year's growth 1.8–2 mm. in diameter, angular, longitudinally ridged, minutely and sparsely puberulous, glabrescent or glabrous, the terminal bud conic, acute, pubescent. Leaves occurring even on the third year's growth, 5–20 mm. apart; stipules minute, often hidden; petioles 10–15 mm. long, one-fifth to one-half the length of the lamina, glabrous or minutely puberulous above, narrowly and deeply canaliculate, the distal half winged by the decurrent leaf-base; lamina thickly coriaceous, olivaceous-brunneous when dry, shiny above, less so beneath, obovate- or oblong-elliptic, 2–7.5 cm. long, 1.5–3.5 cm. wide; obtuse or acute at the base; obtuse, rarely acute or retuse at the apex; margin minutely and remotely serrulate or rarely subentire; midrib impressed and glabrous above, elevated beneath, the lateral nerves 5–7 pairs, obscure above, prominent beneath, loosely reticulate, the veinlets evident on the lower surface. Inflorescences fasciculate, axillary, on last year's growth, with abortive terminal buds, the bracts ovate-deltoid, acute or tricuspidate, puberulous; flowers 4-merous. Staminate flower: individual branches of the fascicles 3-flowered; peduncles shorter than the pedicels, 1–2 mm. long, the pedicels 3–6 mm. long, both sparsely puberulent or glabrescent, the prophylla 1 or 2, basal or subbasal; calyx patelliform, 2 mm. across, shallowly 4-lobed, the lobes deltoid, obtuse or rounded, ciliate; corolla rotate, reflexed, 6 mm. across, the petals oblong, 2.5 mm. long, one-eighth connate at the base, ciliate; stamens shorter than the petals, the anthers oblong-ovoid; rudimentary ovary subglobose-ovoid, obtuse at the apex, inconspicuously 4-lobed. Pistillate flower: individual branches of the fascicles uniflorous, the bracts small, ovate, cuspidate or tricuspidate; pedicels 4 mm. long (after fruiting 6 mm. long) with 2 basal prophylla; calyx as in the staminate flowers; corolla choripetalous, the petals oblong-obovate, 2.5 mm. long; staminodes two-thirds as long as the petals, the sterile anthers sagittate; ovary globose-ovoid, 1.5 mm. in diameter, the stigma discoid. Fruit globose, 5–6 mm. in diameter, the persistent calyx explanate, 2 mm. in diameter, suborbicular in outline, ciliate, the stigma plane, thin-discoid. Pyrenes 4, suborbicular in outline, the ends rounded, 4 mm. long, 3 mm. wide, wrinkled and rugose, irregularly striate-sulcate, the striae reticulate, the back shallowly impressed, the endocarp woody.

CHINA: Hongkong: *Champion* (fragment of type, A); Wu-kau-tin, *W. Y. Chun 5039* (A); Ford (staminate flowers, A, NY; fruiting branches, A); *Lamont* (B); Lugard Road, *Y. W. Taam 1603* (A); Wong-neichong, *Y. W. Taam 2013* (A); along Bride Valley, *Y. Tsiang 49* (A); Peak, *Y. Tsiang 256* (A, NY); Mt. Victoria, *W. J. Tutcher* (ex Herb. Hongkong no. *10213*) (A); *C. Wright* (NY, US). Lantao Island: *C. L. Tso 20193* (A).

Ilex graciliflora is endemic to Hongkong and the near-by islands, where it can be found growing in woods or in thickets as a tree 6–9 m. high. The white flowers appear in April. The red fruits persist long on the tree, even into February or later of the following year.

The glabrescent branchlets, the coriaceous leaves, the fasciculate inflorescences, and the wrinkled and rugose pyrenes of *Ilex graciliflora* indicate close relationship between this species and *Ilex ficoidea* Hemsl., which differs in having leaves with caudate apices, 9 or 10 indistinct parallel lateral nerves, median or submedian prophylla, and very short fruiting pedicels (2–3 mm. long).

54. **Ilex tsangii,** sp. nov.

Arbor glaberrima; ramulis nigrescentibus; foliis subcoriaceis, ellipticis vel ovato-ellipticis, 5–8 cm. longis, 2–3 cm. latis, crenulatis vel subintegris, basi acutis vel cuneatis, apice acuminatis, acuminibus 10–15 mm. longis, costa supra impressa, subtus elevata, nervis lateralibus, utrinque 6–8, supra obscuris, subtus evidentibus; inflorescentiis fructiferis fasciculatis, axillaribus; pedicellis 10–12 mm. longis; fructibus depresso-globosis, 5 mm. longis, 6 mm. diametro; calycibus persistentibus 1.5 mm. diametro, stigmate minute discoideo; pyrenis 4, 4 mm. longis, 3 mm. latis, striatis, rugosis et sulcatis, endocarpio coriaceo.

An entirely glabrous evergreen tree up to 8 m. high with nigrescent branchlets, elliptic leaves with minutely crenulate or subentire margin, long-acuminate apices, fasciculate infructescences, slender fruiting pedicels 10–12 mm. long, and rather small globose fruits.

Branchlets slender, subterete, glabrous; third year's growth 2 mm. in diameter, sparsely and minutely rimulose, the lenticels lacking, the leaf-scars elevated; current year's growth 1–1.5 mm. in diameter, angular, the terminal bud narrowly conic, acute, glabrous. Leaves occurring even on the third year's growth, 5–12 mm. apart; stipules very minute, often obscure; petioles slender, 10–16 mm. long, one-sixth to one-fifth the length of the lamina, narrowly canaliculate above; lamina subcoriaceous, bruneous-olivaceous when dry, ovate-elliptic or elliptic, 5–8 cm. long, 2–3 cm. wide; acute or cuneate at the base; acuminate at the apex, the acumen 10–15 mm. long; margin remotely and inconspicuously crenulate or subentire; midrib narrowly and shallowly impressed above, elevated beneath, the lateral nerves 6–8 pairs, obscure above, evident beneath. Flowers not seen. Infructescences fasciculate, axillary, on second year's growth, fascicles with 2–4 fruits, the fruiting pedicels slender, 10–12 mm. long with 2 minute ciliate basal prophylla. Fruit depressed globose, 5 mm. long, 6 mm. in diameter, when dry black and rugose, the persistent calyx minute, 1.5 mm. in diameter, the stigma minute, thin-discoid. Pyrenes 4, obovate in outline, 4 mm. long, 3 mm. wide, one end slightly pointed, reticulately striate, irregularly rugose and sulcate, the endocarp thick-coriaceous (described from immature fruit).

CHINA: Kwangtung: Ta-pu, *W. T. Tsang 21232* (TYPE A; LU).

This species is endemic to northeastern Kwangtung, where it is a common tree in woods or thickets. The fruit has been reported as yellow in July. The species is closely related to *Ilex graciliflora* Champ., which differs in having thick-coriaceous leaves with obtuse apices.

55. **Ilex chingiana** Hu & Tang in Bull. Fan. Mem. Biol. Bot. 9: 252. 1940.

A glabrous evergreen tree up to 12 m. high with large (11–15 cm. long) coriaceous, oblong-elliptic, remotely serrate and acuminate leaves, very large (15 mm. in diameter) globose fruit, and 4 large wrinkled and pitted pyrenes.

Branchlets robust, straight, glabrous, castaneous when dry; third year's growth 3.5–4.5 mm. in diameter, transversely plicate-rugose when dry, the lenticels lacking, the leaf-scars semi-orbicular; second year's growth longitudinally plicate-rugose, subterete, 3–4 mm. in diameter; current year's growth angular, longitudinally striate, 2.5–3 mm. in diameter, the terminal buds small, conical, the scales glabrous, ciliate, the axillary buds globose, glabrous. Leaves occurring even on the third year's growth, 5–20 mm. apart; stipules obscure; petioles 10–15 mm. long, one-tenth to one-seventh the length of the lamina, glabrous, rugose, narrowly canaliculate above; lamina thick-coriaceous, brunneous-olivaceous when dry, glabrous, rather opaque on both surfaces, oblong-elliptic or very rarely oblanceolate, 11–14 cm. long, 4–5 cm. wide; base obtuse, rarely rounded or cuneate; apex acuminate, the acumen 7–12 mm. long; margin remotely serrate; midrib impressed above, sparsely and minutely puberulent, very prominent and elevated beneath, the lateral nerves 8–12 pairs, slightly elevated above, evident beneath, the reticulation of the veinlets conspicuous above, less so beneath. Infructescence a small fascicle, usually only one fruit maturing; bracts cartilaginous, glabrous, the apex acute, callose, the basal appendage stipule-like, acute, ciliate; fruiting pedicels 2–4 mm. long, minutely and sparsely puberulent when young, glabrescent later, with 2 sub-basal prophylla; persistent calyx explanate, orbicular in outline, 3.5 mm. in diameter, inconspicuously 4-lobed, the lobes rounded, sparsely puberulent and ciliate; fruits globose, 15 mm. in diameter, the stigma navel-like, orbicular in outline when young, later appearing quadrangular, 4–5 mm. in diameter. Pyrenes 4, obovate in outline, 10–12 mm. long, 6–8 mm. wide at the base, reticulately striate, sulcate, wrinkled and pitted, the back flattened and broadly impressed, the endocarp stony.

CHINA: Kweichow: San-hoa, *Y. Tsiang 6396* (NY). Kwangsi: Lu-chen-hsien, *R. C. Ching 6011* (ISOTYPE, A, US), Chuen-yuen, *T. S. Tsoong* (= *Z. S. Chung*) *82033* (A); Ping-nan-hsien, *C. Wang 40344* (A), *40388* (A).

Ilex chingiana is endemic to Kwangsi Province, where it grows as a tree in mixed forests. Specimens collected in June show very young fruits. This may indicate that it flowers in May. Those collected in November have large red fruits.

Because of the large leaves with remotely serrate margins, the large fruit with navel-like stigmas, and the large reticulately striate, sulcate, wrinkled and pitted pyrenes, this Kwangsi species is closely related to the Hainan species *Ilex nuculicava* Hu. The latter species has puberulent branchlets and petioles, pseudoracemose infructescences with smaller fruits, and longer fruiting pedicels.

The infructescences of the material at hand appear solitary, but on careful examination the paucifasciculate nature can easily be detected, for the scars of the falling flowers and bracts are evident.

Only fruiting material has been available for this study. The size of the fruits on these specimens varies considerably with seasonal variation.

As the fruit matures, the mesocarp increases in volume and becomes fleshy. As the fruits enlarge, the tissue of the exocarp next to the stigmatic lobes is torn. When dry, this rent and discolored tissue gives the stigmata a star-like outline. This character, the star-like stigma, is characteristic for this species and a diagnostic character.

When the ripe fleshy fruit is pressed, the exocarp breaks and the fruit flattens. On herbarium specimens such pressed fruits appear much larger than their actual size. This is plainly the case with *C. Wang 40344* and *40388*.

55a. **Ilex chingiana** var. **puberula**, var. nov.

Arbor parva; ramulis glabris, castaneis, gemmis terminalibus pubescentibus; foliis oblanceolatis, 7–12 cm. longis, 3 cm. latis, serratis, basi cuneatis, apice acuminatis, acuminibus 8–14 mm. longis, costa et petiole puberulis; fructibus globosis, 11 mm. diametro, pedicellis pubescentibus, 3 mm. longis.

CHINA: Kwangsi: Ling-wun, *S. K. Lau 28662* (TYPE, A).

This variety grows in mixed forest as a tree 10 m. high with a trunk 30 cm. in diameter.

The variety differs from the typical *Ilex chingiana* in that it has narrower predominantly oblanceolate leaves with cuneate bases and puberulent terminal buds and petioles.

56. **Ilex uraiensis** Yamamoto in Jour. Soc. Trop. Agric. Taiwan **4**: 486. 1932.

Ilex glomeratiflora sensu Yamamoto, Suppl. Ic. Pl. Form. **1**: *32, fig. 13.* 1925, non Hayata.

An evergreen tree up to 25 m. high, with minutely puberulous or glabrescent branches, elliptic or obovate-elliptic leaves, remotely crenate or serrate margins, abruptly and shortly acuminate apices, fasciculate inflorescences, fruiting pedicels 6–8 mm. long, large globose fruit, and irregularly striate and wrinkled stony pyrenes.

Branchlets subterete, cinereous or rarely nigrescent when dry; third year's growth 3 mm. in diameter, longitudinally rimulose, the lenticels lacking, the leaf-scars crescent-shaped, slightly elevated; current year's growth 1–2 mm. in diameter, longitudinally ridged, minutely puberulous or glabrescent, the terminal buds ovoid, pubescent. Leaves occurring also on second year's growth, rarely on the third year's growth, 5–12 mm. apart; stipules minute, deltoid, persistent; petioles 6–10 mm. long, one-tenth to one-sixth the length of the lamina, the distal half winged by the decurrent leaf-base, narrowly canaliculate above; lamina thinly coriaceous, olivaceous when dry, shiny above, opaque beneath, elliptic or obovate-elliptic, 3.5–10 cm. long, 1.2–3.5 cm. wide, cuneate at the base, shortly and abruptly acuminate at the apex, the acumen 3–8 mm. long, the very tip obtuse, the margin remotely crenate or serrate; midrib very slightly impressed above, elevated beneath, the lateral nerves 8–9 pairs, prominent on both surfaces, the reticulation of the veinlets prominent on both surfaces. Inflorescences fasciculate, axillary on the second or even the third year's growth, the individual branches of the fascicles uniflorous, the bracts suborbicular, ciliate; flowers 4-merous. Staminate flowers: pedicels 3–5 mm. long, minutely puberulous, with 2 minute ciliate prophylla at the base; calyx patelliform, 2 mm. in diameter, shallowly 4-lobed, the lobes rounded, ciliate; corolla rotate, 7–8 mm. in diameter, the petals obovate-oblong, 3–5 mm. long, 2.5 mm. wide, ciliate, slightly connate at the base; stamens longer than the petals, the anthers oblong-ovoid, 1.25 mm. long; rudimentary ovary subglobose, the apex rounded or slightly depressed. Pistillate flowers not seen. Infructescences fasciculate, the bracts oblong-ovate, puberulous, and ciliate, with 2 acute stipule-like appendages; fruiting pedicels slender, 6–8 mm. long, pubescent, with 2 sub-basal, deltoid, acute, puberulous, ciliate prophylla. Fruit globose, large, 10–11 mm. in diameter, the persistent calyx suborbicular in outline, 2 mm. in diameter, ciliate, the stigma navel-like, 2.5 mm. in diameter. Pyrenes 4, oblong in outline, the ends obtuse, 7–8 mm. long, 4.5 mm. wide, irregularly striate and wrinkled, the back flattened and depressed, the endocarp stony.

CHINA: Taiwan: *R. Kanehira & S. Sasaki* in 1916 (photo of TYPE, TU); *Y. Shimada* (TU); Sozan, *E. H. Wilson 10288* (A, NY, US), *11213* (A, US); Sirin, *K. Odashima* (Taihoku Imp. Univ. Herb. no. *17751*) (A, NY, US); Kiirun (Taihoku Imp. Univ. Herb. no. *17797*) (A, NY, US); Herb. Univ. Imp. Taihoku no. *2872* (TU).

This species is endemic to Taiwan, where it grows as a common tree up to 25 m. high with a trunk 0.5–1 m. in diameter. The white flowers appear in April, and the mature red fruit persists on the tree during the winter months.

The slender fruiting pedicels, large fruits, navel-like stigma, and the shiny upper surface of the leaves with prominent lateral nerves of this species indicate a close relationship with *Ilex mertensii* Maxim., which has thickly coriaceous leaves with obtuse apices, and palmately striate esulcate pyrenes with sublignified endocarps.

56a. **Ilex uraiensis** var. **formosae**, comb. nov.

Ilex mertensii Maxim. var. *formosae* Loes. in Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. **78**: 338 (Monog. Aquifol. **1**: 338). 1901.

Branchlets glabrous; leaves coriaceous, obovate, 2.5–4.5 cm. long, 1.5–2.5 cm. wide, cuneate at the base, rounded or rarely obtuse at the apex, olivaceous when dry, shiny above, the margin remotely crenulate, the midrib plane or slightly impressed above, elevated beneath, the lateral nerves 4–6 pairs, prominent on both surfaces, the reticulation of the veinlets evident on both surfaces; infructescences fasciculate, uniflorous, the fruiting pedicels 5–10 mm. long, glabrous, with 2 basal prophylla; fruit globose, 10–12 mm. in diameter, the persistent calyx inconspicuous, 1.5 mm. in diameter, the stigma navel-like, 1.5 mm. in diameter; pyrenes 4, oblong in outline, obtuse at the base, obtuse and retuse at the apex, 8 mm. long, 5 mm. wide, irregularly striate and wrinkled, the back flattened and depressed, the endocarp stony.

CHINA: Taiwan: S. Cape, *A. Henry 938* (A, US), *1002* (ISOSYNTYPE of *Ilex mertensii* var. *formosae*) (A), *1251* (ISOSYNTYPE of *Ilex mertensii* var. *formosae*) (A, NY).

The form of the leaf of this variety is like that found in *Ilex mertensii* Maxim., but the texture resembles that found in *Ilex uraiensis*. Thus superficially it may be considered as a variety of either of these two species. The large stony pyrenes of this variety, however, are typically those of *Ilex uraiensis;* hence it has been transferred to this species.

57. **Ilex subficoidea**, sp. nov.

Ilex cinerea sensu Groff in Lingnan Sci. Bull. **2**: 63. 1930, non Champ.

Arbor; ramulis glabris; foliis coriaceis, supra nitidis, ovato- vel oblongo-ellipticis, 7–10 cm. longis, 3 cm. latis, crenatis, basi obtusis, raro rotundatis, apice acuminatis, acuminibus, 7–16 mm. longis, costa supra impressa, subtus elevata, nervis lateralibus 10–11 paribus, supra obscuris, subtus evidentibus; inflorescentiis fasciculatis, axillaribus, flores 4-meris; ♂ 3-floribus, pedunculis 1 mm. longis, pedicellis 2 mm. longis; calycibus 4-lobatis, ciliatis; corolla rotata, 7 mm. diametro, petalis obovato-oblongis, 2.75 mm. longis, sparse ciliatis, staminibus quam petalis longioribus, ovario aborto conico, apice obtuso; infructescentiis fasciculatis, pedicellis 10 mm. longis; fructibus globosis, 10–12 mm. diametro, tuberculatis, stigmate applanato-discoideo; pyrenis 4, 8–9 mm. longis, 5–7 mm. latis, irregulariter rugosis et caveatibus.

An evergreen tree up to 15 m. high, with glabrous longitudinally striate branchlets, ovate- or oblong-elliptic coriaceous and glossy leaves with an abruptly acuminate apex, large (10 mm. in diameter) fasciculate fruits, and large woody wrinkled pyrenes.

Branchlets straight, cinereous, brunneous, or even olivaceous; third year's growth 3–4 mm. in diameter, longitudinally striate and minutely rimulose, the lenticels lacking, the leaf-scars deltoid, ovate, not elevated; current year's growth striate, angular, 1.5–2 mm. in diameter, glabrous, the terminal bud thinly conical, glabrescent or glabrous, the scales densely ciliate. Leaves occurring also on second year's growth, 1–2 cm. apart; stipules minute, broadly deltoid, callose; petioles 5–12 mm. long, one-fourteenth to one-seventh as long as the lamina, canaliculate above, the distal half narrowly winged by the decurrent base; lamina coriaceous, olivaceous when dry, ovate- or oblong-elliptic, 7–10 cm. long, 3 cm. wide; obtuse at the base, seldom rounded, the apex abruptly acuminate, the acumen 7–16 mm. long, the tip obtuse, shiny above, opaque beneath; margin undulate, inconspicuously crenate, the teeth marked with black spots; midrib impressed above, elevated beneath, the lateral nerves 10–11 pairs, obscure above, evident beneath, rather straight, curving upward and reticulate near the margin. Inflorescence fasciculate, axillary, on second year's growth; flowers 4-merous. Staminate inflorescence: individual branches of the fascicles 3-flowered, the bracts broadly ovate, mucronate, ciliate, the basal appendages stipule-like; peduncles 1 mm. long, the pedicels 2 mm. long, pubescent or glabrescent; calyx patelliform, 5 mm.

across, the lobes glabrous, very sparsely ciliate; corolla rotate, 6 mm. across, the petals obovate-oblong, 2.75 mm. long, the apical half very sparsely and weakly ciliate, one-tenth connate at the base; stamens slightly longer than the petals, the anthers ovoid, 0.75 mm. long; rudimentary ovary obtusely conical, glabrous. Pistillate flower not seen. Infructescences fasciculate, the pedicels 10 mm. long, with 2 basal or sub-basal prophylla. Fruit globose, 10–12 mm. in diameter, tuberculate, the persistent calyx 2.5–3 mm. across, 4-lobed, the lobes rounded, ciliate; stigma thin-discoid, distinctly 4-lobed. Pyrenes 4, ovate-elliptic in outline, the ends pointed, 8–9 mm. long, 5–7 mm. wide, irregularly wrinkled and pitted, the endocarp stony.

CHINA: Kiangsi: Kien-nan, *S. K. Lau 3979* (TYPE, fruits, A, US). Kwangtung: Wung-yuen, *S. K. Lau 2304* (A); Lung-t'au Mt., *CCC 12736* (US). Kwangsi: S. Nan-ning, *R. C. Ching 8220* (NY). Hainan: *H. Y. Liang 63772* (NY), *C. Wang 34710* (A, NY), *36535* (A).

INDO-CHINA: Tonkin, *W. T. Tsang 26911* (A).

Ilex subficoidea is a large subtropical tree found in mixed forests south of Lat. 25°N. The flowers are white and appear in January.

The Hainan plants have long petioles and short leaves. But these differences fall within the range of variations displayed by the plant on the mainland.

58. **Ilex nuculicava,** sp. nov.

Ilex cinerea Champ. var., Merr. in Lingnan Sci. Jour. **5**: 115. 1928; Masamune, Fl. Kainant (Hainan) 137. 1940.

Arbor parva; ramulis pubescentibus vel glabrescentibus; foliis coriaceis, oblongo-ellipticis vel raro oblanceolatis, 8–13.5 cm. longis, 2.2–4.5 cm. latis, subintegris, undulatis, vel crenulatis, basi obtusis, apice breviter acuminatis, acuminibus 5–10 mm. longis, costa supra impressa, nervis lateralibus 7–8 paribus, supra obscuris, subtus evidentibus; inflorescentiis fasciculatis, axillaribus, pubescentibus; floribus 4-meris; ♂ 3-floribus, pedunculis 1–2 mm. longis, pedicellis 3–4 mm. longis, calycibus ciliatis, corolla rotata, 7–8 mm. diametro, petalis oblongo-obovatis, 3 mm. longis, staminibus petalis aequantibus, ovario aborto subgloboso vel ovoideo, apice obtuso; ♀ unifloribus, pedicellis 3 mm. longis, corolla choripetala, ovario ovoideo, 2.5 mm. longo, 2 mm. diametro, apice truncato, stigmate discoideo; fructibus globosis, 10 mm. diametro, stigmate umbilicato; pyrenis 4, 6–7 mm. longis, 4–4.5 mm. latis, dorso palmatim striatis et sulcatis, lateralibus rugosis et caveatibus.

An evergreen tree up to 9 m. high with puberulent or glabrescent branchlets, large oblong-elliptic acuminate leaves, fasciculate flowers, large globose drupes and large bony wrinkled and pitted pyrenes.

Branchlets straight, cinereous, plicate and rugose when dry; third year's growth 5 mm. in diameter, longitudinally plicate, rimulose, the lenticels lacking, the leaf-scars semi-orbicular, not elevated, closely associated with the elevated scars of the inflorescences; second year's growth 3 mm. in diameter; current year's growth 1.75–2 mm. in diameter, longitudinally ridged, sparsely pubescent, the terminal buds conic, 3 mm. long, the scales pubescent. Leaves occurring also on second year's growth, 2–12 mm. apart; stipules minute, often obscure; petioles slender, 9–15 mm. long, one-eleventh to one-seventh the length of the lamina, castaneous or nigrescent when dry, canaliculate, sparsely puberulent above, the distal half winged by the decurrent base, rugose beneath; lamina coriaceous, olivaceous when dry, opaque above, paler and opaque beneath, oblong-elliptic or rarely oblanceolate, 8–13.5 cm. long, 2.2–4.5 cm. wide; base obtuse; apex short-acuminate, the acumen 5–10 mm. long; margin subentire, undulate, minutely crenate, marked with black spots; midrib impressed above, sparsely and minutely pubescent, prominent and glabrous beneath, the lateral nerves 7 or 8 pairs, straight, curved upward and loosely reticulate near the margin, obsolete above, evident or prominent beneath, the reticulation of the veinlets obscure above, lacking beneath. Inflorescences fasciculate, axillary, on second year's growth, the scales of the flowering buds persistent, reniform, acute, pubescent, 1 mm. long, 1.5 mm. wide; flowers 4-merous. Staminate inflorescence: individual branches of the fascicles 3-flowered, the bracts broad-ovate, acute, pubescent, with pubescent stipule-like basal appendages, the peduncles 1–2 mm. long, densely pubescent, the pedicels 3–4 mm. long, pubescent, with 0–2 basal or rarely submedian prophylla; calyx patelliform, sparsely pubescent, 2–2.5 mm. in diameter, 4-lobed, the lobes rounded, ciliate, 0.75 mm. long, 1.25 mm. wide; corolla rotate, 7–8 mm. in diameter, the petals oblong-obovate, 3 mm. long, 2 mm. wide, shortly and sparsely ciliate or eciliate, lightly connate at the base; stamens equaling the petals in length, the anthers ovoid, 1.25 mm. long; rudimentary ovary subglobose or ovoid, the apex rounded or obtuse. Pistillate inflorescences: individual branches uniflorous, the pedicels 3 mm. long with 2 basal prophylla, the calyx and corolla as in the staminate flowers; staminode one-third the length of the petals, the sterile anthers sagittate; ovary ovoid, 2.5 mm. long, 2 mm. in diameter, the apical end truncate, the stigma discoid. Fruit globose, 10 mm. in diameter, when dry cinereous and wrinkled, the pedicels 5–6 mm. long, the persistent calyx explanate, 2.5 mm. in diameter, pubescent and ciliate, the stigma navel-like, 3 mm. across. Pyrenes 4, broad-elliptic in outline, tapering at the ends, 6–7 mm. long, 4–4.5 mm. wide, palmately striate and sulcate on the back, wrinkled, pitted and rugose on the sides, the endocarp woody.

CHINA: Hainan: Fan-yah, *N. K. Chun & C. L. Tso, 44244* (TYPE, A; NY, US, fruit); Po-ting, *F. C. How 72490* (A); Man-ning, *F. C. How 73195* (A); Ch'ang-kiang, *S. K. Lau 1714* (A, NY); Bak-sa, *S. K. Lau 26006* (A), *26550* (A), *26697* (A); Five Finger Mt., *F. A. McClure* (CCC no. *9424*) (A, NY), *9458* (A, US), *9534* (US); without precise locality, *C. Wang 34741* (NY).

This species is endemic to the island of Hainan, where it grows in woods or forests at altitudes of 500–1800 m. The flowers appear in April or May.

A close relative is *Ilex cinerea* Champ. Many herbarium sheets have been incorrectly so named. *Ilex nuculicava* resembles *Ilex cinerea* in having pubescent branchlets and terminal buds, and large oblanceolate or oblong-elliptic opaque leaves, but the latter can readily be distinguished by the characteristic short petiole (2–4 mm. long) and the twice trichotomously branched staminate inflorescences.

58a. **Ilex nuculicava** var. **brevipedicellata,** var. nov.

Arbor parva; ramulis et gemmulis terminalibus pubescentibus; foliis oblongo-ellipticis vel oblanceolatis, 7–17 cm. longis, basi cuneatis, apice acuminatis; fructibus globosis, pedicellis 2 mm. longis; pyrenis 4, 6 mm. longis, 5 mm. latis, dorso rugosis et caveatibus.

CHINA: Hainan: *N. K. Chun & C. L. Tso 43859* (TYPE, A; US).

This variety differs from the species in having shortly pedicellate fruits.

58b. **Ilex nuculicava** var. **glabra,** var. nov.

Arbor parva; ramulis et gemmulis terminalibus glabris; foliis lanceolatis vel oblanceolatis, 8–11 cm. longis, 2–3 cm. latis, basi cuneatis, apice acuminatis; fructibus globosis, 9 mm. diametro, calycibus ciliatis; pyrenis 4, 6–8 mm. longis, 5 mm. latis, dorso rugosis et caveatibus.

CHINA: Hainan: Yai-chow, *F. C. How 71094* (TYPE, A; NY, US).

This variety differs from the species in having glabrous buds, branchlets, and inflorescences.

58c. **Ilex nuculicava** var. **auctumnalis,** var. nov.

Arbor parva; gemmulis terminalibus pubescentibus, foliis coriaceis, supra nitidis, oblanceolatis, 6–11 cm. longis, 2–3.5 cm. latis, basi cuneatis, apice acuminatis; inflorescentiis fasciculatis.

CHINA: Hainan: Ling-shui, *F. C. How 73800* (A); Po-ting, *F. C. How 73857* (A); Yai-chow, *H. Y. Liang 62751* (TYPE, A; NY).

This variety differs from the species in having smaller and narrower oblanceolate leaves, with cuneate bases, and in its late flowering season. In Hainan it flowers in the autumn, August-October. No fruiting specimens were available for this study. Additional material may prove it to be a distinct species.

(To be continued)

THE GENUS COCCOLOBA IN CUBA

RICHARD A. HOWARD

THE NEW WORLD GENUS *Coccoloba* is found from Bermuda and Florida on the North American continent, through the West Indies, Mexico and Central America, into South America with many species in the Amazon basin and a few species as far south as Argentina. In 1890, Lindau published a comprehensive monograph of this woody genus (Engl. Bot. Jahrb. **13**: 106–229. 1890) which then included 125 species. Lindau's monograph is notoriously difficult to use and Britton, for his work on the West Indian vegetation, presented a series of treatments of the genus *Coccoloba* as it occurred on each of the islands he studied. Britton's first paper on the genus, in 1915, revised *Coccoloba* for Cuba. In following years Britton described additional new species from Cuba, as did Urban, and subsequent to their work Schmidt continued studies of the genus in Cuba and the Caribbean area. Thus, at the present time approximately 50 species have been reported from Cuba alone, either in the literature or in herbarium records.

The present paper, which considers the genus only in Cuba, is presented to clarify certain points of the morphology of the genus, to describe several new species from Cuba and Hispaniola, and to straighten out specific concepts and bring the nomenclature up to date to aid the work of contemporary students of the Caribbean vegetation.

The author is grateful to Brother Leon of the Colegio de la Salle in Havana, Cuba, for the introduction to this problem and also to Mr. Sandwith of Kew for invaluable help and consultation on certain problems of limitation of the species. Material for this work was supplied from the following herbaria: Arnold Arboretum (A), Jardin Botanique de l'Etat, Brussels, Belgium (BR), Botanical Museum, Copenhagen, Denmark (C), Chicago Natural History Museum (formerly known as the Field Museum) (FM), Gray Herbarium (G), Colegio de la Salle, Havana (HAB), Sauvalle Herbarium of the Academy of Science in Havana (HABA), Kew (K), Univ. of Michigan (MICH), Missouri Botanical Garden (MO), New York Botanical Garden (NY), Herbarium of Juan Roig (R), Natural History Museum, Stockholm, Sweden (S), Estacion Agronomica de Cuba (SV), and the United States National Herbarium (US). I am grateful to the directors and curators of these herbaria for the privilege of studying their material on loan.

In this paper I am following, with qualifications which are mentioned, the proposal of Little (Madroña 7: 244–246. 1944) that the name *Coccoloba* should be conserved. Patrick Browne (Civ. Nat. Hist. Jamaica 209, *pl. 14, f. 3.* 1756) originated the name *Coccolobis* (without generic description) for four species. Linnaeus (Syst. Nat. ed. 10, 1007, 1367.

1759) accepted Browne's four species and applied binomials to them but changed the spelling of the generic name to *Coccoloba* in publishing the first generic description. Recently Sandwith (Jour. Bot. 78: 99. 1940) has regarded *Coccolobis* P. Br. and *Coccoloba* L. as different names and adopted the original Browne name and spelling. Moreover, Sandwith states in his argument that *Coccolobis* is a diminutive name, thus a completely different word, and therefore transfers and new combinations are necessary when one name or the other is adopted. Fortunately for the present monographer *Coccolobis* is not a diminutive form, as *Coccolobion* would be, and the new combinations are not necessary. Actually no problem exists between these two words for *Coccolobis* of P. Browne is invalidly published as a generic name under the present rules of botanical nomenclature while *Coccoloba* L. is a valid publication with the first generic description of the group. Considerable search and bibliographic work would be necessary to determine who published the first valid generic description under the name *Coccolobis.*

However the name for this genus still involves a problem. The generic name *Guaiabara* Miller (Gard. Dict. ed. 4, vol. 2. 1754) is validly published with a generic description for the pre-Linnaean species later listed by Patrick Browne. Therefore *Coccoloba* L., the most widely accepted name for the group, must be conserved to continue in use. Little's proposal for conservation has been approved by the committee on nomenclature of the American Society of Plant Taxonomists and the case will be submitted for consideration and action at the International Botanical Congress in 1950. I am accepting Linneaus' name *Coccoloba* as only an orthographic variant of *Coccolobis,* thereby eliminating the need for new combinations of many of Britton's new species from Cuba, a step which would be necessary if one concluded that the two spellings of *Coccoloba* actually represent two different names.

Lindau's elaborate monograph of *Coccoloba* quite unfortunately introduces several very significant errors of interpretation of the morphology of the genus which has led subsequent workers astray and has built up considerable confusion in this genus.

Lindau considered the flowers of *Coccoloba* to be perfect, and only rarely unisexual by abortion. This is not the case, as careful study of herbarium material will show, and this is easily verified in field studies of the plants. The flowers are regularly unisexual and only occasionally are flowers of a male inflorescence perfect. In the course of field studies made in the Greater Antilles, Florida, and the Bahamas, within the past three years I have seen many species of *Coccoloba.* In all specimens examined in the field the plants were found to be dioecious and the staminate and pistillate plants readily distinguishable. Furthermore, the natives in the areas visited recognized the fact that some trees set fruit and other did not. Recent information from Cuba reports that cultivated specimens of *C. venosa* L. have perfect flowers in some of the staminate inflorescences so the plants may be described as dioecious, occasionally monoecious.

This condition has been recognized by a few workers but has not been incorporated in floristic treatments.

The staminate flowers are usually clustered at each node of the inflorescence. Two to five flowers are commonly produced in the axil of a single bract. In these flowers the stamens elongate and are exserted and the pistil is rudimentary with short contorted styles. Pistillate plants by contrast bear only one flower at each node on the inflorescence axis and in these the stamens are rudimentary, never developing pollen, and are included while the pistil is larger and exserted with longer divergent styles. Lindau recognized these differences in form, i.e., stamens exserted or included, flowers clustered or solitary, but failed to associate a unisexual condition with this morphological pattern. Thus one finds in Lindau's key to the species of *Coccoloba* the basic separations of flowers clustered versus flowers solitary, or stamens exserted versus stamens included. In more than one case the male and female plants of the same species have been described under different specific names.

The unisexual condition of the flower and the pattern of numerous flowers per node in the staminate plants may be confused slightly in the field by the fact that occasionally a male plant will form sterile fruits. This was observed in several male plants of *Coccoloba uvifera* growing in Loomis Park at Miami Beach, Florida. However, in this species the seed was either imperfectly formed in all the fruits sectioned or the fruit was hollow. Likewise these "male" fruits dehisced easily from the pedicels and rarely approached the size of the mature fertile fruits from the pistillate plants.

The habit of growth of the species of *Coccoloba* found in the West Indies has also led to confusion in the interpretation of the species and the formation of descriptions. Three growth habits can be observed in the field and can also be recognized on herbarium material. In one growth form, short shoots are produced. In these the branches are of determinate length with very short internodes. The short shoots may be terminal or lateral. The terminal short shoots frequently resume normal growth after a few seasons as short shoots and so the congested area of short compact internodes may be in the middle of a shoot of normal appearance.

The second form is the normal one, with vigorous shoots of uniformly elongated internodes. The third form is found in adventitious shoots which are produced when the original shoot is cut or damaged. These three forms are significant because of the different size and shape of the leaves produced on each. Adventitious shoots with extremely long internodes will have much larger leaves on larger petioles and with longer ochreae than those of the normal shoots. The leaves of short shoots are commonly smaller in these characteristics than those of the normal shoot. Because of the variation of leaf shape on a single plant, the shape of the leaf, particularly the nature of the leaf apex is not a good taxonomic character and where used must be considered with caution.

The large number of species described by Britton, Urban and Schmidt which I have reduced to synonymy in this paper are commonly based on the failure of these men to recognize the condition of variant growth. The sterile Ekman specimens from Cuba which Schmidt referred to *C. longifolia,* a Jamaican species, are adventitious shoots of *C. diversifolia.* The species described by Schmidt as *C. lineari-lanceolata* is material from an adventitious shoot of *C. pallida,* and the species *C. pilonis, C. acutissima* and *C. woodfredensis* described by Urban and Britton are adventitious shoots or short shoots of *C. reflexa* of Lindau based on a Wright collection.

Once these peculiarities of *Coccoloba* are recognized the species appear more clear-cut and it is hoped that the genus may be completely clarified by the work which is now in progress.

Little described *Coccoloba* as "a large genus of about 130 species". Actually nearly 400 names have been published for this genus. The large genus has been divided into sections by Wright (Griseb. Cat. Pl. Cub. 62. 1866), Meisner (DC Prod. 14: 150–171. 1856) and Lindau (l.c.) in their work on the group. The section as defined by those authors in the original form are not acceptable today in view of our present knowledge of additional species from intermediate areas. The problem of subdividing this large genus will be considered in a later publication. For the present paper I am not dividing the genus although three of the sections recognized by Lindau are represented in the species which follow.

No attempt will be made in this paper to give other than the most important bibliographic references. For a complete list of important as well as casual references to any of the following species, Lindau's monograph of the genus *Coccoloba* (Engl. Bot. Jahrb. **13**: 106–229. 1890) and his later paper in Urban, Symbolae Antillanae (**1**: 215–233. 1899) present most of the literature prior to 1900. Britton's earlier treatment of the genus *Coccolobis* in Cuba appeared in the Bulletin of the Torrey Botanical Club, **42**: 365–371. 1915.

Coccoloba L. Syst. Nat. ed. 10, 1007, 1367. 1759.

Shrubs or trees; branches terete, often geniculate, or arranged in one plane, short shoots commonly developed laterally or the terminal shoots of limited growth becoming long shoots; nodes commonly tumid; ochreae characteristically developed, membranaceous or coriaceous, deciduous or persistent, glabrous, puberulent or pilose; leaves alternate, minute to large, membranaceous, chartaceous or coriaceous, the margin entire to undulate, flat or revolute, the primary veins straight to the margin, much branched at the apex becoming reticulate or arcuate and anastomosing or arcuate and bifurcate-anastomosing, the secondary venation obscure or coarsely to minutely reticulate, the upper leaf surface commonly pitted, rarely pubescent, the lower leaf surface glabrous to pilose, short multicellular glands present or the glands depressed in the lamina producing resinous secretions; petioles terete to stout, broadly and shallowly canaliculate above, pilose to glabrous, the base often tumid, attached at the base of the ochreae or above the base to two-thirds the length of the ochreae; plants dioecious or monoecious; inflorescence racemose of sub-spicate, terminal on the primary or lateral branches, few flowered and short to many flowered and several times the length of the leaves, the rhachis glabrous, puberulent, pilose or with glandular excretion; flowers unisexual, the staminate flowers in clusters of 2–5 at each node of the inflorescence, occasionally solitary, the pistillate flowers solitary; bracts subtending each node, the flowers developing in a membranaceous sheath which ruptures irregularly becoming an ochreola, the ochreolae membranaceous, 1 per flower, rarely stalked, the flowering pedicels shorter than the ochreolae to many times as long, the flowers articulated at the apex of the pedicel; perianth campanulate at the base forming a hypanthium, the lobes 5, imbricate, the outer three slightly larger than the inner, the stamens 7 or 8 borne on the hypanthium, the filaments united at the base, the anthers introrse, the stamens in the pistillate flowers rudimentary; pistil rudimentary in the staminate flowers, trigonous in the pistillate flower, the styles 3, dilated at the apices, the ovary 1 celled, the ovule solitary, attached basally; perianth expanding in fruit, the lobes surrounding the achene or the hypanthium expanding surrounding the achene with the perianth lobes appressed against the apex of the achene or coronate on the achene, the achene with a hard shiny outer layer, the inner layer papery; seed with ruminated endosperm, the major lobes 3, the minor lobes and involutions numerous, the embryo centrally located, the cotyledons orbicular, flat rarely folded, the radicle small, terete.

TYPE SPECIES: *Polygonum uvifera* L.

KEY TO THE SPECIES

A. Perianth lobes investing the achene; leaves usually membranaceous; ochreolar sheath commonly elongating with the flowers; bracts usually black..1. *C. venosa.*

AA. Hypanthium investing the achene, the perianth lobes appressed against the apex of the achene or coronate on the achene; leaves coriaceous or chartaceous (membranaceous in *C. tenuifolia*); ochreolae not elongating with the flowers but broken early; bracts usually straw colored or brown.

B. Inflorescence short, 1–5 flowered, only rarely equalling the leaves; leaves 1–1.5 cm. long.

C. Leaves emarginate at the apex, cordate at the base, turning black on drying........................2. *C. microphylla.*

CC. Leaves spinose-mucronate or rigidly acuminate at the apex, turning dark but not black on drying.

D. Leaves cordate-ovate, the base strongly cordate, the apex long spinose...........................3. *C. armata.*

DD. Leaves ovate to suborbicular, the base rounded to subcordate, the apex rigidly acuminate, not long spinose.... ....4. *C. geniculata.*

BB. Inflorescence several to many flowered, elongate, 2.5–30 cm. long, shorter than the leaves to several times as long as the leaves.

C. Leaves spinose tipped or rigidly acuminate; leaf blades ovate to oblong, glabrous; rhachis of the inflorescence puberulent; pedicels slightly surpassing or twice the length of the ochreolae in fruit...................................5. *C. reflexa.*

CC. Leaves acute, acuminate, rounded or emarginate, not spinose or rigidly acute at the apex.
D. Leaves persistently pubescent, at least below.
E. Leaves puberulent on both surfaces; veins straight to the margin not anastomosing.......6. *C. Clementis.*
EE. Leaves glabrous above, persistently pubescent below.
F. Leaves orbicular, generally umbonate; veins straight to the margin, not anastomosing; pedicels shorter than the ochreolae; rhachis, bracts and ochreolae pilose..............7. *C. Acuña.*
FF. Leaves ovate, oblong or elliptic, flat not umbonate; veins arcuate and anastomosing near the margin.
G. Ochreolae pedicellate, borne at the apex of stout stalks; leaves white pubescent below, the blade turning black on drying.................................8. *C. caesia.*
GG. Ochreolae sessile; leaves not turning black on drying.
H. Mature flowering pedicels or those of the fruit shorter than the ochreolae; leaves pale puberulent below, the hairs blunt at the apex.........9. *C. pallida.*
HH. Mature flowering pedicels or those of the fruit exceeding the ochreolae; hairs attenuate at the apex.
I. Flowering and fruiting pedicels 7–15 mm. long; leaves thick coriaceous; pedicels and flowers bright red......................10. *C. coriacea.*
II. Flowering and fruiting pedicels 1–3 mm. long; pedicels brown or tan; flowers greenish white.
J. Leaves thin coriaceous, persistently pubescent below on the entire lamina; petioles arising from the base of the ochreae; inflorescence 2.5–3.5 cm. long......................11. *C. retirensis.*
JJ. Leaves membranaceous, barbate in the axils of the veins, glabrate on the lamina; petioles arising from above the base of the ochreae; inflorescence 8–18 cm. long.........12. *C. tenuifolia.*
DD. Leaves glabrous below when mature (rarely puberulent when young).
E. Leaves orbicular to reniform, rounded or emarginate at the apex.
F. Fruiting pedicels shorter than the ochreolae; perianth lobes coronate in the fruit, equaling the fruit in length; fruit pilose..13. *C. baracoensis.*

FF. Fruiting pedicels exceeding the ochreolae; perianth lobes shorter than the fruit, coronate or appressed; fruit glabrous.

G. Rhachis of inflorescence keeled below the nodes; leaves thick coriaceous, the secondary venation obscure; fruit oblong, the perianth lobes not coronate.........14. *C. nipensis.*

GG. Rhachis of inflorescence terete or angled, not keeled.

H. Leaves broader than long, thick coriaceous, not turning black on drying; fruit obpyriform............15. *C. uvifera.*

HH. Leaves thin coriaceous or chartaceous; fruit ovoid, perianth lobes more or less coronate.

I. Leaves coarsely reticulate veined on both surfaces, turning black on drying.

J. Rhachis of inflorescence puberulent; primary veins of the leaves free to the margin......................16. *C. Northropiae.*

JJ. Rhachis of inflorescence glabrous; primary veins of the leaves arcuate, anastomosing near the margin..17. *C. retusa.*

II. Leaves smooth above, finely reticulate below, not turning black on drying; inflorescence puberulent; veins anastomosing near the margin...........................18. *C. praecox.*

EE. Leaves ovate, oblong, elliptic but not orbicular.

F. Rhachis puberulent to pilose.

G. Fruiting pedicels shorter than the ochreolae or only slightly exceeding them.

H. Inflorescence stout, 10–30 cm. long; leaves thick coriaceous, generally more than 10 cm. long.

I. Veins of the leaves straight to the margins; perianth red, puberulent.....................19. *C. Shaferi.*

II. Primary veins arcuate, anastomosing near the margins; perianth white, glabrous............20. *C. costata.*

HH. Inflorescence slender, 2–6 cm. long; leaves thin coriaceous, generally less than 7 cm. long.

I. Fruit obovoid, the lobes appressed against the apex of the achene; secondary venation reticulate on both surfaces, leaves commonly with glandular excretions resembling peltate scales on the lower surface.... ....21. *C. benitensis.*

II. Fruit ovoid, the perianth lobes more or less coronate; leaves smooth, not reticulate above, without noticeable glandular excretions.

J. Leaves smooth on both surfaces, the lamina thin coriaceous, not rigid, the apex acute to obtuse but not mucronate; petioles pilose; pedicels of the fruit shorter than the ochreolae..... ....22. *C. rufescens.*

JJ. Leaves smooth above, minutely reticulate below, the lamina usually rigidly coriaceous, the apex acute or acuminate, commonly short spinose mucronate; petioles puberulent; fruiting pedicels equal to or rarely half again as long as the ochreolae....... ....5. *C. reflexa.*

GG. Fruiting pedicels 2–10 times as long as the ochreolae.

H. Leaves broader than long, thick coriaceous, without conspicuous reticulate venation..............15. *C. uvifera.*

HH. Leaves longer than broad; secondary venation reticulate, at least below.

I. Mature leaves 3–5 cm. long, oblong-ovate to orbicular.

J. Primary veins straight and free to the margins, the leaf blades usually turning black on drying, shining above, commonly reticulate on both surfaces.......... ....16. *C. Northropiae.*

JJ. Primary veins arcuate, dichotomous and anastomosing near the margin, the leaf blades not turning black on drying, smooth above, minutely reticulate below.

K. Leaf apex rounded or emarginate; perianth lobes imbricate, appressed against the apex of the achene....18. *C. praecox.*

KK. Leaf apex acute to acuminate, often spinose mucronate; perianth lobes more or less coronate.... ....5. *C. reflexa.*

II. Mature leaves 8–25 cm. long.

J. Leaves membranaceous, commonly barbate in the axils when mature; petioles attached above the base of the ochreae........ ....12. *C. tenuifolia.*

JJ. Leaves coriaceous, glabrous; petioles attached at the base of the ochreae.

K. Fruiting pedicels 8–15 mm. long.....10. *C. coriacea.*

KK. Fruiting pedicels 3–5 mm. long.

L. Leaves conspicuously coarsely reticulate on both surfaces, the blade with glandular excretions below..... .....23. *C. Wrightii.*

LL. Leaves smooth or minutely reticulate on both surfaces; glands usually sunken, excretions not evident.

M. Leaf blades smooth ....20. *C. costata.*

MM. Leaf blades minutely reticulate. 15a. *C. uvifera* × *diversifolia.*

FF. Rhachis glabrous or with glandular excretions.

G. Rhachis and flowers with glandular excretions appearing as scales or peltate protuberances.

H. Perianth lobes coronate in fruit, the fruit 7–9 mm. long; leaf blades with small glandular excretions below............ ....23. *C. Wrightii.*

HH. Perianth lobes appressed to the apex of the achene.

I. Leaf blades ovate, cordate or rounded and unequal at the base, apex rounded or obtuse; glands sunken in pits or depressed; fruit fusiform, 10 mm. long or longer....24. *C. Leonardii.*

II. Leaf blades oblong, narrowed at the base, acute to acuminate at the apex; glandular excretions appearing as peltate scales; fruit ovoid to globose, to 6 mm. long.....21. *C. benitensis.*

GG. Rhachis and flowers glabrous.

H. Fruiting pedicels shorter than the ochreolae.

I. Primary veins straight to the margin; leaf blades thick coriaceous; petioles glabrous...........19. *C. Shaferi.*

II. Primary veins arcuate, anastomosing near the margin; leaf blades thin coriaceous.

J. Fruit ovoid, the perianth lobes coronate; petioles pilose pubescent ....25. *C. Swartzii* f. *pubescens.*

JJ. Fruit fusiform, the perianth lobes appressed and imbricate against the apex of the achene; petioles glabrous...........................24. .*C. Leonardii.*

HH. Fruiting pedicels longer than the ochreolae.

I. Leaves bullate, cordate auriculate at the base; flowers red on pedicels 5 mm. long; fruiting pedicels 10 mm. long.............26. *C. Cowellii.*

II. Leaves flat; flowers green or white.

J. Leaf blades cordate at the base, minutely reticulate on both surfaces; flowering pedicels 7–10 mm. long; fruiting pedicels to 15 mm. long...10. *C. coriacea.*

JJ. Leaf blades rounded or narrowed at the base, not cordate.

K. Leaves shining above when dry, usually turning black on drying; fruit ovoid, the perianth lobes coronate, the fruit to 6 mm. long.................17. *C. retusa.*

KK. Leaves dull, dark but not black on drying; fruit globose to obpyriform, the perianth lobes appressed against the apex of the achene, the mature fruit 10–13 mm. long................27. *C. diversifolia.*

1. **Coccoloba venosa** L. Syst. Nat. ed. 10, 1007. 1759; Fawcett and Rendle, Jour. Bot. 51: 123. 1913.

Coccoloba punctata L. Sp. Pl. ed. 2, 523. 1762.

Uvifera arbor americana, fructu aromatico punctatus, Pluk. Alm. 394. *t. 237, fig. 4*. 1696, as to leaf only.

Coccoloba nivea Jacq. Hist. Stirp. Amer. 115, *pl. 78*. 1763; Enum. Pl. 19. 1762.

Guaiabara venosa (L.) House, Am. Midl. Nat. 8: 64. 1922, (as *Guaibara*).

Trees to 10 m. tall; branches terete, glabrous, the nodes not tumid; ochreae membranaceous, deeply cleft, acuminate on one side, or truncate, to 2 cm. long, glabrous or with flattened glands; leaf blades oblong-lanceolate to elliptic, the apex short acuminate, the base narrowed and slightly cordate or cuneate or obtuse, 8×4, 10×4.5, 16.5×6.5, 21×9, 27×10.5 cm. long and broad, membranaceous, glabrous except for clusters of hairs in the axils of the veins, sparsely glandular below; midrib and primary veins slightly prominent on both surfaces, the primary veins 8–13 pairs, straight or arcuate, bifurcate and anastomosing at the margins, the petioles 5–10 mm. long, glabrous; leaves of the adventitious shoots about the same size, the internodes much elongate and the ochreae to 4 cm. long; inflorescence terminal or terminal on short lateral branches, the rhachis puberulent, angular; staminate flowers in clusters of 2–5, the pistillate flowers solitary, the bracts lanceolate-ovate, to 1.5 mm. long, black, puberulent to pilose or commonly with a fringe of hairs at the apex; ochreolae membranaceous, enlarging with the expanding bud, each flower with an ochreola, to 2 mm. long, the flowering pedicels 1–2 mm. long, glabrous; hypanthium less than 0.5 mm. long, the perianth lobes broadly ovate, 1.5–2 mm. long and broad, slightly unequal, the fertile stamens to 1 mm. long; fruiting pedicels 1.5–2.5 mm. long, the fruit broadly ovoid, the perianth lobes fleshy, white or pink enclosing the black achene, the hypanthium scarcely evident in the fruit, the fruit 3–4 mm. long and broad.

DISTRIBUTION: Cuba (introduced), Hispaniola, Puerto Rico, Jamaica, Virgin Islands, Lesser Antilles, Trinidad.

CUBA: Las Villas: Atkins Garden, Soledad, P. I. 98831 collected by Walsingham without number (G). In flower and fruit Nov. and March.

The history and synonymy of this species is quite confused. Fawcett and Rendle did considerable work in publishing their note on this species for the Flora of Jamaica. While *C. nivea* Jacq. has a clear-cut description and is well illustrated and might well be selected as the type, I am following Fawcett and Rendle's interpretation since it is now widely accepted in the Caribbean area. Lindau was completely confused in his treatments of *C. punctata, C. excoriata* and *C. venosa* and his work is difficult to untangle.

The specimen from Cuba is an introduction now under cultivation at the Atkins Garden at Soledad. The records of the garden list this as a plant introduced by the United States Department of Agriculture with the number 98831 from Great Inagua in the Bahamas. There are no specimens of this species from the Bahamas in the collections I have studied and either the place of origin of this cultivated material is confused or the specimen might be growing in the Bahamas, also under cultivation, without herbarium records available.

According to correspondence with H. G. Walsingham of the Atkins Garden there is but one specimen in the Garden. That tree flowers and fruits regularly. From field studies made of other species I have concluded that the genus *Coccoloba* consists of dioecious plants; however, this specimen from Cuba must be monoecious. The majority of the ten herbarium specimens I have for study from the Soledad plant are with staminate inflorescences and flowers. On four specimens the flowers are perfect and have developed fruit. No truly pistillate flowers were seen in this collection.

The fruits of *C. venosa* are extremely attractive with the white or pink fleshy perianth lobes surrounding a jet black achene. Jamaica has been assumed the type locality of this species although, as Fawcett and Rendle point out, no collections are known from that island.

2. **Coccoloba microphylla** Griseb. Cat. Pl. Cub. 62. 1866.

Uvifera microphylla O. Ktze. Rev. Gen. **2**: 561. 1891.

Virgate shrub 1–2 m. tall to small tree 5 m. tall, branches often arranged in one plane, commonly with brown shredding bark, the youngest branches puberulent, nodes not at all tumid; short shoots well developed, often spine-like at the tips; ochreae subcoriaceous, 1 mm. long, puberulent, commonly dehiscent from the side opposite the petiole and remaining attached to the petiole, appearing as auriculate wings; leaf blades orbicular to reniform, apex emarginate, base slightly cordate, 1 × 1, 5 × 5 mm. long and broad, coriaceous, turning black on drying, venation reticulate, conspicuous on both surfaces; inflorescence terminal on short shoots, rhachis very short, flowers appearing subsessile; bracts ovate, less than 0.5 mm. long, ochreolae membranaceous, less than 0.5 mm. long, flowering pedicels 0.5 mm. long, hypanthium less than 0.5 mm. long, perianth lobes 1 mm. long and broad, fertile stamens 1 mm. long; fruiting pedicels less than 1 mm. long, fruit not known.

DISTRIBUTION: Cuba.

CUBA: Oriente: Sierra de Nipe, at Rio Piloto, *Ekman 15069* (S); Gamboa, *Ekman 14996* (A, FM, G, NY, S, US). Matanzas: Pan de Matanzas, SE of Canasí, *Ekman 16513* (S); E. of Canasí, Cuabal del Espinal *Leon 12975* (NY). Las Villas: Cieneguita, *Combs 725* (FM, G, MO, NY, US); San Marcos, *Wright 2249* (type collection, G, MO, NY, S), *Leon 9187* (NY); Motembo, *Leon, Edmund & Fortún 8554* (NY), *Leon & Laustalot 11368* (NY). Pinar del Rio: Coloma, *Britton, Britton & Gager 7023* (NY), *Roig & Fors 4214* (NY). Isle of Pines: Siguanea, *Britton, Britton & Wilson 15376* (NY, US), *Ekman 12183* (US). Collected in flower: Feb., Aug., Sept. Local name: *uverillo*.

3. **Coccoloba armata** Griseb. Cat. Pl. Cuba 62, 283. 1866; Sauvalle, Fl. Cub. 139. 1868; Britton, Bull. Torrey Bot. Club **42**: 366. 1915.

Uvifera armata O. Ktze. Rev. Gen. **2**: 561. 1891.

Much branched shrub 1–3 m. tall becoming a tree 10 m. tall; branches commonly in one plane, puberulent, nodes slightly tumid; ochreae 1 mm. long, commonly breaking free on the side away from the petiole; leaf blades cordate, apex rigid, long spinose mucronate, base cordate, 5 × 4, 12 × 9 mm. long and broad, coriaceous, glabrous, midrib impressed above, primary veins inconspicuous, upper surface smooth, lower surface minutely reticulate, margin slightly erose or entire, flat or recurved; petioles 1 mm. long, base tumid or corky, leaves of adventitious shoot 18 × 18 mm. long and broad; flowers in short terminal inflorescence, 2 or 3 flowers clustered together, rhachis very short or none, bracts ovate, less than 0.5 mm. long, ochreolae membranaceous, 0.5 mm. long, flowering pedicels less than 0.5 mm. long, perianth yellow-white, hypanthium less than 0.5 mm. long, perianth lobes 1 mm. long and wide, fertile stamens 1 mm. long; fruiting pedicels less than 1 mm. long; fruit ovoid, narrowed at both ends, to 5 mm. long, 4 mm. in diameter, red, mature perianth lobes appressed against the apex of the achene, achene dark brown or black.

DISTRIBUTION: Cuba.

CUBA: Oriente: Guantanamo Bay, *Britton 1974* (NY); La Carbonera, Guantanamo, *Ekman 2878* (FM, S, US), *Ekman 10170* (A, S); Sierra de Nipe, near Rio Piloto, *Ekman 9993* (S); Bay of Sagua, Tánamo, *Linden 1857* (BR). Las Villas: Motembo, *Leon, Edmund & Fortún 8556* (NY), *Leon & Roca 8205* (NY); Mordazo, *Leon & Cazañas 5975* (NY); Calicita, Loma de Ciego, *Combs 531* (FM, G, MO, NY, US); Rio San Juan, *Britton, Earle & Wilson 5890* (NY); Manacas, *Howard 5503* (G). Havana: Madruga, *Leon & Cesàire 8956* (NY); Loma Coca near Campo Florida, *Ekman 13217* (S); Miñas, *Ekman 13140* (NY, S). Pinar del Rio: Sierra de Viñales, *Ekman 16587* (S); Cabañas Bay, *Ekman 10930* (NY, S); San Marcos, *Wright 2250* (G, MO, NY, S, US, type Collection). Collected in flower: May, Aug., Nov. Collected in fruit: Jan., Aug., Sept., Nov., Dec.

The original description of this species in Cat. Pl. Cuba lists *Wright 1250* as the specimen upon which the species is based. This is corrected in the emended list of Wright collections (l.c. 288) to read *Wright 2250*.

Field studies on this species are much needed. There are two aspects to the leaves of herbarium specimens. In some the leaves are smooth, in others minutely reticulate on both surfaces. In addition the plants of these two divisions have a slightly different appearance. At present there is no satisfactory way of handling these two divisions and all are cited as one species.

The majority of the specimens cited above are sterile. The flowers are small and the almost complete absence of an inflorescence axis adds to the difficulty of selecting flowering or fruiting material in the field.

4. **Coccoloba geniculata** Lindau, Engl. Bot. Jahrb. **13**: 141. 1890.

Uvifera geniculata O. Ktze. Rev. Gen. **2**: 561. 1891.

Virgate shrub, 1–2 m. tall; branches commonly short, contorted or geniculate, the youngest puberulent, nodes slightly tumid, ochreae cylindrical, membranaceous, oblique at the apex, 2–3 mm. long, leaf blades ovate to suborbicular, often umbonate, apex acute, commonly with a spiny mucro, base rounded, 1.5 × 1, 2.5 × 1.5, 3 × 2.5 cm. long and broad, coriaceous, glabrous, smooth often shining above, dull beneath, midrib impressed above, prominent below, primary veins 9–11 pairs, inconspicuous, secondary venation obscure, leaf surface glandular dotted above and below, margin entire, recurved; petioles 2–4 mm. long, puberulent or papillose, tumid at the base; leaves of adventitious shoots ovate, 4 × 2 cm. on petioles 5 mm. long; inflorescence terminal, often clustered, 0.5–1.5 cm. long, rhachis papillose rarely minutely puberulent, staminate flowers in clusters of 3–8, female flowers solitary, female inflorescence short, generally consisting of 1–3 flowering nodes; bracts membranaceous, 1.5–2.5 mm. long, 2–3 mm. broad, glabrous; ochreolae membranaceous, several concentrically arranged, flowering pedicels to 1 mm. long, perianth pink, hypanthium 0.5 mm. long, perianth lobes 1.5 mm. long and broad, filaments of fertile stamens less than 1 mm. long; fruit from a staminate plant ovoid, 5 mm. long, 2.5 mm. diameter, glabrous, perianth lobes appressed against the apex of the achene.

Distribution: Cuba.

CUBA: Oriente: Sabana de Yaba, Yareyal, Holguin, *Leon 15783* (NY). Camaguey: Santayana, *Ekman 15339* (A, FM, NY, S); Caobilla, *Acuña 8876* (R. #4029, S. V. #8876, Herb. C. E. Baker #13700). Las Villas: Santa Clara city, *Ekman 14042* (S), *16331* (S), *18842* (NY, S), *Leon 14950* (NY), *Britton & Cowell 10199* (NY), *13325* (NY), *Britton, Britton & Wilson 6189* (NY); Puerto Principe, *Wright 2255* (G, NY, MO, HABA, type Collection). Collected in flower: Feb., Mar., June, July, Oct. Collected in fruit: July.

Unfortunately the specimen (*Wright 2255*) on which Lindau based this species consists of adventitious shoots or fast growing shoots with larger leaves, and an abnormal inflorescence. Lindau's use of the specific epithet *geniculata* refers to the angular path of this abnormal inflorescence. It could, however, apply as well to the commonly geniculate nature of the branch system of the more typical plants now assigned to the species. The specimens collected by *Britton & Cowell 13325* and *Britton, Britton & Wilson 6189* show the relationship between the normal short shoot geniculate type of growth and the occasional adventitious shoot with the larger leaves.

In the plants with more normal growth habit than the type collection the inflorescence is short, rarely exceeding 1 cm. in length. Three to eight staminate flowers are clustered in concentric ochreolae as in the Wright specimen but the flowering axis is much shorter. In the female plants I have examined the flowering axis is likewise very short and may consist of only three nodes with a total of three flowers, one per node of the rhachis.

The fruit mentioned in the description above was one of two fruits attached to the specimen collected by *Ekman 15339*. This specimen has staminate flowers on the plant but as occasionally happens the ovary may develop and apparently a mature fruit is produced. In this case, as in many cases I examined in the field, the fruit was hollow, with no evidence of an embryo and endosperm being formed. The shape and size of this fruit may be regarded as indication of that of fertile fruits. This conclusion is based on evidence obtained from the study of other fruits of similar abortive nature from other species studied in the field.

5. **Coccoloba reflexa** Lindau, Engl. Bot. Jahrb. **13**: 141. 1890.

Coccoloba pilonis Urb., Fedde Repert. Sp. Nov. **13**: 445. 1914; Schmidt, Fedde Repert. Sp. Nov. **32**: 79. 1933.

Coccolobis woodfredensis Britton, Bull. Torrey Bot. Club **42**: 367. 1915.

Coccoloba acutissima Urb., Fedde Repert. Sp. Nov. **18**: 113. 1922.

Uvifera reflexa O. Ktze. Rev. Gen. **2**: 562. 1891.

Shrub 1–2 m. tall; branches terete often geniculate, puberulent when young, nodes slightly tumid; ochreae membranaceous, puberulent 2–5 mm. long; leaf blades ovate to ovate-elliptic or oblong, rarely lanceolate, apex abruptly acuminate, often spinose mucronate, base rounded to slightly cordate, 4 × 2, 5.5 × 2.5, 7 × 4, 8 × 3 cm. long and wide, coriaceous, smooth and shining above, dull beneath, glabrous except for the puberulent midrib, primary veins 5–7 pairs straight to arcuate anastomosing, inconspicuous, secondary venation reticulate below, blade punctate glandular dotted on both surfaces, margin entire, commonly recurved; petiole 3–6 mm. long, puberulent; inflorescence terminal, 2.5–8 cm. long, rhachis puberulent, staminate flowers in clusters of 2–5, pistillate flowers solitary, bracts ovate, 0.5 mm. long, ochreolae membranaceous, 0.5 mm. long, flowering pedicels 0.5–1 mm. long, hypanthium 0.5 mm. long, perianth lobes 1–1.3 mm. long and broad, fertile stamens 1 mm. long; fruiting pedicels 0.8–1.2 mm. long, fruit black, ovoid, to 6 mm. long, 3 mm. diameter, perianth lobes appressed against the apex of the achene.

DISTRIBUTION: Cuba.

CUBA: Oriente: Loma Pilon near Holguin, *Shafer 1232* (type collection of *C. pilonis*, NY, US), *Ekman 3289* (S); Cerro de Fraile, Holguin, *Ekman 7582* (S), *Ekman 15716* (S); Sabana de la Yaba, Yareyal, *Leon 15702* (NY); Sierra de Nipe, Rio Piloto, *Ekman 2718* (S), *19149* (S), *19162* (S), *2237* (type collection of *C. acutissima*, S); Loma Mensura, Sierra de Nipe, *Ekman 9733* (S); Cabeza de Nipe, Sierra de Nipe, *Ekman 2479* (S); Bio-Trail, Sierra de Nipe, *Ekman 4787* (S); ridge between Rio Bayate and Rio Piedra, Sierra de Nipe, *Ekman 15035* (S); Woodfred to Piedra Gorda, Sierra de Nipe, *Ekman 15255* (S), *Shafer 3180* (type collection of *C. woodfredensis*, NY); Punta Padre, *Curbelo 109* (NY); Playa Vaca, Moa, *Acuña 12408* (SV). Without locality: *Wright 2256* (type collection of *C. reflexa*, G, MO, HABA). Collected in flower: July, Aug., Sept. Collected in fruit: July, Aug., Sept., Oct., Nov., Dec.

Schmidt pointed out in his paper in Fedde, Rep. **32**: 79. 1933, that the present collection of specimens represents the extremes of a species with variable leaf shapes. In doing so Schmidt reduced *C. woodfredensis* and *C. acutissima* to the synonymy of *C. pilonis*. Unfortunately Schmidt did not look far enough, for *C. reflexa* of Lindau based on a Wright collection (*2256*) represents the same species and being an older name must be used for this species.

Again the variation in the leaves can be associated with the growth habit of the plant, the larger and narrowed leaves of the type of *C. acutissima* are vigorous shoots while the smaller leaves represent a more normal growth pattern. All types of leaves can be found on one or a few sheets of the same collection. The large number of collections from the vicinity of Holguin and from Sierra de Nipe indicate the range of variation to be expected in one species in one area.

As Schmidt correctly points out the amount of puberulence on the rhachis of the inflorescence varies considerably from specimen to specimen. Also the characters Britton used to separate *C. woodfredensis* and *C. pilonis* in his revision of the genus *Coccoloba* (Bull. Torrey Bot. Club **42**: 365. 1915) are entirely variable and can not be used.

6. **Coccoloba Clementis,** sp. nov.

Frutex ramulis teretibus, nigrescentibus exsiccis, puberulis, ochreis brunneis, membranaceis, puberulis, petiolos 6–8 mm. excedentibus, unilateraliter perincisis, apice dilatatis; lamina matura obovata vel elliptica, apice rotundata, basi acuta vel rotundata, chartacea, supra et subtus persistente puberula et glandulosa, 5 × 3.5 vel 6 × 4 cm. longa et lata, margine undulato maturitate recurvato, nervo medio supra subconspicuo, nervis primariis supra inconspicuis, nervo medio et venis subtus prominentibus, nervis primariis 3–5, ad marginem rectis, non anastomosantibus, venis secondariis obscuris; petiolis 3–5 mm. longis, supra subcanaliculatis, puberulis; inflorescentia terminalis 5–12 cm. longa, rhachi dense puberulo, bracteis late ovatis plus minusve 0.5 mm. longis, 1.5–2 mm. latis, puberulis, brunneis, membranaceis, ochreolis circa 0.5 mm. longis, puberulis, pedicello puberulo ochreolas non excedente; floribus masculinis 2 vel 3 per nodulum puberulis, hypanthio 1 mm. longo, lobis 5, imbricatis, exterioribus 1.5 × 1 mm. longis et latis, interioribus sub-brevioribus, staminibus 7 vel 8, filamentis plerumque 1 mm. non aequantibus antheris circa 0.5 mm. longis; pistillo rudimentario ad 1 mm. longo, stylis 3; flos foemina et fructus ignotus.

CUBA: Oriente: Rio Cromita, Cayoguain, Punta Gorda, *Clemente 4097* (TYPE, G; ISOTYPE, HAB).

The specimens cited above were collected in flower on July 25th. The species is distinct from others from the West Indies in the undulate leaf margin and the persistent puberulence on both leaf surfaces.

7. **Coccoloba Acuña,** sp. nov.

Frutex ramulis teretibus, pilosis, nodis tumescentibus; ochreis membranaceis, pilosis, 2–4 mm. longis, ad basin cylindricis, ad apicem sursum dilatatem et obliquis; lamina orbiculare, bullata, apice rotundata, basi rotundata, 1.5 × 1.5, 2 × 2 cm. longa et lata, coriacea, supra glabra, nitida, subtus pilosa, nervo medio et venis primariis supra impressis vel obscuris, nervis primariis 4 vel 5, ad marginem rectis, bifurcatis, non anastomosantibus, venis secondariis subtus dense reticulatis; petiolis teretibus, 3–4 mm. longis, pilosis; inflorescentia terminalis, 2–4 cm. longa, rhachi piloso, bracteis ovatis, 1.5 mm. longis, 1.5–2 mm. latis, pilosis; ochreolis membranaceis, 1 mm. longis, pilosis, pedicellis ochreolas non excedente; floribus masculinis 2 vel 3 per nodulum, hypanthio 0.5 mm. longo, lobis ovatis, 1 mm. longis, 1 mm. latis, staminibus 8, filamentis 0.5–1 mm. longis, pistillo rudimentario; floribus foemineis 1 per nodulum, perianthio masculinis similibus, staminibus rudimentariis, pistillo 1 mm. longo; fructu ovoideo, nigro, glabro, ad 8 mm. longo, 4 mm. diametro, lobis perianthii coronatis, 1 mm. longis.

CUBA: Oriente, Breñales de Playa Vaca, Moa, *Acuña 13094* (SV), *Clemente 4104* (TYPE, G; ISOTYPE, HAB). Collected in flower: Nov. Collected in fruit: July.

This species resembles *C. baracoensis* in having orbicular leaves but can be distinguished by the umbonate character of the leaf blade, the pubescence on the lower surface of the leaf and the glabrous fruits. It also resembles the small leaf forms of *C. geniculata* from which it is distinct on the pubescence of the leaf and the long inflorescence.

8. **Coccoloba caesia** Ekman ex Schmidt, Fedde Repert Sp. Nov. 24: 74. 1927.

Small tree; branches terete, glabrous, nodes not tumid; ochreae membranaceous, 6–8 mm. long, glabrous, turning black on drying; leaf blades elliptical, rarely ovate-elliptical, apex rounded, base narrowed commonly oblique, 9 × 3.5, 13 × 4, 17 × 6.5 cm. long and broad, subcoriaceous, turning black on drying, margin entire, slightly recurved, midrib and veins slightly prominent above, prominent below, primary veins 8–12 pairs, arcuate anastomosing, secondary venation reticulate, conspicuous above, obscured below by club shaped papillae arising from the epidermal cells giving the lamina a gray or ashen appearance; petioles 8–12 mm. long, glabrous, arising from the middle of the ochreae; inflorescence terminal, solitary or with a smaller spike at the base, 12–19 cm. long, rhachis slightly puberulent, staminate flowers in clusters of 2 or 3, pistillate flowers solitary, bracts broadly ovate, less than 0.5 mm. long, puberulent, ochreolae borne on stout puberulent stalks 1–1.5 mm. long in the staminate flowers, 2–3 mm. long in the pistillate flowers, ochreolae membranaceous, puberulent, pedicels not evident, hypanthium less than 0.5 mm. long, the perianth lobes ovate, 1.5 mm. long, filaments of fertile stamens 1.5–1.8 mm. long; fruit obovoid, 8 mm. long, 4–5 mm. broad, narrowed at the base, lobes of the perianth appressed against the apex of the achene.

DISTRIBUTION: Cuba.

CUBA: Oriente: Sierra de Nipe, Loma Mensura, *Ekman 9894* (TYPE, S; ISOTYPES, G, NY); near Rio Piloto, *Ekman 3351* (FM, S), *6420*

(NY, S); Baracoa, Lomas de Cuaba, *Ekman 4237* (S); Sierra Maestra, edge of Arroyo Corojo near Nagua, *Ekman 14739* (FM, NY, S); Loma del Gato, *Clemente 3681* (HAB); Florida Blanca, Santiago de Cuba, *Bucher 231* (NY, R). Collected in flower: May, Oct., Nov. Collected in fruit: Jan.

The stalked ochreolae characterize this species which is also distinct on the gray pubescence of the lower leaf surface. The type specimen is staminate.

9. **Coccoloba pallida** Wr. in Griseb. Cat. Pl. Cub. 61. 1866.

Coccoloba lineari-lanceolata Schmidt, Fedde Repert. Sp. Nov. **24**: 76. 1927.
Uvifera pallida O. Ktze. Rev. Gen. **2**: 561. 1891.

Shrub or small tree to 7 m. tall; branches terete, papillose or puberulent, short shoots conspicuously developed, ochreae membranaceous, 1–2 mm. long, puberulent to pilose; leaf blades ovate to elliptic-ovate, apex rounded or obtusely acuminate, base rounded to obliquely cordate, 4 × 2, 5.5 × 3.5, 6.5 × 2, 9.5 × 6 cm. long and broad, coriaceous, glabrous and pitted above, minutely and densely white papillose below, the hairs short and blunt with rounded apices, midrib and primary veins impressed above, prominent below, primary veins 5–8 pairs, straight or arcuate, bifurcate and anastomosing near the margin, secondary venation densely reticulate on both surfaces; petioles 1–4 mm. long, puberulent attached above the base of the ochreae; leaves of adventitious shoots ovate-lanceolate to lanceolate-oblong, 11 × 3, to 19 × 4 cm. long and broad, petioles 3–4 mm. long, ochreae 3–8 mm. long; inflorescence terminal, 3.5–6.5 cm. long, rhachis puberulent, staminate flowers in clusters of 2–4, pistillate flowers solitary, bracts ovate, less than 0.5 mm. long, puberulent, ochreolae membranaceous, spreading, to 1 mm. long, puberulent; flowering pedicels less than 0.5 mm. long; hypanthium less than 0.5 mm. long, perianth lobes 0.5–1 mm. long and broad, fertile stamens less than 1 mm. long; fruiting pedicels less than 0.5 mm. long; fruit ovoid, to 7 mm. long, 3.5 mm. thick, perianth lobes appressed against the apex of the achene.

DISTRIBUTION: Cuba.

CUBA: Matanzas: Matanzas City, *Ekman 17211* (type Collection of *C. lineari-lanceolata,* S). Havana: Jibacoa beach, *Leon 13248* (G). Pinar del Rio: Cajalbana, *Ekman 10488* (S), *Leon 4945* (NY); San Marcos, *Wright 2254* (type collection, G, HABA, MO, NY, S); Loma Pelada, Cayajabos, *Leon 13221* (NY), *13545* (NY), *13812* (G, HAB, NY). Collected in flower: Dec. Collected in fruit: Jan., Mar. Common names: *Uvero blanco, Uverillo.*

Schmidt's statement that *Coccoloba lineari-lanceolata* is distinct from all other West Indian species of *Coccoloba* is evidence he did not recognize the character of adventitious shoots and the accompanying variation of leaf form that is characteristic of the genus *Coccoloba*. The Ekman collection which is the type of *C. lineari-lanceolata* is of vigorous shoots probably adventitious in nature. Ekman noted on the collector's label that the specimen was rare in Matanzas where he collected it. The characteristic pubescence of *C. pallida* and the striking venation pattern as well as the high attachment of the petiole on the ochreae allow this sterile collection to be placed in *C. pallida*.

10. **Coccoloba coriacea** Sagra, Fl. Cub. **11**: 184. 1853; Lindau, Engl. Bot. Jahrb. **13**: 153. 1890.

Uvifera coriacea O. Ktze. Rev. Gen. **2**: 561. 1891.
Coccoloba calobotrys Meisner, DC. Prod. **14**: 157. 1856.

Shrub to slender tree 7 m. tall; branches terete, stout, puberulent at the nodes, often of determinate growth (short shoots) with several concentric ochreae at the base, nodes not tumid; ochreae membranaceous, 4–7 mm. long, short pilose pubescent; leaf blades elliptic-lanceolate to oblong-lanceolate, apex acuminate, often with rigid tip, base rounded to cordate, 11 × 4, 13 × 6, 17 × 2.5, 21 × 9 cm. long and broad, coriaceous, glabrous, midrib and veins flat above, conspicuous below, primary veins 5–7 pairs arcuate, bifurcate and anastomosing near the margin, secondary venation minutely reticulate on both surfaces; petioles 5–8 mm. long, puberulent to glabrate; leaves of adventitious shoots 19 × 6, 21 × 9 cm. long and broad; inflorescence terminal, 10–27 cm. long, rhachis papillose to puberulent; staminate flowers commonly single, occasionally in clusters of 2 or 3 flowers, pistillate flowers solitary; bracts ovate, less than 0.5 mm. long, ochreolae membranaceous, 0.5 mm. long; flowering pedicels 7–10 mm. long, glabrous, perianth red, glabrous, hypanthium 1 mm. long, perianth lobes ovate, 2 mm. long, 1.5 mm. broad, fertile stamens 1 mm. long; fruiting pedicels to 15 mm. long, fruit ovoid, acuminate at both ends, to 7 mm. long, 5 mm. thick, perianth lobes sub-coronate.

DISTRIBUTION: Cuba.

CUBA: Oriente: Sierra de Nipe, Piedra Gorda to Woodfred, *Shafer 3543* (NY, US); Rio Canapé, *Ekman 9593* (S); Bio-Trail, *Ekman 4778* (NY, S); Pico Turquino, *Acuña 10075* (SV); Enseñada de Mora, *Britton, Cowell & Shafer 13003* (FM, MO, NY, US); Nagua, Mucural Hill, *Leon 11031* (NY); Rio Yara, *Ekman 14158* (S); *14841* (S); Mayari, *Wright 2258* (G, HABA, MO). Pinar del Rio: Loma de Cajalbana, *Ekman 10487* (NY, S); Cajalbana, *Leon & Charles 4932* (NY). Havana: Vuelta de Abajo, *Sagra 544* (fr.), *290* (fl.) (NY). Collected in flower: Mar., April, July, Aug., Sept.

A specimen collected by Ramon de le Sagra in Havana Province and found in the Meisner herbarium at the New York Botanical Gardens is the type of *Coccoloba calobotrys* Meisner. Two packets are in the corners of this sheet labelled *Sagra 544* (fr) and *Sagra 290* (fl). The specimen according to the label was from the DeCandolle Herbarium and may well be a fragment of the specimen mentioned by Sagra in the original description. *Coccoloba calobotrys* Meisner therefore may well be based on the same specimen as *C. coricea* Sagra. The numbers may have been assigned to the specimens after the publication of the Flora of Cuba.

This species is difficult to distinguish from *C. costata* in sterile condition.

11. **Coccoloba retirensis** sp. nov.

Arbor parva ramulis teretibus, dense ferrugineo-pilosis; ochreis cylindricis, coriaceis, dense ferrugineo-pilosis, 3–5 mm. longis; lamina oblonga vel elliptica, apice acuta, basi rotundata, 5.5 × 2.5, 7 × 3.5, 9 × 4 cm. longa et lata, coriacea, supra glabra, subtus dense pilosa, nervo medio et venis primariis supra inconspicuis, subtus prominentibus, venis primariis 5–7, arcuatis, prope marginem bifurcatis, anastomosantibus, venis secondariis supra et subtus dense reticulatis, margine vix recurvato; petiolis 5–8 mm. longis, pilosis; inflorescentia terminalis, 2.5–3.5 cm. longa, ad basem plures ochreas pilosas gerens, rhachi dense piloso, bracteis ovatis, 0.5 mm. longis, 1 mm. latis, pilosis, ochreolis membranaceis, ad 1 mm. longis, pedicello piloso, 1–1.5 mm. longo; floribus foemineis 1 per nodulum, glabris, hypanthio 0.5 mm. longo, lobis 5, imbricatis, 1.5 mm. longis, 1–1.5 mm. latis, staminibus rudimentariis, ad 1 mm. longis, pistillo 2 mm. longo, stylis 3; floribus masculinis et fructu ignotis.

CUBA: Pinar del Rio, Santa Cruz de los Pinos, Retiro, *Ekman 18614* (TYPE, S).

Collected in flower March 5, 1924. Ekman's collectors label bears the abbreviation "cult." The specimen cited is not referable to any species from the Caribbean, Central or South America now known to me and so I assume the plant may have been under cultivation as a shade tree and is native to Cuba.

12. **Coccoloba tenuifolia** L. Syst. Nat. ed. 10. 1007. 1759, Amoen. **5**: 397. 1760; Fawcett and Rendle, Jour. Bot. **51**: 124. 1913.

Coccoloba jamaicensis Lindau, Engl. Bot. Jahrb. **13**: 206. 1890.
Uvifera jamaicensis O. Ktze. Rev. Gen. **2**: 561. 1891.
Coccoloba leptostachyoides Lindau, Engl. Bot. Jahrb. **13**: 207. 1890.
Uvifera leptostachyodes O. Ktze. Rev. Gen. **2**: 561. 1891.
Coccolobis? frutescens etc. Browne, Hist. Jam. 210, *pl. 14, fig. 3.* 1756.
Coccolobis bahamensis Britton, Bull. N. Y. Bot. Gard. **4**: 116. 1905.

Shrub or small tree to 5 m. tall; branches terete, puberulent, becoming short shoots often well developed, nodes slightly tumid; ochreae membranaceous above, coriaceous and persistent below, to 15 mm. long, puberulent; leaf blades elliptical, apex short acuminate, base narrowed, unequally rounded to subcordate, 3.5 × 2, 7 × 4.5, 9.5 × 6, 12 × 10 cm. long and wide, membranaceous, subcoriaceous, glabrous above, finely puberulent below, tomentose in the axils of the primary veins and often extending onto the secondary venation or the blade, midrib and primary veins flat or impressed above, prominent below, primary veins 4 or 5 pairs, arcuate, anastomosing, secondary venation finely reticulate; petioles 6–9 mm. long, persistently puberulent, attached above the enlarged base of the ochreae; inflorescence terminal 8–18 cm. long, weak and pendent, rhachis puberulent; staminate flowers 1–4 in a cluster, pistillate flowers solitary, bracts broadly ovate, less than 0.5 mm. long, puberulent, ochreolae membranaceous about 0.5 mm. long, puberulent; flowering pedicels 1–2 mm. long; hypanthium 0.5–1 mm. long, perianth lobes 1–1.5

mm. long and broad, filaments of fertile stamens 1 mm. long, rudimentary stamens of pistillate flowers less than 0.5 mm. long; fruiting pedicels 1–2 mm. long, fruit ovoid to globose, 5–6 mm. long, 4 mm. thick, perianth lobes appressed to the apex of the achene.

DISTRIBUTION: Jamaica, Cuba, Bahamas. Type from Jamaica.

CUBA: Oriente: S. of Niguero between Rio Nuevo and the coast in limestone based forests. *Ekman 16152* (S).

The specimen collected by Ekman was unidentified in the Stockholm herbarium. Unfortunately it is a sterile specimen collected Jan. 16, 1923. It can be referred without question to this species, previously unreported from Cuba since *C. tenuifolia* is readily identified by the puberulent, membranaceous leaves and the characteristic attachment of the petiole to the ochreae sheath.

Lindau listed *Coccoloba tenuifolia* L. among the uncertain species at the end of his monograph. The specimen in the Linnaean herbarium is an excellent flowering specimen, however, and is readily determinable. Fawcett and Rendle review this situation in Jour. Bot. **51**: 124. 1913 and refer *C. jamaicensis* and *C. leptostachyoides* of Lindau to the synonymy of *C. tenuifolia* L.

Coccolobis bahamensis of Britton must likewise be referred to the synonymy of *C. tenuifolia* L. The Bahama material is abundant and while most of the leaves are in the small end of the size range cited in my description above the species does not merit varietal status.

13. **Coccoloba baracoënsis** Schmidt, Fedde Repert. Sp. Nov. **24**: 73. 1927.

Small tree; branches terete, ferruginous pilose-pubescent, nodes not tumid; ochreae cylindrical, membranaceous, pilose, 1–3 mm. long, deeply cleft opposite the petiole; leaf blades orbicular, apex rounded, base slightly cordate, 2.5 × 2.5, 4.5 × 4.5, 8.5 × 6.5 cm. long and broad, coriaceous, glabrous, smooth and shining above, minutely reticulate and densely glandular below, margin entire, slightly recurved, midrib and primary veins inconspicuous above, slightly prominent below, primary veins 3–5 pairs, arcuate and becoming reticulate near the margin, not prominently anastomosing; petioles 4–5 mm. long, pilose; inflorescence terminal, 6–14 cm. long, rhachis striate, pilose, staminate flowers not known, pistillate flowers solitary, bracts ovate, 1–1.5 mm. long, pilose, ochreolae membranaceous, flaring, pilose, 1 mm. long, flowering pedicels less than 1 mm. long, perianth pilose, hypanthium less than 1 mm. long, perianth lobes 1.5 mm. long, 1 mm. broad, stamens rudimentary, less than 0.5 mm. long, pistil 1–1.5 mm. long; fruiting pedicels shorter than the ochreolae, fruit globose and crowned by long attenuate perianth lobes, densely pilose, fruit 3 mm. diameter, the perianth lobes 3 mm. long, achene smooth, shining, golden in color.

DISTRIBUTION: Cuba.

CUBA: Oriente: Baracoa, Lomas de Cuaba, *Ekman 4297* (TYPE, S;

ISOTYPE, NY); Sierra Azul, *Ekman 4427a* (S). Collected in flower and fruit in January.

14. **Coccoloba nipensis** Urban, Fedde Repert. Sp. Nov. **13:** 445. 1914.

Coccoloba uviferiella Lundell, Contrib. Univ. Mich. Herb. **6:** 12. 1941.

Shrub to tree, 10 m. tall; branches terete, glabrous, nodes tumid, ochreae membranaceous, tightly cylindrical, 6–8 mm. long; leaf blades orbicular to elliptical, oval or rarely sub-obovate, apex rounded or slightly emarginate, base cordate, rounded or rarely narrowed, 3 $\times$ 2, 3 $\times$ 3, 4 $\times$ 4, 5 $\times$ 4 cm. long and wide, coriaceous, glabrous, smooth above and below, densely glandular pitted below; midrib and primary veins flat to obscure above and below, primary veins 4 or 5 pairs, evident only near the midrib, margin entire; petioles 3–8 mm. long, glabrous, tumid at the base; inflorescence terminal 6–9 cm. long, rhachis glabrous, strongly keeled below the bracts and flowers; staminate flowers solitary or in clusters of 2 or 3, pistillate flowers solitary, bracts ovate, less than 0.5 mm. long, ochreolae membranaceous, 0.5 mm. long, glabrous, flowering pedicels 1–2 mm. long, hypanthium less than 0.5 mm. long, perianth lobes 0.5–1 mm. long and broad, fertile stamens less than 1 mm. long; fruiting pedicels to 4 mm. long, divaricate at a sharp angle from the rhachis, fruit oblong, rounded at both ends, to 8 mm. long, 5 mm. thick, perianth lobes appressed against the apex of the achene.

DISTRIBUTION: Cuba.

CUBA: Oriente: Sierra de Nipe, Woodfred, *Shafer 3565* (type Collection, FM, G, MO, NY, US); Rio Piloto, *Ekman 15188* (FM, S), *19168* (S); Sierra de Nipe, *Ekman 9963* (A, NY); Loma Minqura, *Shafer 3815* (FM, MO, NY, US); Rio Joa, Baracoa, *Ekman 3661* (S); Moa, *Mrs. Bucher 44* (NY), *45* (NY), *101* (TYPE of *C. uviferiella*, NY, MICH), *Victorin & Clemente 21712* (G), *Howard 5953* (G), *Mrs. Bucher* without number (SV #11106); Playa de Moa, *Clemente, Chrysogone & Nestor 4327* (G), *Leon & Clemente 23273* (G); Cayo Chico near Moa, *Acuña 13093* (SV). Collected in flower: May, June, July. Collected in fruit: July, Sept.

Lundell describing *C. uviferiella* reports "this species suggests the common sea grape *C. uvifera* to which it is allied." Apparently Lundell overlooked the description of *C. nipensis* published 27 years earlier and the specimens in the New York Botanical Garden cited above. *Coccoloba uviferiella* is a perfect match for *C. nipensis* and the species must be placed in synonymy.

A note in Britton's handwriting in the herbarium in the New York Botanical Garden reports the type specimen of this species to be in Berlin. Since that specimen is presumably destroyed I consider the specimen at NY to be the new type specimen since it is in the best condition of the isotypes cited above.

15. **Coccoloba uvifera** L. Syst. Nat. ed. 10, 1007. 1759.

Polygonum Uvifera L. Sp. Pl. 365. 1753.

Guaiabara Uvifera (L.) House, Am. Midl. Nat. **8:** 64. 1922.

Tree of strand areas, 2–15 m. tall, branches terete, stout, papillose to pilose, nodes not tumid, ochreae rigid coriaceous at the base, membranaceous at the apex, 3–8 mm. long, papillose to pilose; leaf blades orbicular to reniform, apex rounded, truncate or emarginate, base rounded to broadly cordate, one lobe often extending around the petiole, 6 × 8, 11 × 13, 13 × 18 cm. long and broad, thick and fleshy when fresh, coriaceous when dry, glabrous and minutely punctate on both surfaces, midrib and primary veins prominent on both surfaces, frequently brightly colored when fresh, primary veins 3–5 pairs, usually straight, bifurcate and weakly anastomosing near the margin, commonly barbate in the axils of the basal veins, secondary venation minutely reticulate or obscure; petioles stout, 7–10 mm. long, papillose to pilose; leaves of adventitious or fast growing shoots usually variable in size and shape commonly obovate; inflorescence stout, 15–30 cm. long, rhachis puberulent; staminate flowers in clusters of 1–7, pistillate flowers solitary, bracts ovate, 1–1.5 mm. long, 2 mm. broad, puberulent, ochreolae membranaceous, 1 mm. long, puberulent, flowering pedicels 1–2 mm. long, perianth yellow-white or greenish, hypanthium 2–3 mm. long, perianth lobes 4 mm. long, 3–4 mm. wide, fertile stamens to 4 mm. long; fruiting pedicels 3–4 mm. long, fruit obpyriform, 1.2–2 cm. long, 8–10 mm. diameter, narrowed at the base, rounded truncate at the apex, the perianth lobes appressed against the apex of the achene, perianth rose-purple when mature, the achene black.

DISTRIBUTION: Along shores, Florida, Bermuda, through the Caribbean to S. America.

CUBA: Oriente: Gibara to Punta Hicacos, *Shafer 1485* (US, NY); Santiago, *Taylor 324* (NY). Las Villas: Soledad, *Jack 585* (A), *4118* (A), *4533* (A), *5092* (A), *5319* (A); Rancho Luna, E. of Cienfuegos Bay, *Howard 4209* (G); Castillo de Jagua, *Combs 569* (G, FM, MO, NY). Havana: *Liebmann* without number (C, several sheets); Morro Cojimar, *Ekman 372* (S); Playa de Marianao, *Palmer & Riley 852* (US); Rancho Bayeros, *Wilson 1339* (C); Santiago las Vegas, *A. L. & H. N. Moldenke 19915* (NY); Playa Mariano, *Van Hermann 887* (NY). Camaguey: Cayo Sabinal, *Shafer 1125* (US, NY). Isle of Pines: Nueva Gerona, *Curtis* without no. (NY). Without locality: *Wright 2259* (G). Collected in flower: Mar., April, Aug., Sept. Collected in fruit: June, July, Aug. Common names: *uva, uva de la caleta, uvero, uva de playa.*

15a. **Coccoloba uvifera** L. × **C. diversifolia** Jacq., hybr. nov.

Shrub or tree; branches terete, minutely pilose; ochreae coriaceous, persistent, oblique and flaring at the apex, pilose; leaf blades oblong to obovate-oblong, apex rounded to sub-acute, base obliquely rounded to obliquely cordate, 11 × 8, 14 × 9.5, 16 × 10.5 cm. long and broad, coriaceous, midrib and primary veins prominent on both surfaces, secondary venation conspicuously reticulate both surfaces, primary veins 5–7 pairs, arcuate, anastomosing, leaf blade glabrous above, crispose pilose on midrib and veins below and in axils of veins and on lamina parallel to midrib, densely resinous glandular below; petiole stout, 1–1.5 cm. long, minutely pilose; inflorescence terminal 7–15 cm. long, rhachis puberulent, bracts broadly ovate 1 mm. long, puberulent, ochreolae membranaceous, 1 mm. long, puberulent, flowering pedicels 1.5–2 mm. long, puberulent; staminate flowers in clusters of 2–3, hypanthium 0.5 mm. long, perianth lobes 0.5–1 mm. long, stamens 1 mm. long; pistillate flowers not seen; fruiting pedicels 2–4 mm. long, fruits not seen.

CUBA: Pinar del Rio: Sta. Cruz de Los Pinos, *Ekman 18615* (S), Range, *Roig 11935* (SV).

In the nature of the pubescence, the texture of the leaves and the pattern of primary venation this material approaches *C. uvifera.* The secondary venation and the type of glands found on the leaves are similar to those of *C. diversifolia.* The shape of the leaf blade is intermediate between these two species. *Coccoloba uvifera* apparently hybridizes freely with many other species of the same genus. Unfortunately single collections in the herbarium are usually of little value in the study of possible hybridization and field studies are needed with just this idea in mind.

16. **Coccoloba Northropiae** Britton, Bahama Flora 117. 1920, (as *Coccolobis*).

Coccoloba leoganensis var. *parvifolia* Griseb. Cat. Pl. Cub. 61. 1866.
Coccoloba retusa Lindau, Engl. Bot. Jahrb. **13**: 150. 1890, in part.

Shrub or small tree to 4 m. tall; branches terete, pilose becoming glabrate, nodes slightly tumid; ochreae membranaceous, 2–3 mm. long, glabrous; leaf blades orbicular to obovate or elliptic, apex rounded, obtuse or emarginate, base narrowed, 3 × 2.5, 4 × 3 cm. long and wide, thinly coriaceous, glabrous, turning black on drying, commonly shining above, dull beneath, midrib and primary veins equally prominent on both surfaces, secondary venation reticulate, primary veins 4–6 pairs, straight, diffuse branching and becoming reticulate near the margin, not arcuate and anastomosing, margin entire, flat; petioles 3–5 mm. long, short pilose pubescent; leaves of adventitious shoots variable in shape, 5 × 3, 6 × 4 cm. long and wide on petioles to 7 mm. long; inflorescence terminal 5–7 cm. long, rhachis puberulent, the female more so than the male, bracts ovate, less than 0.5 mm. long, ochreolae membranaceous, less than 0.5 mm. long; male flowers in clusters of 2, female flowers solitary, flowering pedicels 0.5–1 mm. long, hypanthium 1 mm. long, perianth lobes 1 mm. long and wide, fertile stamens less than 1 mm. long, stamens of pistillate flowers rudimentary, less than 0.5 mm. long; fruiting pedicels 1.5 mm. long, fruit ovoid, to 5 mm. long, 3 mm. thick, perianth lobes appressed against the apex of the achene.

DISTRIBUTION: Cuba, Bahamas. (Type collection, *Curtis* without number from New Providence, Bahamas).

CUBA: Oriente: Santiago de Cuba, *Ekman 19206* (S); San German, *Ekman 6346* (S); Loma Estrella, Sierra de Nipe, *Ekman 6392* (S). Pinar del Rio: Morillo, *Ekman 17376* (S); Viñales, Sierra de Viñales, *Ekman 18037* (NY, S); Sierra de Pendejeral, groupa del Rosario; Sierra de Organos, *Ekman 17525* (S). Without location: *Wright 2251* (G, HABA, MO, S). Collected in flower: Mar., May, June, July. Collected in fruit: Sept. Local name: *uverillo.*

Both Lindau and Grisebach have misinterpreted *C. retusa* by including *Wright 2251* in that species. The puberulence of the plant and the character of the venation of the leaves make this Wright specimen, and the other specimens cited above, clearly distinct from *C. retusa.* This represents the first report of *C. Northropiae* from Cuba.

17. **Coccoloba retusa** Griseb., Cat. Pl. Cub. 61. 1866; Lindau, Engl. Bot. Jahrb. **13**: 150. 1890, in part.

Uvifera retusa O. Ktze. Rev. Gen. **2**: 562. 1891.

Coccoloba retusa forma *acuminata* Lindau, Engl. Bot. Jahrb. **13**: 151. 1890.

Coccolobis colomensis Britton, Bull. Torrey Bot. Club **42**: 369. 1915.

Shrub 1–2 m. to tree 17 m. tall; branches terete, glabrous, nodes slightly tumid, ochreae membranaceous, 5–9 mm. long, glabrous; leaf blades ovate, oblong, elliptic or obovate, apex acute, rounded or emarginate, rarely acuminate, base narrowed, rounded or subcordate, commonly unequal, 3.5 × 2.5, 7 × 5.5, 10 × 4 cm. long and broad, coriaceous, glabrous, shining above, turning black on drying, midrib and primary veins prominent on both surfaces, primary veins 4–7 pairs, straight towards the margin bifurcating and anastomosing near the margin, secondary venation reticulate, conspicuous both surfaces, margin entire or undulate; petioles 6–10 mm. long, glabrous; inflorescence terminal, 4–14 cm. long, rhachis glabrous, staminate flowers solitary or in clusters of 2–4, pistillate flowers solitary, bracts ovate, less than 0.5 mm. long, ochreolae membranaceous less than 0.5 mm. long, flowering pedicels developing after the flower opens, i.e. flowers sessile at the apex of the inflorescence, or on pedicels 0.5 mm. long near the base, hypanthium 0.5 mm. long, perianth lobes 0.5–0.7 mm. long and broad; fertile stamens less than 1 mm. long; fruiting pedicels 0.5–1 mm. long, fruit ovoid, rounded at the base, to 6 mm. long, 3 mm. thick, perianth lobes coronate.

DISTRIBUTION: Cuba.

CUBA: Oriente: Loma del Gato, *Leon, Clemente & Roca 10269* (NY), *Leon 12363* (NY), *Acuña 9820* (SV), *Crisostomo 3329* (G); Sierra de Nipe, Rio Jimbambay, *Ekman 15138* (G, S); Rio Piloto, *Ekman 4748* (A, NY, S), *5014* (S), *5794* (NY, S), *6415* (FM, MICH, S), *6691* (A, S), *9767* (NY, S), *9790* (MO, S); Rio Piedra, *Ekman 9817* (NY, S); Nagua on Rio Yara, *Ekman 14840* (A, FM, NY, S, US); Cayo del Rey, *Ekman 4793* (S); Papayo near Sevilla, *Ekman 9462* (A, FM, G, MO, NY, S, US); Bayate near Cauto, *Ekman 6192* (MICH, S); Arroyo del Cristo, S. of Nagua, *Ekman 14754* (FM, NY, S); Charco Largo, Punta Padre, *Curbelo 281* (NY); Bayate near Arroyo Piedra, *Ekman 4668* (S); Manacal, Sierra Maestra, *Ekman 9358* (MICH, S); El Paraiso, Holguin, *Ekman 7607* (S); Santiago, *Clemente 4242* (HAB); Mucural Hill, near Nagua, *Leon 11034* (NY); Rio Seboruco to falls of Rio Mayari, *Shafer 3688* (G, NY, US); Jagueyes de Mulas, *Roig 14* (NY); Facallores, *Wright 1668* (type Collection of *C. retusa* f. *acuminata*, G), *Wright 2252* (G, HABA, MO, NY, S, type Collection *C. retusa,* see discussion). Las Villas: Cieneguita, *Combs 374* (FM, G, MO, NY); Savana de Motembo, *Leon, Fortún & Edmund 8568* (NY); Cayo Ramones, Jucaro Quemado, Peninsula de Zapata, *Roig & Cremata 2255* (FM); Sabana de Manacas, Laguna Asiento Viejo, *Leon 9283* (NY); Central Australia, Peninsula Zapata, *Ekman 18328* (S); Lomas de Banao, *Luna 110* (NY); El Porvenir to Aguacate, *Britton & Wilson 5361* (NY); Mina Carlotta, Sierra de San Juan, *Howard 5628* (G), *5661* (G). Havana: Loma de la Pita, San Miquel, *Leon, Ekman, Johnston, & Roig 9101* (NY), *Leon 11529* (NY); Loma de Neponuiceno, San Miquel de Casanova, *Leon 11601* (NY); Campo Florida at Rio Quezada, *Ekman 13237* (A, FM, NY, S, US). Pinar del Rio: Loma Pelada, Cayajabos, *Leon & Roig, 13538* (NY), *13539* (NY), *Leon 13205* (NY); Çoloma, *Britton, Britton & Gager 7037* (NY, US, type Collection of *C. colomensis*), *Ekman 17828* (NY, S), *Britton & Cowell 9848* (G, NY, US); Sabalo, Rio Sabalo, *Ekman 11447* (NY, S); Savannas SE of Los Palacios, *Leon & Roca 7368* (NY); Los Palacios to San Juan de Zayas, *Shafer 1813* (NY); Rio Blanco, *Ekman 17294* (S). Isle of Pines: Rio Las Casas, Nueva Gerona, *Ekman 12005* (S), *12010* (S); Manati, *Blain 185* (FM); Los Indios, *Britton, Britton & Wilson 14243* (NY); Coe's Camp, Enseñada de Siguanea, *Britton & Wilson 14846* (NY, US); Mal Pais to La Ceiba, *Ekman 11915* (S); San Juan, *Roig & Cremata 1783* (NY). Locality Unspecified: Herb. Sauvalle *2173* (HABA). Collected in flower: Feb., Mar., June, July, Aug., Sept., Oct., Dec. Collected in fruit: Jan., Feb., Sept., Oct., Nov., Dec. Local names: *uverillo, Cocuyo de la maestra.*

The numerous collections of *Coccoloba retusa* cited above show a tremendous range of variation in the size and shape of the leaves. Lindau described one form for the species but since this is just a small part of the normal variation of leaf shape it is not recognized as valid in this treatment.

Coccolobis colomensis which Britton based on a Britton & Gager specimen from Pinar del Rio is also separated by Britton on characters found in the shape of the leaf. Leaf shape is an unstable base for specific distinction in this genus and I am reducing Britton's species to synonymy of *C. retusa.*

The type collection of *Coccoloba retusa* is *Wright 2252.* I have seen six examples of this collection as cited above but in the packets attached to the sheets of the Gray Herbarium collection are a variety of notes regarding the location where the collection was made. These are "Monte Verde Sept. 7," "Potosi, Monte Yow, Oriente, Oct. 10," "Retin, Oct. 19." Thus the collection seems to be mixture. All of the material distributed under the number *Wright 2252* however is referable to *C. retusa.*

18. **Coccoloba praecox** Wright ex Lindau, Engl. Bot. Jahrb. 13: 142. 1890.

Uvifera praecox O. Ktze. Rev. Gen. **2**: 562. 1891.

Coccoloba Ekmani Urban, Fedde Repert. Sp. Nov. **14**: 331. 1916.

Shrub to tree 9 m. tall; branches terete, nodes tumid, twigs puberulent when young becoming glabrate; ochreae membranaceous, puberulous, 4–6 mm. long; leaf blades ovate to oblong-ovate, apex acute with a mucro or rounded, occasionally slightly emarginate, base rounded to sub-cordate, 3 × 2.5, 4.5 × 3.5, 5 × 4.5 cm. long and broad, thin coriaceous to chartaceous, glabrous, upper surface smooth or minutely reticulate, lower surface minutely reticulate, midrib impressed above, slightly prominent below, puberulent, primary veins 5–7 pairs, inconspicuous, arcuate anastomosing near the margin, margin entire with a prominent edge, flat; petioles 4–8 mm. long, puberulent; leaves of adventitious shoots, ovate-oblong, rounded or emarginate at the apex, 5 × 5.5 cm. to 6.5 × 4.5 cm. long and broad; inflorescence terminal 2–9 cm. long, rhachis puberulent, staminate flowers solitary or in clusters of 2 or 3, pistillate flowers solitary, bracts ovate less than 0.5 mm. long, puberulent, ochreolae less than 1 mm. long, flowering pedicels 0.5–1 mm. long, hypanthium 0.5 mm. long, perianth lobes 1–1.5 mm. long, fertile stamens with filaments 1–1.5 mm. long; fruiting pedicels 1–1.5 mm. long, fruit ovoid, 4 mm. long, 2.5 mm. thick, perianth lobes sub-coronate.

DISTRIBUTION: Cuba.

CUBA: Oriente: Charco, *Wright 2253* (type Collection, G, HABA, MO, NY, S); Punta Padre, *Curbelo 74* (HAB, NY), *Roig 5537* (NY); Mir, between Victoria de las Tunas and Holguin, *Ekman 7541* (MO, S); Anafe, near Caimito del Guayabal, *Ekman 188* (S). Camaguey: Camaguey City, *Britton, Britton & Cowell 13115* (NY, US); Sabana de la Caridad, Cespedes, *Roig, Luaces & Aranjo 910* (NY); Santayana, *Ekman 19036* (S); Savana de Providencia, *Roig 8209* (NY). Las Villas: Mordazo, *Leon 9232* (NY), *Leon & Cazañas 5929* (NY); Casilda, *Ekman 18879* (S). Matanzas: Cuabal del Espinal, Canasí region, *Leon & Roig 13354* (HAB, NY), *13355* (NY), *Acuña 11290* (SV); Pan de Matanzas, *Ekman 16510* (S). Havana: Cuabal de Salomon, Minas, *Leon 13787* (NY), *13887* (NY); Cuabal de Jesús María, Minas, *Leon 13334* (NY), *13335* (NY); Madruga, *Leon & Cesàire 8940* (NY); Lomas de Jatas, Guanabacoa, *Ekman 580* (type Collection of *C. Ekmani*, FM, S), *10905* (S), *16532a* (S), *16532b* (NY, S), *Leon 7342* (NY, HAB); Loma Coca near Campo Florida, *Ekman 13220* (S), *16437a* (S), *16437b* (A, S), *19005* (A, FM, MO, NY, S, US). Pinar del Rio: Mayari, S. of San Cristobal, *Fors 4790* (NY). Collected in flower: Apr., May. Collected in fruit: Apr., May.

The type collection of *C. Ekmani*, (*Ekman 580*) was considered distinct on the ovate to suborbicular leaves however these minor variations in shape can be matched in many leaves of the original Wright collection. *Coccoloba Ekmani* is not a valid species.

19. **Coccoloba Shaferi** Britton, Bull. Torrey Bot. Club **42**: 369. 1915, (as *Coccolobis*).

Coccoloba azulensis Schmidt, Fedde Repert. Sp. Nov. **24**: 73. 1927.

Shrub or tree to 7 m. tall; branches terete, puberulent or papillose, contorted, short shoots, commonly developed with concentric ochreae, ochreae 7–9 mm. long, membranaceous, puberulent; leaf blades ovate to ovate-elliptic, rarely lanceolate-ovate, apex obtusely acuminate to rounded, base cordate, 5 × 3, 7 × 5.5, 9 × 6, 14 × 9 cm. long and wide, coriaceous, glabrous, dull both surfaces, midrib and primary veins slightly impressed above, prominent below, primary veins 5–7 pairs, straight to the margins, not arcuate nor anastomosing or rarely bifurcating close to the margin and reticulate, blades densely pitted on both surfaces, secondary venation reticulate slightly conspicuous both surfaces, margin entire, slightly revolute, petioles 7–10 mm. long, glabrous; leaves of vigorous or adventitious shoots lanceolate-ovate, apex acuminate, 12 × 3 to 14 × 4.5 cm. long and wide; inflorescence terminal 10–25 cm. long, rhachis, bracts, ochreolae and perianth papillose or puberulent, flowering pedicels shorter than the ochreolae, staminate flowers in clusters of 2–4 flowers, rarely solitary, pistillate flowers solitary, bracts ovate, 2 mm. long, ochreolae membranaceous, 2–3 mm. long, perianth red, hypanthium 2–3 mm. long, perianth lobes oblong, 3 mm. long, 2 mm. broad, fertile stamens 2 mm. long; fertile pistil 4 mm. long; fruit not known.

DISTRIBUTION: Cuba.

CUBA: Oriente: near mouth of Rio Yamaniguey, *Shafer 4252* (NY); Camp Toa to Camp La Barga, Northern Oriente, *Shafer 4165* (TYPE, NY); Sierra de Moa, *Ekman 4511* (S), *Bucher 104* (NY), *104a* (NY), *Shafer 8351* (NY), *Howard 6050* (G); Monte de la Brena, Sierra de Moa, *Leon, Clemente & Alain 22567* (G), *22582* (G), *Clemente & Crisostomo 4966* (G); Sierra Azul, *Ekman 4427b* (type collection of *C. azulensis*, S); Narave at Baracoa, *Ekman 4054* (NY, S). Collected in flower: Jan., Feb., Mar., Apr., July, Aug., Sept., Dec.

Following the original description of *C. azulensis* Schmidt reports his new species to be similar to *C. Shaferi* but differing in the longer inflorescence and the glabrous inflorescence rhachis. Apparently this comparison was made with the original description of *C. Shaferi* for the specimens of *C. Shaferi* cited above have inflorescences 10–20 cm. long instead of the 12 cm. originally reported by Britton. The pubescence of the inflorescence rhachis, bracts, ochreolae and perianths varies considerably from small protuberances of epidermal cells called a papillose puberulence to short pilose hairs. In all characters the Ekman specimen selected as the type of *C. azulensis* seems to grade into the larger collection of *C. Shaferi* and may be regarded as an extreme of variation. I have therefore reduced Schmidt's species to the synonymy of *C. Shaferi.*

20. **Coccoloba costata** Wr. ex Sauvalle, Fl. Cub. 139. 1868; Lindau, Engl. Bot. Jahrb. **13**: 155. 1891; Schmidt, Fedde Repert. Sp. Nov. **27**: 105. 1929.

Uvifera costata O. Ktze. Rev. Gen. **2**: 561. 1891.
Coccoloba leoganensis var. *cordata* Griseb. Cat. Pl. Cub. 61. 1866.

Tree; branches stout, pubescent with a ferrugineous to golden pubescence; ochreae membranaceous, 4–6 mm. long, ferrugineous puberulent; leaf blades ovate to elliptic, apex obtuse, acute or obtusely acuminate, base obliquely cordate, 7 × 5, 13 × 8, 18 × 12, 24 × 15 cm. long and broad, coriaceous, golden shining above, dull brown below, midrib and veins impressed above, prominent below, primary veins 5–7 pairs, arcuate, anastomosing, blade pitted, glandular above and below, glabrous; petiole stout, 8–10 mm. long, slightly puberulent; leaves of adventitious shoots to 35 × 22 cm. long and broad, petioles 1.5 cm. long; inflorescence terminal, rhachis puberulent, 15–20 cm. long, staminate flowers in clusters of 2–4, pistillate solitary, bracts ovate, 0.5 mm. long, ochreolae membranaceous, 0.5 mm. long, flowering pedicels 0.5 mm. long, hypanthium 0.5 mm. long, perianth lobes 0.5–1 mm. long and broad, fertile stamens 1 mm. long; fruiting pedicels to 1.5 mm. long, fruit globose, to 6 mm. long, 3 mm. thick, perianth lobes coronate.

DISTRIBUTION: Cuba.

CUBA: Oriente: Monte Verde, *Wright 1393* (G, HABA, MO, S, type Collection); Sierra de Nipe, Rio Piloto, *Ekman 2725* (FM, NY, S); Piedra Gorda to Woodfred, *Shafer 3084* (FM, G, NY, US); Arroyo del Medio, *Ekman 15243* (A, S); Loma Mensura *Ekman 3205* (S); Baracoa, Lomas de Cuaba, *Ekman 4229* (S); Moa, *Leon, Clemente & Alain 22518* (G), *Clemente 4360* (G); Punta Gorda, Sierra de Moa, *Clemente 4053* (G); Alta Loma Naranja, *Bucher* without number (SV #10099). Collected in flower: Jan., June. Collected in fruit: Aug., Oct. Common name: *uvilla.*

21. **Coccoloba benitensis** Britton, Bull. Torrey Bot. Club **42**: 370. 1915, (as *Coccolobis*).

Coccolobis monticola Britton, Bull. Torrey Bot. Club **50**: 37. 1923.
Coccolobis brevipes Britton, Bull. Torrey Bot. Club **42**: 371. 1915.

Shrub or small tree; branches terete, densely puberulent, commonly branching in one plane, nodes slightly tumid; ochreae 3–4 mm. long, membranaceous, densely ferrugineous pilose; leaf blades ovate to ovate-elliptic, apex acute to acuminate, base narrowed or rounded, 2 × 1, 4 × 2, 6.5 × 3.5, 7.5 × 3 cm. long and wide, coriaceous, glabrous and pitted above, coarsely reticulate and glabrous below but densely to sparingly covered with peltate resinous exudate, margin entire, slightly recurved, midrib impressed above, slightly keeled when dry, primary veins 3 or 4 pairs, prominent both surfaces, secondary venation reticulate, conspicuous both surfaces; petioles 2–4 mm. long, flattened above, ferrugineous pilose on the upper surface, commonly covered with peltate resinous exudate below; leaves of adventitious shoots with ochreae 9–12 mm. long, blades to 10.5 × 5 cm. long and wide, petioles to 8 mm. long; inflorescence terminal or terminal on short shoots, 2–3 cm. long, several concentric ochreolae at the base, rhachis puberulent or with glandular exudate, bracts minute, less than 0.5 mm. long, ochreolae minute, less than 0.5 mm. long, flowering pedicels less than 1 mm. long; staminate flowers in clusters of 2 or 3, pistillate flowers solitary, hypanthium 1 mm. long, lobes 0.5 mm. long, filaments of staminate flowers 1 mm. long, in pistillate flowers 0.1 mm. long, rudimentary pistil in male flower 0.3 mm. long, pistil in female flowers to 3 mm. long; fruiting pedicels 1–1.5 mm. long, fruit ovoid to globose, 6 mm. long, 4 mm. thick, perianth lobes appressed at the apex of the achene, perianth of fruit commonly with glandular exudate.

DISTRIBUTION: Cuba.

CUBA: Oriente: Camp San Benito, *Shafer 4049* (TYPE, NY), *4044* (FM, NY, US); Sierra de Moa, Camp la Gloria, *Shafer 8230* (NY, US); Sierra Maestra, Arroyo Jiménez, *Ekman 14802* (NY, S); Rio Yara and Rio Palmamocha, *Ekman 14331* (US, S), *14389* (A, FM, S); Pico Turquino, *Leon 10713* (type of *C. monticola,* NY), *Leon 10902* (NY); Sierra Maestra, Estribo Cardero, *Roig, Acuña & Bucher 6590* (NY); Arroyo Veinticinco *Wright 2257* (type Collection of *C. brevipes,* G, HABA, MO, NY). Collected in flower: July, Aug. Collected in fruit: Aug.

Britton failed to recognize the various patterns of growth found in specimens of *Coccoloba.* The presence of short shoots, vigorous growth, and adventitious shoots each with very different aspects and sizes of leaves, petioles and ochreae has led to numerous duplication of species descriptions. *Coccoloba benitensis* was chosen as the type and name of this group because the shoots are near the normal to be expected for the species and because the specimens have female flowers and fruit. The type specimen of *C. brevipes* Britton is described by Wright in field notes as a subscandent bush. This I judge to be vigorous shoots and the larger internodes, leaves, petioles and ochreae support this view. On the other hand the material of *C. monticola* is from a specimen which appears stunted but which possesses short shoots and has small internodes, leaves, etc. Britton was impressed with the peltate "black dots" on the lower leaf surface which are actually glandular excretions. These may be present on the upper or lower leaf surface of all specimens as well as on the rhachis of the inflorescence and on the perianth and the fruit. The amount of resinous exudate is frequently impressive.

22. **Coccoloba rufescens** Wr. ex Lindau, Engl. Bot. Jahrb. **13**: 143. 1890.

Uvifera rufescens O. Ktze. Rev. Gen. **2**: 562. 1891.
Coccoloba rufescens Wr. forma *longifolia* Lindau, l.c. **13**: 143. 1890.
Coccoloba punctata var. *parvifolia* Griseb. Pl. Wright. 175. 1860.

Shrub or small tree, 2–4 m. tall; branches terete, nodes slightly tumid, youngest branches ferrugineous pilose; ochreae cylindrical, 3–4 mm. long, cleft almost to the base, pilose; leaf blades ovate, elliptic or oblong-ovate, apex acute to acuminate, base narrowed, rounded, often oblique, 5 × 2.5, 7.5 × 3, 9 × 4 cm. long and broad, coriaceous, smooth above, usually shining, midrib and primary veins sub-prominent below, secondary venation obscure, lamina densely and minutely glandular punctate below; petioles 3–5 mm. long, pilose; inflorescence terminal, 2–6 cm. long, rhachis pubescent; staminate flowers unknown; pistillate flowers solitary, bracts broadly ovate, less than 1 mm. high, 2 mm. broad, pilose, ochreolae membranaceous 0.5 mm. long, strongly bilobed, pilose, pedicels shorter than the ochreolae, perianth white, glabrous, hypanthium 1–1.5 mm. long, lobes ovate, 1–1.5 mm. long, stamens rudimentary, pistil oblong triangular; fruit globose, 5 × 4 mm., slightly narrowed at apex and the base, perianth lobes coronate, 1.5–2 mm. long.

DISTRIBUTION: Cuba.

CUBA: Oriente: Mt. Verde, *Wright 462* (type Collection, FM, G, MO, NY, S), *Wright 1394* (FM, G, HABA, MO, NY, S); Baracoa, Lomas de Cuaba, *Ekman 4220* (NY, S); Montes de la Breña, Moa, *Acuña 13090* (SV), *Acuña 13092* (SV); Camp Toro to Camp La Barga, *Shafer 4152* (NY); Cayoquán, *Victorin & Clemente 21519* (HAB); Sierra de Nipe, *Bucher* without no. (SV #11493). Without location: *Wright 462a* (G). Collected in flower: Feb., Apr. Common name: *uvero de costa.*

23. **Coccoloba Wrightii** Lindau, Engl. Bot. Jahrb. **13**: 151. 1890; Schmidt, Fedde Repert. Sp. Nov. **24**: 27. 1927.

Uvifera Wrightii O. Ktze. Rev. Gen. **2**: 562. 1891.

Coccolobis saxicola Britton, Bull. Torrey Bot. Club **50**: 37. 1923.

Shrub or small tree, to 3 m. tall; branches terete, glabrous, ochreae membranaceous, 4–6 mm. long, puberulent to tomentose; leaf blades ovate, elliptic, obovate or rarely ovate lanceolate, apex acute to abruptly short-acuminate, base narrowed to obtuse, usually slightly oblique, 5 × 2.5, 8 × 4, 10 × 7, 11 × 10 cm. long and broad, coriaceous, young leaves often shining above, mature leaves generally dull both surfaces, midrib and primary veins impressed above, the lamina commonly umbonate between the veins, primary veins 4–6 pairs, prominent below, arcuate, anastomosing near the margin, secondary venation reticulate, conspicuous on both surfaces, leaves glandular below, margin entire, slightly recurved; petioles 4–7 mm. long, papillose to puberulent; leaves of adventitious shoots to 20 × 17 cm. long and broad, petioles 2.5 cm. long, ochreae to 2 cm. long; inflorescence terminal, 3–10 cm. long, rhachis papillose with glandular excretions, staminate flowers in clusters of 2–5, pistillate flowers solitary, bracts ovate, 0.5 mm. long, ochreolae membranaceous 1 mm. long, papillose or glandular, flowering pedicels 1 mm. long, perianth greenish white, hypanthium 1 mm. long, perianth lobes 1–1.5 mm. long and broad, fertile stamens with filaments united below into a tube 1 mm. long, free portion of filaments 0.5 mm. long; fruiting pedicels 1–3 mm. long, fruit ovoid, slightly contracted at the base, rounded at the apex, 7–9 mm. long, 4–5 mm. diameter, perianth lobes slightly coronate.

DISTRIBUTION: Cuba.

CUBA: Oriente: Sierra Cristal, at Rio Lebisa, *Ekman 6864* (NY, S); Sierra de Imías, crest of Punton del Maté, *Leon 12280* (G, NY); Manacal, Sierra Maestra, *Ekman 9378* (A, NY, S); Cueva del Aura, Sierra Maestra, *Roig & Bucher 6688* (NY), *Bucher 171* (R, HAB); Loma del Gato, *Bucher 259* (NY), *Leon, Clemente & Roca 10167* (type Collection of *C. saxicola*, NY); Pico Turquino, Sierra Maestra, *Acuña 7671* (R); Maestra Range, *Leon 10712* (NY, R); Alto Loma del Naranjo, Baracoa, *Bucher* (R #1033, SV); Arroyo Jiménez, Sierra Maestra, *Ekman 14785* (NY, S); Hongolosongo, Loma del Gato, *Clemente 1815* (NY); Rio Yara and Rio Palmamocha divide, Sierra Maestra, *Ekman 14386* (S); Loma Mensura, Sierra de Nipe, *Ekman 9922* (NY, S); Monte Real, Sierra del Cobre, *Ekman 7863* (S); Valley of Rio Yaminiguey, *Shafer 4229* (NY, US); Monte de la Breña, Sierra de Moa, *Leon, Clemente & Nestor 23325* (G); Punta Gorda, Sierra de Moa, *Clemente 4038* (G); Monte Grande de Centeno, *Leon, Clemente & Alain 22664* (G); Charrascal del Coco, Sierra de Moa, *Leon, Alain & Chrysogone 22631* (G); La Guinea, *Wright 1395* (FM, G, MO, NY, type Collection). Las Villas: Lomas de Banao, *Luna 468* (NY); El Purial and Los Guineos, Lomas del Banao, *Ekman 16235* (S); Pico Potrerillo, Trinidad Mts., *Ekman 18947* (S). Collected in flower: June, July, Aug. Collected in fruit: Jan., Mar., July, Aug., Oct.

This is a species of mountain areas, collected from 700–1100 meters altitude. Lindau described the type collection of *Wright 1395* as flowering in June. The Wright material cited above which I have seen was collected Dec. 17, 1859 according to the label attached and the material is in fruit. Apparently this is another mixture of Wright labels.

24. **Coccoloba Leonardii,** sp. nov.

Arbor ad 10 m., ramulis teretibus, glabris, nodis vix tumescentibus, ochreis subcoriaceis, glabris, 3 mm. longis; lamina ovata, apice rotundata vel acuta, basi rotundata vel subcordata, lateribus inaequalibus, in petiolum subdecurrente, 6.5 × 4, 8 × 5.5, 11 × 7 cm. longa et lata, coriacea, glabra, supra cineracea, subtus brunnea, nervo medio et nervis primariis supra et subtus prominentibus, nervis primariis 5–7, arcuatis, anastomosantibus, venis secondariis reticulatis; petiolis 8–11 mm. longis, supra late canaliculatis, glabris; inflorescentia terminalis, 5.5–14 cm. longa, rhachi glabra, bracteis ovatis, 0.5–1 mm. longis, ochreolis membranaceis, 1 mm. longis, pedicello ochreolas non excedente; floribus masculinis 2–4 per nodulum, hypanthio 0.5 mm. longo, lobis 1.5 mm. longis et latis, filamentis ad 1 mm. longis, pistillo rudimentario circa 0.5 mm. longo, floribus foemineis perianthio masculinis similibus, staminibus rudimentariis, pistillo 1–1.5 mm. longo; fructu late fusiformi, 10 × 5, 11 × 7 mm. longo et diametro, supra nigro, subtus brunneo, lobis perianthii subcoronato, 1 mm. longo.

DISTRIBUTION: Haiti, Cuba.

HAITI: Tortue Island: Tableland N.E. of Basse Terre, 30′ tree in dry thickets in rocky ravines, *E. C. & G. M. Leonard 12466* (TYPE, A; ISOTYPES, MO, NY, US); La Vallée, *E. C. & G. M. Leonard 11335* (MICH, US), *11381* (A, G, K, US), *11421* (NY, US), *11423* (G, US); Pte. Petite Bois, *Ekman 4150* (S). Navassa Island: West of the lighthouse, *Ekman 10843* (S, US). Dept. du Nord: Morne la Vigie, Cap Haitien, *Ekman 2706* (S, US); Bayeux, *Nash 293* (FM, NY). Dept. du Nord-Ouest: Saline Michel near Port au Paix, *Ekman 3931* (S).

CUBA: Oriente: Bayate, between Rio Bayate and Arroyo Bibano, *Ekman 9003* (S), *9622* (S).

A new species readily distinct by the fusiform bicolorus fruit from others of the Antilles with sessile flowers and fruits.

This species is named in honor of its collector, E. C. Leonard of the Smithsonian Institution in Washington, D. C. who has a continuing interest in the flora of Hispaniola.

The two collections made by Ekman in the Oriente province of Cuba are both sterile adventitious shoots but they can be referred to this species without question on the venation and glandular characters of the leaf blades.

25. **Coccoloba Swartzii** Meisner, DC. Prod. **14**: 159. 1856.

Coccoloba neglecta Fawcett & Rendle, Jour. Bot. **51**: 124. 1913.
Uvifera Swartzii O. Ktze. Rev. Gen. **2**: 562. 1891.

Tree 8–20 m. tall; branches terete, glabrous, nodes slightly tumid; ochreae 10–12 mm. long, basal portion 3–5 mm. long, coriaceous, persistent, upper portion 5–7 mm. long, membranaceous, deciduous; leaf blades ovate to elliptic, apex acute, base narrowed, rounded or slightly cordate, 7 × 5, 11 × 9, 15 × 7.5 cm. long and broad, coriaceous, usually turning black on drying, glabrous, pit-like depressions on the upper surface, small glands on the lower surface, midrib and veins inconspicuous or flat above, prominent below, primary veins 6 or 7 pairs, arcuate anastomosing, secondary venation conspicuous, reticulate; petioles 10–18 mm. long, glabrous, attached at the base of the ochreae; inflorescence terminal, 10–15 cm. long, rhachis glabrous or with glandular exudate, rarely papillose, staminate flowers in clusters of 3–5 with tightly concentric ochreolae forming a truncate cylinder after the flowers have fallen, pistillate flowers solitary, ochreolae erect in flower, flattened against the rhachis in fruit, bracts ovate, 1–1.5 mm. long, ochreolae membranaceous 1–1.5 mm. long, flowering pedicels shorter than the ochreolae, hypanthium 0.5 mm. long, perianth lobes 1–1.5 mm. long, fertile stamens with filaments 1 mm. long; fruit ovoid, 8–10 mm. long, 6 mm. thick, perianth lobes 1–1.5 mm. long, coronate.

DISTRIBUTION: Jamaica, Hispaniola, Puerto Rico, Virgin Islands, St. Croix, Antigua, Montserrat, Guadeloupe, Martinique, St. Lucia, Barbados.

25a. **Coccoloba Swartzii** forma **pubescens**, forma nova.

A speciei ramis junioribus, petiolis, laminis ad basin, ochreis et rhachi inflorescentiae saltem at basin puberulis vel pilosis differt.

ANTIGUA: Sugar Loaf Mt., *Box 1543* (US), *1544* (US); Blubber Valley, *Box 1411* (TYPE, US), Orange Valley, *Box 1184* (US).

BARBUDA: Martello Tower, *John C. Beard 372* (A, MO); Codrington Village, *Fairchild 3830* (A, US), *Box 602* (US).

GUADELOUPE: *De Ponthieu 86* (FM).

CUBA: Oriente: Punta Padre, *Curbelo 224* (NY). Local name: *uvillon* (Cuba).

The significance of pubescence in the genus *Coccoloba* has not received any attention by the earlier monographers. I can do little in interpreting the variations in pubescence with the material on hand but it is hoped within the course of this study to have large collections from single plants and uniform populations to determine what variations are to be expected within one plant, within the species and to determine what factors cause pubescence. The specimens cited above differ from the species only in the presence of a pubescence which varies from minute papillae of epidermal cells to hairs many times the diameter of the epidermal cell. The pubescence may be on all parts or only on a few. A long inflorescence may have a pilose pubescence at the base and only papillae near the apex of the rhachis. For the present it seems well to designate these variations as forms until the species can receive more adequate treatment in the field and perhaps cytological study.

26. **Coccoloba Cowellii** Britton, Bull. Torrey Bot. Club **42**: 368. 1915, (as *Coccolobis*).

Shrub to 3 m. tall; branches terete, puberulent when young becoming glabrate, commonly geniculate, nodes commonly tumid, ochreae subcoriaceous, 5–7 mm. tall, dark brown, puberulent; leaf blades ovate-elliptic to ovate-lanceolate, apex acuminate to rounded, base cordate, 9 × 6 cm. long and wide on normal shoots, coriaceous, strongly bullate, midrib and primary veins impressed above, prominent below, primary veins 5–7 pairs, arcuate anastomosing, upper leaf surface smooth, shining, lower leaf surface sparsely puberulent becoming glabrate, secondary venation obscure; petioles 3–6 mm. long, puberulent; leaves of vigorous shoots or of adventitious shoots extremely variable in shape usually lanceolate-ovate, long attenuate at the apex, cordate at the base, to 23 × 2.5 cm. long and wide; inflorescence terminal 11–23 cm. long, with several concentric ochreae at the base, rhachis glabrous, red in color; staminate flowers in clusters of 2–4, pistillate flowers solitary, bracts ovate, less than 0.5 mm. long, ochreolae membranaceous, to 0.5 mm. long, flowering pedicels 5 mm. long, bright red, perianth red, hypanthium 1 mm. long, perianth lobes 2 mm. long and broad, fertile stamens with filaments to 2 mm. long, functional pistil 2.5 mm. long; fruiting pedicels 5–10 mm. long, fruit dark red, ovoid, rounded at the base, attenuate at the apex, to 6 mm. long, 4 mm. thick, perianth lobes subcoronate, 1–2 mm. long at apex of fruit.

DISTRIBUTION: Cuba.

CUBA: Oriente: Loma del Mucaral, Nagua, S. of Yara, *Leon & Ekman 11031* (G). Camaguey: savannahs near Camaguey City, *Britton, Britton & Cowell 13151* (TYPE, NY; ISOTYPES, FM, MO, US); Santayana, *Leon 15787* (G, NY), *15789* (NY), *Ekman 19037* (S).

This is a striking species with its smooth shining bullate leaves and the handsome red inflorescence with flowers on long pedicels. Specimens collected in flower in April, June and July; collected in fruit in July.

The variation between the normal leaves and the leaves of vigorous and adventitious shoots is as striking in this species as any in the genus. More extensive collections of this species are desired.

27. **Coccoloba diversifolia** Jacq. Enum. Pl. 19. 1760, Hist. Stirp. Amer. 114, *pl. 76.* 1763.

Coccoloba cubensis Meisn., DC. Prodr. **14**: 162. 1857.
Uvifera cubensis O. Ktze. Rev. Gen. **2**: 561. 1891.
Coccoloba floridana Meisn., DC. Prodr. **14**: 165. 1857.
Coccoloba Curtissii Lindau, Engl. Bot. Jahrb. **13**: 159. 1891.
Uvifera Curtissii O. Ktze. Rev. Gen. **2**: 561. 1891.

Coccoloba laurifolia Lindau, Engl. Bot. Jahrb. **13**: 158. 1891, and all recent authors, not Jacquin.

Coccoloba longifolia Schmidt, Fedde Rep. **24**: 73. 1927, not Fischer.

Guaiabara laurifolia (Jacq.) House, Am. Midl. Nat. **8**: 64. 1922 (as *Guaibara*).

Shrub or tree to 7 m. tall; branches terete, often geniculate by limited growth, glabrous, nodes rarely slightly tumid; ochreae coriaceous in the lower portion, this persisting, membranaceous and deciduous above, 3–5 mm. long; leaf blades ovate, oval, oblong, elliptic, lanceolate or obovate, variable on a single shoot, apex rounded, obtuse, acute or acuminate, base cuneate to rounded or subcordate, 4 × 3.5, 7 × 5.5, 8 × 4.5, 12 × 8 cm. long and wide, coriaceous, often shining above, dull beneath, glabrous, midrib and primary veins slightly prominent above, secondary venation reticulate on both surfaces, primary veins 3–7 pairs, arcuate, anastomosing before reaching the margin, margin entire, commonly slightly recurved; petioles glabrous, 7–10 mm. long; leaves of adventitious shoots similar in shape to those of normal growth but larger in size, 17 × 8, 24 × 13, 32 × 12.5 cm. long and wide, on petioles 1–2.5 cm. long; leaves of wind-swept specimens often much smaller than those of normal shoots, 2 × 1.3, 3 × 2 cm. long and wide; inflorescence terminal, 4.5, 9, 11 to 18 cm. long, rhachis glabrous; staminate flowers in clusters of 2–5, pistillate flowers solitary; bracts ovate, less than 0.5 mm. long, 1 mm. broad, glabrous; ochreolae membranaceous, less than 0.5 mm. long, glabrous, flowering pedicels 2–4 mm. long, glabrous; hypanthium 1 mm. long, perianth lobes 2 × 2 to 3 × 1 mm. long and broad, filaments of stamens from male flowers 1 mm. long; fruiting pedicels 3–4.5 mm. long, fruit globose to obpyriform, 10 × 7, 12 × 8, 13 × 8 mm. long and thick, perianth lobes appressed at the apex of the achene.

DISTRIBUTION: Florida, Bahamas, Greater and Lesser Antilles.

CUBA: Oriente: Santiago and vicinity, *Ekman 1399* (S), *Ekman 7776* (S), *Ekman 8938* (FM, S), *Ekman 8962* (MO, S), *Havard 20* (NY), *Leon & Clemente 3045* (G, HAB), *Clemente 3792* (G, HAB), *3793* (G, HAB); Bayate, Monte Oscuro, *Ekman 6110* (NY, S), *6247* (MICH, S, US), *4628* (S); Bayate at Paso Estancia, *Ekman 6276* (A, S); Monte de Ocujal, near Central Manate, *Leon 15759* (G, NY, HAB), *Leon 16796* (HAB); Punta Maisi, *Shafer 7929* (FM, NY, US); Preston, *Ekman 3470* (FM, S); Jiguani, *Ekman 15028* (G, MO, S); Gibara to Punta Hicacos, *Shafer 1473* (NY, US); Punta Piedra, Nipe Bay, *Britton, Britton & Cowell 12487* (NY); Imias, *Leon 12157* (NY), *12486* (NY); Sabanalamar, near Central Manati, *Leon 15737* (NY); Cupey, *Ekman 4942* (FM, S), *6300* (S); Palma Sola, *Wright 112* (HABA); Sierra de Nipe, near Rio Piloto, *Ekman 5795* (S); Banes, near Puerto Rico, *Ekman 6632* (S); Locality unspecified, *Linden 2047* (BR, K, TYPE of *C. cubensis*), *Wright 3668* (G), *Le Roy*, without number (NY). Camaguey: La Gloria, *Shafer 415* (FM, G, NY, US); Santa Luces, *Shafer 952* (FM, G, NY, US); Ganado, Cayo Sabinal, *Shafer 898* (NY, US). Isle of Pines: Milian, N. of Caleta Grande, *Roig & Cremata 1853* (NY); S. of Santa Fe, *Jennings 656* (G, NY, US). Collected in flower: May, July, Nov. Collected in fruit:

Feb., Mar., Apr., June, July, Aug., Sept., Nov., Dec. Local names in Cuba: *uvilla, uvillo, uverillo, uva de paloma, fruta de paloma.*

For many years a species of *Coccoloba* with sessile flowers and fruit, that is, the pedicels shorter than the ochreolae, has been passing under the name of *C. diversifolia* Jacq. The drawing of *C. diversifolia* in the original publications by Jacquin shows a fruiting specimen with pedicels 3–4 times the length of the ochreolae. It is obvious therefore that material called by all recent authors *C. laurifolia* is really *C. diversifolia* Jacq. *Coccoloba laurifolia* Jacq. is based on a flowering specimen collected near Caracas, Venezuela. Sufficient material from S. America is not available to me at the present time to determine if this is identical with the W. Indian *C. diversifolia* here treated. It may well be, and *C. laurifolia* Jacq. may well belong in the synonymy of the present species. In any case *C. laurifolia* Jacq. is a later name than *C. diversifolia* which must be used for the specimens under consideration here. All recent authors have overlooked this misinterpretation and it is unfortunate that such a widespread species and one commonly used as a horticultural plant must have a change of name.

The type drawing of *C. diversifolia* Jacq. can be matched in any one of a dozen of the collections cited above. The leaf variation is tremendous on a single herbarium sheet and on single trees which I have observed in the field. Young vigorous shoots may have large leaves. Specimens growing along the sea coast and exposed to strong winds and salt spray are often much contorted in form and the leaves are much smaller than protected plants growing a few yards farther inland. In the Bahamas it was possible to observe the effect of cutting of these trees to clear garden patches. Recently cut trees developed large, fast-growing adventitious shoots with tremendous leaves when compared with the undisturbed trees. Many of these adventitious shoots and leaves match the specimens which Schmidt referred to *C. longifolia* Fisch. ex Lindau (*Ekman 1399, 4628*).

As in many other species of *Coccoloba* in the Caribbean the fruits of *C. diversifolia* will commonly change shape in the process of maturing. For that reason it is difficult to use the shape of the fruit as diagnostic of a species. Fully mature fruits must be used in comparison of size and shape in this species.

Coccoloba cubensis of Meisner was based on a collection made by Linden. I have seen two specimens of this collection from the Brussels and Kew Herbaria. Both are similar and the leaves are small in comparison with the bulk of the material cited above. If this species were considered from the standpoint of the Cuban material alone, then *C. cubensis* would be comparable to the recent material from the Isle of Pines and might be worthy of varietal status; however, when material from the Bahamas, Florida, Jamaica, Puerto Rico and Hispaniola is considered, then the Linden specimens become one end of a long line of variations.

Lindau described the species *Coccoloba Curtissii* based on two collections of Curtiss from Florida, one from the Florida Keys and the other from Merritts Island. Lindau distinguished this species on the presence of small protuberances (teeth) between the stamens in the flowers. Unfortunately Lindau did not recognize the unisexual condition of the flowers in *Coccoloba*. The specimens of Curtiss cited by Lindau are staminate and the protuberances which he mentioned can be found in many flowers of the specimens cited above.

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THE GENUS CARYA IN MEXICO

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FIVE SPECIES OF *Carya* have been reported from Mexico, *C. illinoensis* (Wang.) K. Koch, *C. myristicaeformis* (Michx. f.) Nutt., *C. mexicana* Engelm., *C. tetraptera* Liebmann, and *C. Diguetii* Dode. The distribution of the first three is given in Standley, Trees and Shrubs of Mexico (Contrib. U. S. Nat. Herb. 23: 165–167. 1920), Martinez, Las Plantas mas utiles que existen en la republica mexicana (pp. 295–297. 1928), and Martinez, Catalogo de nombres vulgares y cientificos de plantas mexicanas (pp. 330–333. 1937). In the last article the distribution is given under the alphabetically arranged common names such as *nogal, nogalillo, nuez.*

Various collectors during the past twenty years have added information concerning the distribution of the species. Studies by the writer on the types of the last two species mentioned above indicate these to be synonyms of the first species. One species has been reduced to varietal rank and one new species related to *C. cordiformis* has been proposed.

The writer wishes to thank the curators of the various herbaria for their generosity in lending specimens; especially Dr. O. Hagerup, Botanisk Museum, Copenhagen, Dr. H. Humbert, Museum d'Histoire Naturelle, Botanique, Paris, and Dr. R. Llamas, Instituto de Biologia, Chapultepec, Mexico.

Following is a key to the Mexican species of *Carya:*

1. Leaflets 5, each serration with a dense tuft of hairs on one or both sides of its apex; bud-scales brown, imbricated; fruit not winged at the sutures, the husk rather thick.......................4. *C. ovata* var. *mexicana.*
1. Leaflets 7–15, the serrations glabrous or ciliate but without special dense subapical tufts of hairs; bud-scales valvate; fruit winged at the sutures at least above, the husk thin...................................... 2
   2. Buds bright yellow; leaflets strongly to densely glandular-lepidote beneath, the glands yellow; all leaflets sessile; nut slightly flattened, not mottled, 4-celled in lower half, thin-shelled; seed probably bitter, the endosperm ruminating........................3. *C. Palmeri.*
   2. Buds grayish-hairy (over yellow) or brownish; leaflets either remotely lepidote or densely grayish- or brownish-lepidote beneath; leaflets sessile or stalked; nut terete, mottled, 2-celled, or if 4-celled only at extreme base; seed sweet, the endosperm not ruminating.. 3
      3. Buds and often twigs very densely grayish- or brownish-lepidote, essentially glabrous; leaflets not falcate, usually sessile, very densely grayish- or brownish-lepidote beneath, usually appearing lustrous or silvery white; bud-scale scars crowded, forming a narrow ring; nut very thick-shelled, without lacunae in the septa; common peduncles of the staminate catkin clusters well developed, at the base of the terminal leafy growth only.... ....2. *C. myristicaeformis.*

3. Terminal buds hairy, the lateral brown with scattered yellowish glands, glabrous or hairy; leaflets remotely yellow-lepidote beneath, not lustrous, often strongly falcate, the terminal and often the lateral stalked; bud-scale scars high, the pairs separate, not forming a ring; nut mostly thin-shelled, with lacunae in the primary septa and in the secondary internal ribs; peduncles of the staminate catkin clusters very short, at base of terminal leafy shoots and also on special leafless shoots from old wood.. ....1. *C. illinoensis.*

A list of collections is recorded for each species in order to validate the distribution. Also recorded are the herbaria wherein the specimen may be found. When the material is sterile no symbol is given. Whenever staminate flowers, pistillate flowers, immature fruit, or mature fruit as well as leaves are present, indication is made by the abbreviations *stam.*, *pist.*, *im. fr.*, or *fr.* respectively; *fr. only* indicates that no leaves are present. The following are the herbaria and their abbreviations as used in this paper: AA = Arnold Arboretum; CM = Chicago Natural History Museum; BPI = Bureau of Plant Industry, U. S. D. A.; GH = Gray Herbarium; MO = Missouri Botanical Garden; Mich = University of Michigan; NY = New York Botanical Garden; Tenn = University of Tennessee; Tex = University of Texas; US = U. S. National Herbarium; USFS = U. S. Forest Service; WEM = the writer's persônal herbarium; Cop = Botanisk Museum, Copenhagen, Denmark; Mex = Instituto de Biologia, Chapultepec, Mexico; Paris = Museum d'Histoire Naturelle, Botanique, Paris, France.

1. **Carya illinoensis** (Wang.) K. Koch, Dendr. 1: 593. 1869.

Carya pecan (Marsh.) Engl. & Graebn., Notizbl. Bot. Gard. Mus. Berlin, App. **9**: 19. 1902.

Carya tetraptera Liebmann, Vidensk. Meddel. Naturh. For. Kjøbenh. **1850**: 80. 1850.

Carya Diguetii Dode, Bull. Soc. Bot. France **55**: 470. 1908.*

Large tree; leaflets 9–17, the lateral ones sessile or short-stalked, acute at the base, typically narrow, oblong-lanceolate, falcate, but sometimes broader, ovate, not falcate; terminal leaflet stalked; twigs, rachises, and lower leaflet surfaces glabrate to densely puberulent; bud-scales valvate; terminal bud grayish yellow-hairy, the lateral buds brown, glabrate or occasionally pubescent, with few to many yellow glands, the bud-scales frequently broken off and exposing the densely silky-pubescent inner leaves; bud-scale scars broad, the pairs separated, not forming a ring; clusters of staminate catkins subsessile or short-stalked (stalk usually 1–3 mm. long), located at the base of an elongate leafy new growth and also in pairs at the base of special short leafless branches from old wood; fruit brown, elliptical to oval, mostly 4-winged and -angled to the base; nut elliptical to oval, cylindrical, not angled or very slightly so above,

* See Little, Amer. Midl. Nat. 29: 501. 1943 for other synonyms and discussion of name.

brown, mottled with irregular darker brown markings; husk and nut-shell thin; true secondary (dorsal) septa essentially absent, the short projections from the primary wall not usually reaching the outer wall of the nut, the nut 2-celled in the lower half or somewhat 4-celled at the extreme base; primary septa and internal secondary ribs (ridges) with lacunae, the lacunae of the latter not clearly covered with a hard wall.

VERNACULAR NAMES: *La nuez chiquita; nogal liso; liso o encarcelado; nogal morado; nuez encarcelado; nogal de Cuilpan; nogalito; pecan.*

NUEVO LEON: Monterrey, *C. K. Dodge 19* stam. (GH, US); *C. H. & M. T. Muller 65* fr. (AA, CM, Tex, Mex); *C. R. Orcutt 1076* fr. (US); *C. S. Sargent* in 1900 (*Canby 222*) stam. (AA, US). — Monterrey, Sierra de la Silla, alt. 1700 ft., *C. G. Pringle 11177* fr. (CM, GH, MO, NY, US, Mex). — Monterrey, Remate, *G. Arsène 6164* (*Abbon 179*) fr. (AA, GH, MO, US). — Galeana, along bank of stream, alt. 5400 ft., *V. H. Chase 7737* im. fr. (BPI, CM, GH, MO, NY). TAMAULIPAS: San Jose, Sierra de San Carlos, *H. H. Bartlett 10394* fr. (US). — La Morita, Marmolejo, *H. H. Bartlett 10738* fr. (US). — South Victoria, La Jolla Ranch, *R. Runyan 1011* stam., pist. (AA, Tex, US); *R. Runyan & B. C. Tharp 4070* stam., pist. (Tex). — Jaumave, *H. W. Viereck 302* (US); *L. H. Dewey* 3/31/1903 (MO). — Circa les minas de Victoria a Tula, *J. L. Berlandier 855–2275* (GH). SAN LUIS POTOSI: Tamazunchale, *M. T. Edwards 937** (CM, MO, Tex). — Alvarez, *C. C. Parry & E. Palmer 835 ½ pro parte*, fr. (GH, MO, US). JALISCO: Zapotlan, *B. P. Reko 4672* stam. (US). HIDALGO: Ixmiquilpan, *J. N. Rose, J. H. Painter & J. S. Rose 8945* fr. (CM, NY, US). — Tecozantla, *F. Salazar* in 1913, fr. (US, Mex). GUANAJUATA: Moist soil in stream-bottom canyon, 5 km. west of Xichu, alt. 1600 m., *E. L. Little Jr. 11074* fr. (USFS, WEM). — Pamillas, Rio Pamillas, 25 km. northeast of San Luis de la Paz, moist soil in canyon bottom, alt. 1740 m., *E. L. Little Jr. 11090* fr. broadly winged (USFS, WEM); same general locality, *E. L. Little Jr. 11091* fr. essentially wingless (USFS, WEM), and *E. L. Little Jr. 11092* fr. narrowly winged (USFS, WEM). COAHUILA: Muzquiz, *E. Marsh 6* pist. (Tex). — Monclova, alt. 2000 ft., *S. S. White 1702* (Mich). OAXACA: Oaxaca, at foot of Cerro de San Felipe, open pasture-like area, *A. J. Sharp 45915* (Tenn, WEM). — Oaxaca, Monte Alban, *J. N. Rose & W. Hough 4657* fr. (US). — Cuilapa, *F. Liebmann 3777* im. fr., old pist. (Cop, CM). — MORELOS?: (marked "Morelia: Parco"): *Arsène* I/1910 (CM). MEXICO: "Mexique, region de Mexico," *M. L. Diguet* in 1908, fr. (Cop, Paris).

This species was reported by both Standley (1920) and Martinez (1928, 1937) as growing in Nuevo Leon, San Luis Potosi, and Hidalgo. Both authors indicate also possible distribution in Oaxaca, apparently referring to the uncertainty of the identification of the collections of Liebmann. In addition to the above states, the species is now definitely known from Tamaulipas, Jalisco, Guanajuata, Coahuila, Oaxaca, and possibly from Morelos and Mexico D. F. I. M. Johnston (Jour. Arnold Arb. 25: 435. 1944) writes as follows about its presence in Coahuila: "Reported as growing wild in northeastern Coahuila along the bottomlands of the Rio San Diego, Rio Rodrigo, and Rio Sabinas, by Pablo

* Specimen incomplete, hence identification uncertain; it might be *Carya Palmeri*.

Frick, Mexico Forestal 1: 11–14, fig. (1923), and by Angel Roldan, Mexico Forestal 3: 30–32, fig. (1923). I have been told of pecan-trees which formerly grew about Muzquiz and Naciemiento. I have seen no specimens from Coahuila. However, the species is to be expected in northeastern Coahuila, for pecans have been collected in Val Verde (Devils River) and Uvalde Counties in adjoining Texas." The pecan also grows wild in southeastern United States.

The natural distribution in Mexico is somewhat uncertain, as the trees have definitely been introduced in some areas (see Martinez 1928), and few herbarium labels have clear notes on habitats. On *Liebmann 3777* it is recorded that the trees grow wild on hillsides, and on *Runyan 1011* it is indicated that the trees are abundant on the sides of mountains in Tamaulipas. On the other hand, the field notes on Dewey's specimen indicate that the many large trees at Jaumave, Tamaulipas, have been introduced from Texas. It is evident that much of the range indicated above is a natural one, with part of the range represented by cultivated trees only, and in other areas by a mixture of native and cultivated trees.

The writer has seen the types of both *Carya tetraptera* Liebm. and *C. Diguetii* Dode. The type of the former, *Liebmann 3777* (with four sheets collected at different times) consists of essentially glabrous specimens of typical pecan with 9–11 (7–13?) narrow stalked leaflets. The immature, strongly 4-winged fruits and the nearly mature fruit indicate that the fruit and nut are elongate, essentially elliptical or oval. The sterile isotype at the Chicago Museum of Natural History has hairy, broader, less falcate leaflets characteristic of certain trees of *C. illinoensis.* Dode (1908) described *C. Diguetii* as belonging to the section EUCARYA and related to *C. texana* DC., having 6–10 sessile leaflets, and the staminate catkins on new wood. (Little, Amer. Midl. Nat. 29: 502. 1943, has pointed out that the name *C. texana* has been used for two or possibly three different species, in two different sections; the photograph of the type of *C. texana* DC. from Geneva seen by the writer merely shows that the 9–13 leaflets are very hairy and does not indicate the section to which it belongs, but the number of leaflets suggests APOCARYA.) However, the type specimen, collected by Diguet in 1908 (poorly pressed by the collector), belongs to the section APOCARYA. Some of the staminate catkins are clearly on special short branches from the old wood, the bud-scales are valvate, and there are lacunae in the primary septa and in the secondary internal ribs of the nut. The nut, although small (19–21 mm. long and 13–15 mm. in diameter) and somewhat oval-cylindrical, is a typical pecan both externally and internally. The nuts from Copenhagen examined by the writer were so darkened by oil and age that darker markings could not be observed. *Pringle 10167* (cited by Dode as C. Pringle, Sierra Madre above Monterrey, Mexique, 2500–3000 ft., 1906, distributed without fruit as *C. myristicaeformis* Nutt.), stated by Dode as undoubtedly belonging to this species, and upon which much of his description of the leaves seems to have been based, actually belongs to *C.*

Palmeri described below. The disposition of *C. Diguetii* must, however, be based on the type specimen. (It should be pointed out that the specimen of *Pringle 1963* referred by Sargent in Sylva 7: 146. 1895, to *C. myristicaeformis*, is true *C. myristicaeformis*. Dode erroneously cited — by references — *Pringle 10167* and *Pringle 1963* as the same.)

2. **Carya myristicaeformis** (Michx. f.) Nutt. ex Ell. Sketch Bot. S. Car. & Ga. 2: 628. 1824.

Carya myristicaeformis Nutt. Gen. No. Amer. Pl. 2: 222. 1818; *nomen nudum* (see discussion of name in Little, 1943).

Small or large tree; leaflets 7–9, rarely 11, all typically sessile or subsessile, usually not falcate; younger parts of twigs, rachises, and lower leaflet-surfaces densely brown- or gray-glandular-scaly (lepidote), the scales often touching each other, the lower surface of the leaflets usually lustrous brown or silvery white, typically glabrate; bud-scales valvate, brownish; terminal buds about 7 mm. long, broadly ovate, not flattened; bud-scale scars narrow, crowded, forming a ciliate ring, though this is not always distinct; staminate catkins with a definite common peduncle located only at the base of strong new leafy growth; fruit densely brown-scaly, 4-wing-valved to base, the husk thin; nut oval, cylindrical, medium brown, mottled, not angled, with very thick shell, the secondary septa so low that they appear absent, so nut 2-celled except at the extreme base where it is 4-celled; lacunae in the nut-shell essentially absent.

VERNACULAR NAME: *Nutmeg hickory* (in the U. S. A.).

NUEVO LEON: Monterrey: *C. H. & M. T. Muller 64* fr. (AA, CM, Mex); *C. H. Muller 2655* fr. (BPI, GH); *C. G. Pringle 1963* fr. (AA, CM, GH, MO, NY, US). — Santiago, Horsetail Falls, *V. H. Chase 7802* fr. (BPI, CM, GH, MO, NY). — 15 mi. SW. of Galeana, *C. H. & M. T. Muller 1142* fr. (AA, CM, Mich, NY, US, Mex). — El Cercado, 30 mi. S. of Monterrey, *C. H. & M. T. Muller 1352* fr. (AA, CM, Mich, Mex). — Hacienda Vista Hermosa, 35 mi. S. of Monterrey, alt. 2350 ft., *S. S. White 1629* fr. (GH, Mich).

Martinez (1928) does not seem to report it, but Standley (1920) and Martinez (1937) report it from Nuevo Leon. It has so far been reported from no other state. This species also occurs in southeastern United States.

The field notes for *Muller 2655* state: "Large shrub up to 15 ft. or small tree to 25 ft. Mature trunks with bark scaling like shagbark. A common constituent of the oak-hickory wood. Canon Diente."

3. **Carya Palmeri** * sp. nov.

Shrub or medium-sized tree up to 1 × 40 feet; larger leaves 23–37 cm. long, 15–28 cm. wide; leaflets 9–11, rarely 13, lanceolate to oblong- or ovate-lanceolate to rarely obovate, sessile, the lateral with rather broad

* Foliolis 9–11, rariter 13, sessilibus, subtus dense aureo-glanduloso-lepidotis; gemmis aureis, perulis valvatis; fructibus 4-alatis, exocarpio tenue; nuce non variegata, subcompressa, putamine dissepimentisque tenuissimis, ad medium 4-loculato.

obtuse or even subcordate bases, occasionally falcate, finely serrate, strongly yellow-glandular-scaly beneath, the glands thick, leaflets greenish or more commonly appearing strongly yellowish brown beneath but not truly lustrous-sericeous as in *C. myristicaeformis;* uppermost lateral leaflets 9–20 cm. long, 2–6 cm. wide, the terminal leaflet only slightly larger; twigs, rachises, and lower leaflet-surfaces glabrate or commonly strongly pubescent; terminal bud 8–11 mm. long, slender, strongly flattened, all buds bright yellow because of dense yellow glands, glabrate to slightly puberulent at apex, frequently short-stalked, the bud-scales valvate, apparently only one or two pairs; bud-scale scars rather broad, the pairs separated, not forming a ring; staminate catkins about 8 cm. long on new growth at base of elongate leafy shoots or on special short leafless shoots from old wood, the common peduncle of the cluster short, 4–8 or even to 12 mm. long; bract of the flower slender, longer than the bracteoles; fruit frequently with a short stipe, 3–4 cm. long, 2–3 cm. thick, strongly 4-ridged to the very base, usually winged along the sutures to the base, strongly yellow-scaly, the husk very thin, 0.5–1 mm. thick, final dehiscence uncertain; nut gray-brown, not mottled, not angled, only slightly flattened, about 2.4 cm. thick parallel to the primary partition, the shell very thin (about 1 mm. thick), cavity for embryo very large, the secondary septa strongly developed to about the middle of the nut, so nut 4-celled to about the middle, primary septa and secondary internal ribs with strong brown-filled lacunae; endosperm ruminating, hence seed probably bitter. This species belongs to section APOCARYA.

NUEVO LEON: Monterrey, Sierra Madre, alt. 2600 ft., *C. G. Pringle 13957* fr. (GH, Mich, US). — Monterrey, Cañon Diente, *C. H. Muller 2643* fr. (BPI, GH). — Monterrey, Sierra Madre, alt. 2500–3000 ft., *C. G. Pringle 10167* stam. (GH, MO, NY, US, Mex, Paris). — Monterrey, Sierra Madre, *C. G. Pringle 13200* fr. (TYPE GH; CM, US, Mex), Sept. 7, 1904. — Municipio de Villa Santiago, Cañon Guajuco, Rancho Vista Hermosa, abundant in upper oak-hickory forest, *C. H. Muller 2034* im. fr. (AA, CM, Mich, Mex). — Villa de Santiago, Horsetail Falls, alt. 2500 ft., *Mr. & Mrs. W. C. Leavenworth 811* (CM, MO).

The species is named after Mr. Ernest J. Palmer, one of the foremost students of *Carya,* a friend of the writer, and for many years collector and research assistant at the Arnold Arboretum, Harvard University.

Most of the specimens were originally called *C. myristicaeformis,* because of the strong yellow color of the lower surface of the leaflets. *Carya Palmeri* differs from *C. myristicaeformis* in its bright yellow buds, the yellow-brown color of the lower leaflet-surfaces, and especially in the external and internal structure of the nut. It differs in these same respects from *C. illinoensis,* and in addition in the sessile leaflets. The species is very closely allied to *C. cordiformis* in that the buds, sessile leaflets, and internal structure of the nut are essentially identical. *Carya Palmeri* differs in having: (1) the fruit 4-winged-valved to the base instead of to the middle; (2) 9–13 instead of 7–9 (rarely to 11) leaflets; (3) more frequently hairy rachises and twigs; (4) strongly yellow fruit and lower leaflet surface; (5) the leaflets more frequently falcate; (6) a stipe to the fruit; and (7) a longer staminate floral bract.

There are two different groups of specimens representing the species, one with strikingly yellow or yellowish brown lower surfaces of the leaflets (*Pringle 13957, Pringle 13200, Muller 2034*) and one with leaflets somewhat greener beneath (*Muller 2643, Leavenworth 811, Pringle 10167*). This second group is closer to *C. cordiformis* in its leaves, and it suggests the possibility that *C. Palmeri* might be a hybrid between *C. cordiformis* and either *C. illinoensis* or *C. myristicaeformis*. Certain features, however, are not intermediate. In each group mentioned above the leaflets and rachises may be glabrate or strongly pubescent, and the leaflets may be narrow and small, or broader and larger. In *Pringle 13200* and *Muller 2034* the uppermost lateral leaflets are 9–11 cm. long and 2–3.5 cm. wide, the leaves up to 23 cm. long and 15–20 cm. wide; in *Leavenworth 811* the leaflets are 15–20 cm. long and 5–6 cm. (terminal 6.5 cm.) wide, the leaves 28–37 cm. long and 22–28 cm. wide.

4. **Carya ovata** (Mill.) K. Koch var. **mexicana** (Engelm.) comb. nov.
Carya mexicana Engelm. ex W. B. Hemsley, Biol. Cent. Amer. Bot. **3**: 162. 1883.

Tree, 15 to 20 meters high; leaflets 5, mostly obovate, sometimes oblanceolate, at least the terminal one strongly stalked, each serration with one or two dense subapical tufts of hairs, the serrations slender appressed to short, divergent and stout; rachis, twigs, and lower surface of leaflets glabrate to pubescent; buds brown, the terminal ones 9–15 mm. long, the scales overlapping, the outer persistent in winter; bud-scale scars crowded into a narrow usually hairy ring; staminate catkins at the base of long leafy shoots, the common peduncle elongate; fruit subglobose to oval, with a comparatively thin husk (3–6.5 mm. or even 1.5–3 mm. thick), 4-valved to the base, brown, not notably glandular nor winged; nut flattened, slightly to strongly 4-angled, whitish to whitish brown; secondary partition high, sometimes thick, the ends of the primary septa frequently much thickened, without lacunae.

VERNACULAR NAMES: *Nogalillo de San Luis Potosi; nogal motudo; nogal Rayado.*

NUEVO LEON: Sierra Madre Oriental: Puerto Blanco to Tarey, 15 miles SW. of Galeana, *C. H. & M. T. Muller 1226* fr. (AA, CM, Mich, NY, Tex, US, Mex).—El Cercado, 30 miles S. of Monterrey, *Muller 1355* (AA, CM, Mich, Tex). SAN LUIS POTOSI: Alvarez, *C. C. Parry & E. Palmer 835 ½ pro parte* (see under *C. illinoensis* for other *835 ½*), type of *C. mexicana* at Kew not seen by the writer, but the following three isotypes seen: lf., fr. MO, lf. only GH, fr. only AA.—*Parry & Palmer 834½* (GH).—*E. Palmer 71* fr. (AA, BPI, GH, CM, MO, NY, US, Mex).—*Goodman 1910, 1916*, fr. only (AA). TAMAULIPAS: San Jose, *H. H. Bartlett 10253* (CM, GH, US).—Cerro Barril, *Bartlett 10488* (US); *Bartlett 10490* fr. (US).—Cerro Zamora, El Milagro, *Bartlett 11080* fr. (CM, GH, US).—La Jolla Ranch, So. Victoria, *R. Runyan 1019* stam. (AA, US). QUERETARO: Pinal de Amoles (Armales?), *E. W. Nelson & E. A. Goldman 3934* (GH, US). HIDALGO: near Chapatla, below Alumbres, not far from Zacualtipan, alt. 6500 ft., *A. J. Sharp 46207* (Tenn, WEM). PUEBLO: slopes above Rio Necaco, toward Huauchinango, alt. 4700 ft., *A. J. Sharp 45377* (Tenn, WEM). — "Parco," *Nicolas* in 1909 (CM).

Both Martinez (1937) and Standley (1920) report the *Mexican shag-bark* from San Luis Potosi and Queretaro. In addition to these states, collections have been made from Nuevo Leon, Tamaulipas, Pueblo, and Hidalgo. *Carya ovata,* called *shag-bark* or *shell-bark hickory* occurs in the eastern United States, extending from southern Maine to as far south as Texas.

This species was separated from *C. ovata* by Engelmann by its smaller buds, its more pubescent leaves, and its closer, more appressed serratures on the leaflets. The buds on the type, it is true, are somewhat shorter than those found in characteristic *C. ovata,* but they may represent axillary buds on fruiting twigs or terminal buds at the tips of short twigs. As pointed out by Rehder (1935), the buds on some specimens are 15 mm. long. The serrations are appressed on the type, but on many other specimens the serrations are short, divergent and broad as characteristic in *C. ovata;* furthermore some specimens of *C. ovata* from the northwestern portion of its range in the United States have slender appressed serrations.

Rehder (1935) pointed out that he saw no character distinguishing *C. mexicana* from *C. ovata.* According to the view of the writer the Mexican trees are difficult to separate even as a variety, but on certain trees the nut shell or the partitions are quite thick, the nut shell is often only slightly angled, and the husk may be quite thin (not on the type). Consequently in the aggregate these trees, all certainly very closely related, may be considered a geographical variety. Many of these features may, however, be found separately on individual trees of characteristic *C. ovata* in the United States, as far north as Massachusetts.

Rehder's *C. mexicana* forma *polyneura* should be transferred to this new variety.

4a. **Carya ovata** (Mill.) K. Koch var. **mexicana** (Engelmann) Manning forma **polyneura** (Rehder) comb. nov.

Carya mexicana Engelm. forma *polyneura* Rehder, Jour. Arnold Arb. **16**: 448. 1935.

This form (*C. H. & M. T. Muller 1226,* type at AA; and *Muller 1355*) appears different at first glance, but is probably a mere ecological form, possibly a variation occurring on certain parts of a tree. In the leaflets the veins are closer and more conspicuous. More field study is necessary. It is interesting that in its glabrous twigs and leaflets and dark buds this form approaches *C. carolinae-septentrionalis* (Ashe) Engl. & Graebn., the weak North Carolina segregate of *C. ovata.*

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FURTHER NOTES ON THE FERNS OF FIJI

Edwin B. Copeland

The impetus for the preparation of these notes comes from a study of a collection of 377 numbers of ferns collected in Fiji by Dr. A. C. Smith in 1947.[1] My earlier publication on Fijian Ferns[2] contains numerous binomials which, in my present opinion,[3] are outmoded; the sequence followed in my Bulletin of 1929 is also outmoded, but for convenience of reference it is followed in the present report. In this treatment I insert brief notes on most of the species which have been reported from Fiji since my earlier report, and I also indicate the correct binomial for each species there discussed, in cases where such a change is needed. Five new species are here described, and several combinations are proposed as new. The first set of Dr. Smith's ferns is deposited in the Gray Herbarium and an essentially complete set, including types of the novelties here described, is in the herbarium of the University of California.

Botrychium daucifolium Wall. is reported as occurring in Fiji by Christensen in Bishop Mus. Bull. 177: 7. 1943. I have seen no specimens in support of this record, but such an occurrence is to be expected.

Angiopteris opaca Copel., previously thought to be a Fijian endemic, is now reported from Samoa by Christensen in Bishop Mus. Bull. 177: 8. 1943.

Trichomanes omphalodes (Vieill.) C. Chr. = **Microgonium omphalodes** Vieill.

Trichomanes vitiense Baker = **Microtrichomanes vitiense** (Baker) Copel., ranging from Queensland to Samoa.

Trichomanes bimarginatum v. d. B. = **Microgonium bimarginatum** v. d. B.

Trichomanes saxifragoides Presl = **Gonocormus minutus** (Blume) v. d. B.

Trichomanes erectum Brack. and T. alternans Carr. = **Crepidophyllum Endlicherianum** (Presl) Reed in Am. Fern Jour. 38: 89. 1948.

Trichomanes humile Forst. = **Crepidophyllum humile** (Forst.) Reed, loc. cit.

[1] Dr. Smith's collections were made under the auspices of the Arnold Arboretum of Harvard University and the John Simon Guggenheim Memorial Foundation, with the aid of grants from the Penrose Fund of the American Philosophical Society and the Bache Fund of the National Academy of Sciences.

[2] Bishop Mus. Bull. 59: 1–105. 1929.

[3] Copeland, E. B. Genera Filicum. 1947.

TRICHOMANES BIPUNCTATUM Poiret = **Crepidomanes bipunctatum** (Poiret) Copel.

TRICHOMANES MEIFOLIUM Bory = **Macroglena meifolium** (Bory) Copel.

TRICHOMANES APHLEBIOIDES Christ = **Vandenboschia aphlebioides** (Christ) Copel., ranging westward to Sumatra.

TRICHOMANES MAXIMUM Blume = **Vandenboschia maxima** (Blume) Copel.

TRICHOMANES CAUDATUM Brack. = **Macroglena caudata** (Brack.) Copel., ranging from Queensland to Tahiti.

TRICHOMANES ASAE-GRAYI v. d. B. = **Macroglena Asae-Grayi** (v. d. B.) Copel., a species structurally similar to the preceding; it is *Trichomanes longisetum* Brack., and Carr., *nec* Bory; known also from Samoa and Tahiti.

TRICHOMANES CARTILAGINEUM Vieill. & Pancher, at least in part, as well as T. DENTATUM v. d. B. and T. SEEMANNII Carr. = **Selenodesmium dentatum** (v. d. B.) Copel., common in Fiji and neighboring archipelagos.

TRICHOMANES HARVEYI Carr. = **Nesopteris intermedia** (v. d. B.) Copel., ranging from New Guinea to Polynesia.

TRICHOMANES APIIFOLIUM Presl = **Callistopteris apiifolia** (Presl) Copel.

"TRICHOMANES AUSTRALICUM v. d. B." was an error in citation in Bishop Mus. Bull. 59: 27. 1929. The correct name is **Cephalomanes Boryanum** (Kunze) v. d. B.

HYMENOPHYLLUM FLABELLATUM Labill. = **Mecodium flabellatum** (Labill.) Copel.

HYMENOPHYLLUM DILATATUM (Forst.) Sw., which = *Mecodium dilatatum* (Forst.) Copel., is endemic in New Zealand. Fijian plants passing under this name and as H. FORMOSUM Brack. = **Mecodium imbricatum** (Blume) Copel., ranging from Tahiti to Java.

Mecodium polyanthos (Sw.) Copel., a pantropic species, is represented, among other Fijian collections, by *Parks 20614* and *20769*.

HYMENOPHYLLUM AUSTRALE Willd., which = *Mecodium australe* (Willd.) Copel., is known only from New Zealand and Tasmania and perhaps Victoria. Fijian plants so identified represent **Mecodium samoense** (Baker) Copel., known also from Samoa and Queensland.

Hymenophyllum affine Brack. looks like a real *Hymenophyllum*.

HYMENOPHYLLUM MULTIFIDUM (Forst.) Sw., which = *Meringium multifidum* (Forst.) Copel., is endemic in New Zealand. Its Fijian vicar, HYMENOPHYLLUM FEEJEENSE Brack., = **Meringium feejeense** (Brack.) Copel.

HYMENOPHYLLUM DENTICULATUM Sw. = **Meringium denticulatum** (Sw.) Copel.

Meringium Macgillivrayi (Baker) Copel. in Philip. Jour. Sci. 67: 44.

1938 (*Trichomanes Macgillivrayi* Baker; *Hymenophyllum Macgillivrayi* Copel.), was overlooked in Bishop Mus. Bull. 59 (1929).

To *Schizaea,* in my treatment of 1929, should be added:

Schizaea (*Actinostachys*) **melanesica** Selling in Svensk Bot. Tidsk. 38: 208. 1944.

MOTURIKI: *Seeman 793.* VANUA LEVU: Thakaundrove: Maravu, near Salt Lake, alt. 0–450 m., *Degener & Ordonez 14144* (in dense wet forest); Mathuata: "Mudthuata Mts." [Mathuata Range, on mainland opposite Mathuata Island], *U. S. Expl. Exped.;* summit ridge of Mt. Numbuiloa, east of Lambasa, alt. 500–590 m., *Smith 6518* (also observed in dry forest on upper northwestern slopes).

In his original discussion Selling cites only two specimens, the type from New Caledonia and *Seeman 793* (without locality) from Fiji. The species is now known to occur from New Caledonia to Tonga, but it is rare at least in Fiji; Dr. Smith reports seeing it in only the one locality cited above, during his two collecting trips.

GLEICHENIA OCEANICA Kuhn = **Sticherus oceanicus** (Kuhn) Ching.

GLEICHENIA BRACKENRIDGEI Fournier (in Ann. Sci. Nat. Bot. V. 18: 269. 1873) = **Sticherus Brackenridgei** (Fournier) comb. nov.

GLEICHENIA LINEARIS (Burm.) Clarke = **Dicranopteris linearis** (Burm.) Underw.

GLEICHENIA CAUDATA Copel. (in Bishop Mus. Bull. 59: 9. *pl. 2.* 1929) = **Dicranopteris caudata** (Copel.) comb. nov.

GLEICHENIA JAPONICA Spreng. = **Hicriopteris glauca** (Thunb.) Copel.

CYATHEA HORNEI (Baker) Copel. (*Alsophila Hornei* Baker) = **Gymnosphaera Hornei** (Baker) Copel. Gen. Fil. 99. 1947.

ALSOPHILA DISSITIFOLIA Baker, judging by the description, must also be a species of *Gymnosphaera.*

Cyathea microlepidota sp. nov.

C. gregis *C. affinis,* stipite 60 cm. alto, deorsum atropurpureo griseo-furfuraceo paleis albidis anguste lanceolatis valde attenuatis 15 mm. longis sparso, sursum fusco glabrescente cicatricibus linearibus ornato; lamina 1.5 m. alta, ovata, rhachibus inferne stramineis subglabris; pinnis infimis 25–30 cm., medialibus 50 cm. longis, 20 cm. latis, sessilibus; pinnulis 10 cm. longis, 2 cm. latis, subacuminatis, infimis brevi-pedicellatis, profunde pinnatifidis, segmentis infimis basicopicis modo reductis et interdum liberis, segmentis sequentibus 5 mm. latis, rotundatis, fere integris, costis superne setulis inflexis atrocastaneis, inferne squamulis concoloribus minutis in setulas dissolutis obsitis, sursum glabrescentibus, costulis fere glabris, venis furcatis; soris medialibus, globosis, indusiis in segmenta magna persistentia ruptis.

VANUA LEVU: Mathuata: Seanggangga Plateau, in drainage of Korovuli River, vicinity of Natua, alt. 100–200 m., in patches of forest in open rolling country, Nov. 25, 1947, *Smith 6654* (TYPE in herb. Univ. Calif.) ("Mbalambala." Caudex 2–4 m. high, about 5 cm. diam.; fronds about 7–9 per plant, about 1.5 m. long, the stipe about 60 cm. long, the pinnae 7–9 pairs.)

Well characterized by the minute, dark, dissected squamulae on the nether face of the costa; and notable, in the group of indusiate species with broad segments, for the long stipe and only moderately reduced lowest pinnae.

Cyathea subsessilis Copel. in Philip. Jour. Sci. 6C: 359. 1911.

Christensen (in Bishop Mus. Bull. 177: 25. 1943) has identified *Smith 1902*, from Mt. Ndikeva, Thakaundrove, Vanua Levu, as this species, described from Samoa. The collection is indeed not typical *C. propinqua* Mett., under which name it was distributed; but neither is it typical *C. subsessilis*.

Cyathea plagiostegia Copel., previously considered endemic to Fiji, is now reported from Samoa by Christensen, who lists several collections in Bishop Mus. Bull. 177: 28. 1943.

Cyathea truncata (Brack.) Copel. is common in Samoa (cf. Christensen in Bishop Mus. Bull. 177: 30. 1943).

Cyathea subbullata Copel. in Bishop Mus. Occ. Papers 15: 79. 1939.

VITI LEVU: Mba: Immediate vicinity of Nandarivatu, alt. 800–900 m., in dense forest along stream, *Smith 5045;* hills east of Nandala Creek, about 3 miles south of Nandarivatu, alt. 850–970 m., in dense forest, *Smith 5925;* Naitasiri: Northern portion of Rairaimatuku Plateau, between Mt. Tomanivi [Mt. Victoria] and Nasonggo, alt. 870–970 m., in dense forest, *Smith 6145.*

Previously known from the type, *St. John 18304,* from mountains west of Matawailevu, now in the Province of Naitasiri [formerly Tholo East]. The species is very near to the Tahitian *C. decurrens* (Hook.) Copel. and the New Caledonian *C. alata* (Fournier) Copel.

Lastrea Archboldiae sp. nov.

L. rhizomate brevi-repente, basibusque stipitum paleis fuscis lanceolatis integris 5 mm. longis vestitis; stipitibus gracilibus, 30 cm. longis, sursum glabrescentibus; lamina 25 cm. longa, basi truncata 16 cm. lata, apice acuminata, profunde bipinnatifida, rhachi sparse setifera; pinnis fere omnibus breviter pedicellatis, infimis basi angustatis, acuminatis, costis superne velutinis, inferne setis albis sparsis vestitis; segmentis erecto-patentibus, maximis 1 cm. longis 3–4 mm. latis, rotundatis, integris, sparse ciliolatis, herbaceis, viridibus, superne et ad venas et ad laminam sparse setosis; venis ca. 7-paribus, fere omnibus simplicibus, infimis supra sinus excurrentibus; soris medialibus, indusiis parvis setulosis.

VITI LEVU: Mba: Vicinity of Nandarivatu, alt. 750–900 m., Feb.-March, 1941, *Degener 14273* (TYPE in herb. Univ. Calif.) (in open forest).

Apparently near to *Dryopteris savaiensis* (Baker) C. Chr., as described by Christensen in Bishop Mus. Bull. 177: 82. 1943, but with distinctly stalked pinnae, and without evident aerophores.

DRYOPTERIS PRENTICEI (Carr.) Kuntze = **Lastrea Prenticei** Carr.

DRYOPTERIS BRACKENRIDGEI (Mett.) Kuntze = **Lastrea Brackenridgei** (Mett.) Carr.

DRYOPTERIS HARVEYI (Mett.) Kuntze = **Lastrea Harveyi** (Mett.) Carr.

DRYOPTERIS VISCOSA (J. Sm.) Kuntze = **Lastrea viscosa** J. Sm.

Christensen (in Bishop Mus. Bull. 177: 82. 1943) cites *Smith 1669* from Fiji as *Dryopteris pubirachis* (Baker) C. Chr. This is probably correct, but I am still unable to distinguish it satisfactorily from *Lastrea viscosa.* Two supposed species of New Guinea, *Dryopteris subnigra* Brause and *D. oligolepia* v. A. v. R., represent the same species or group.

DRYOPTERIS GORDONI (Baker) C. Chr. = **Ctenitis Gordoni** (Baker) Copel. Gen. Fil. 123. 1947.

DRYOPTERIS SETIGERA (Blume) Kuntze probably = **Lastrea Torresiana** (Gaud.) Moore.

DRYOPTERIS LEUCOLEPIS (Presl) Maxon = **Lastrea leucolepis** Presl.

DRYOPTERIS SQUAMIGERA (Hook. & Arn.) Kuntze = **Ctenitis squamigera** (Hook. & Arn.) Copel. Gen. Fil. 125. 1947.

DRYOPTERIS TENUIFRONS C. Chr. = **Ctenitis tenuifrons** (C. Chr.) Copel. Gen. Fil. 125. 1947.

DRYOPTERIS FIJIENSIS (Hook.) C. Chr. = **Ctenitis fijiensis** (Hook.) Copel. Gen. Fil. 124. 1947.

Ctenitis davallioides (Brack.) comb. nov.

Lastrea davallioides Brack. U. S. Expl. Exped. **16**: 202. 1854.

Dryopteris davallioides Kuntze, Rev. Gen. 812. 1891; Copel. in Bishop Mus. Bull. **59**: 44. 1929, **93**: 34, *pl. 6.* 1932; C. Chr. in Bishop Mus. Bull. **177**: 97. 1943.

Dryopteris microtricha Copel. in Bishop Mus. Bull. **59**: 10, 44. 1929.

Ctenitis microtricha Copel. Gen. Fil. 124. 1947.

Without yet feeling certain, I agree with Christensen (loc. cit.) that my *Dryopteris microtricha* is probably a synonym of *Lastrea davallioides.* I am also uncertain as to the proper genus for this plant. By its pubescence it seems to be a *Ctenitis,* but the anadromic dissection of the frond indicates *Rumohra.* The best developed known specimen is probably *Smith 5188,* from the summit of Mt. Tomanivi [Mt. Victoria], Mba, Viti Levu, alt. 1290–1323 m., an epiphyte in mossy forest. This specimen has fronds more than a meter long, including the stipe, and hexapinnatifid in the lower part.

DRYOPTERIS GONGYLODES (Schkuhr) Kuntze = **Cyclosorus gongylodes** (Schkuhr) Link, the type of its genus.

DRYOPTERIS HAENKEANA (Presl) Kuntze, at least as to its Guam type, is not distinguishable from **Cyclosorus unitus** (L.) Ching; see Wagner & Grether in Bishop Mus. Occ. Papers 19: 52. 1948.

DRYOPTERIS INVISA (Forst.) Kuntze = **Cyclosorus invisus** (Forst.) Copel. Gen. Fil. 142. 1947.

DRYOPTERIS ARIDA (Don) Kuntze = **Cyclosorus aridus** (Don) Ching.

DRYOPTERIS ARBUSCULA (Willd.) Kuntze = **Cyclosorus arbuscula** (Willd.) Ching; but the presence of this species in Fiji is doubtful.

DRYOPTERIS NYMPHALIS (Forst.) Copel. = **Cyclosorus**; but its distinctness from *C. parasiticus* (L.) Farwell and *C. dentatus* (Forst.) Ching is uncertain.

Cyclosorus Degeneri sp. nov.

C. stipitibus fasciculatis, ad vestigia infima pinnarum 2–8 cm., ad pinnas normales 15 cm. longis, basi paleis paucis parvis lanceolatis atrofuscis praeditis, ubique pubescentibus; vestigiis pinnarum 5–15-paribus, approximatis, triangularibus, 2–4 mm. longis et latis; lamina usque ad 45 cm. longa et 10 cm. lata, acuminata, basi gradatim angustata, pinnata, rhachi ubique minute setulosa; pinnis approximatis, sessilibus, medialibus 5 cm. longis 9 mm. latis, subacutis, basi truncatis, vix medio ad costam lobatis, costis venisque setulosis, facie laminare minutissime setulosa, subcoriaceis, lobis 2–3 mm. latis obtusis; venis 4–5-paribus, 2-paribus anastomosantibus; soris medialibus, indusiis persistentibus, setosis.

VANUA LEVU: Thakaundrove: Maravu, near Salt Lake, alt. 0–450 m., Jan. 1941, *Degener & Ordonez 14209* (TYPE in herb. Univ. Calif.) (in coconut grove near ocean).

Not évidently nearly related to any other known species. The numerous vestigial lower pinnae are found on several species, the most similar of which may be *Dryopteris Christophersenii* C. Chr., which is exindusiate.

DRYOPTERIS MAGNIFICA Copel. = **Cyclosorus magnificus** (Copel.) Copel. Gen. Fil. 143. 1947.

DRYOPTERIS MICROSORA Copel. = **Cyclosorus microsorus** (Copel.) Copel. Gen. Fil. 143. 1947.

DRYOPTERIS PENNIGERA (Forst.) C. Chr. = *Cyclosorus pennigerus* (Forst.) Copel., which probably does not occur in Fiji. The local plant of this alliance is **Cyclosorus costatus** (Brack.) Copel. Gen. Fil. 142. 1947.

DRYOPTERIS UROPHYLLUS (Wall.) C. Chr. = **Cyclosorus urophyllus** (Wall.) Copel. Gen. Fil. 143. 1947.

DRYOPTERIS RUBRINERVIS (Mett.) C. Chr. = **Cyclosorus rubrinervis** (Mett.) Copel. Gen. Fil. 143. 1947.

DRYOPTERIS SIMPLICIFOLIA (J. Sm.) Christ = **Cyclosorus simplicifolius** (J. Sm.) Copel. Gen. Fil. 143. 1947.

DRYOPTERIS CESATIANA C. Chr. = **Cyclosorus Beccarianus** (Cesati) Copel. Gen. Fil. 142. 1947.

In *Tectaria*, since my publication of 1929, two additional Fijian species have been described:

Tectaria Degeneri Copel. in Sargentia 1: 3. 1942; related to *T. Godeffroyi* (Luerss.) Copel. but with remarkably slender pinnules and segments.

Tectaria elegans Copel. loc. cit.; a relative of *T. leuzeana* (Gaud.) Copel.

POLYSTICHUM ARISTATUM (Forst.) Presl = **Rumohra aristata** (Forst.) Ching.

Polystichum aculeatum (L.) Schott is the collective designation of several Fijian species which I do not yet venture to identify more accurately.

Polystichum pilosum sp. nov.

P. P. obtuso J. Sm. et *P. mutico* Copel. simile, stipitibus caespitosis 30–40 cm. altis stramineis gracilibus, deorsum paleis stramineo-ferrugineis 1 cm. longis 2 mm. latis acuminatis inconspicue sublaceris squamulisque laceris albidis vestitis, sursum paleis piliformibus paucis adspersis; lamina 15–20 cm. longa 7–8 cm. lata, bipinnata, rhachibus pilis et paleis piliformibus basibus parvis dilatatis dilaceratis pallidis densius vestitis; pinnis inferioribus oppositis subacutis, infimis deflexis; pinnulis oblique rhomboideis, 7 mm. longis, 4 mm. latis, rotundatis sed interdum minute spinuliferis, lateribus integris vel interdum minute spinuliferis, herbaceis, pallide viridibus, utraque facie pallide pilosis; soris parvis superficialibus, indusiis peltatis, laceris, margines versus perpallidis.

VANUA LEVU: Mathuata: Southern slopes of Mt. Numbuiloa, east of Lambasa, alt. 350–500 m., Nov. 3, 1947, *Smith 6484* (TYPE in herb. Univ. Calif.) (on cliffs in thin forest on rocky slope).

ATHYRIUM ACCEDENS (Blume) Milde = **Callipteris prolifera** (Lam.) Bory.

ATHYRIUM JAVANICUM (Blume) Copel. = **Diplaziopsis javanica** (Blume) C. Chr.

ASPLENIUM REMOTUM Moore. As the oldest name of this extremely polymorphic species, Christensen (in Bishop Mus. Bull. 177: 66. 1943) has chosen **Asplenium marattioides** (Brack.) C. Chr. Brackenridge gave it three specific names.

ASPLENIUM ADIANTOIDES (L.) C. Chr. is now known by its most familiar name, **Asplenium falcatum** Lam.

ASPLENIUM GIBBEROSUM (Forst.) Mett. = **Loxoscaphe gibberosum** (Forst.) Moore. *Loxoscaphe foeniculaceum* (Hook.) Moore is more finely dissected.

STENOCHLAENA OLEANDRIFOLIA Brack. = **Lomariopsis oleandrifolia** (Brack.) Mett.

STENOCHLAENA BRACKENRIDGEI (Carr.) Underw. = **Lomariopsis Brackenridgei** Carr.

Orthiopteris Copel. in Bishop Mus. Bull. 59: 14, 66. 1929.

Orthiopteris was described with one important error: the apex of the stem bears small, dark paleae. The later described genus *Ithycaulon* Copel. is therefore not distinct. For discussion see Copeland, Gen. Fil. 49, 50. 1947.

SACCOLOMA MOLUCCANUM (Blume) Mett. = **Orthiopteris minor** (Hook.) Copel.

BALANTIUM STRAMINEUM (Labill.) Diels = **Culcita straminea** (Labill.) Maxon.

I now have on hand 18 Fijian collections representing this species, with a rather firm, entire or lobed or shallowly lacerate indusium. A species distinguished by Brackenridge and Maxon, *C. blepharodes* Maxon, is characterized most definitely by "indusium ample, delicately membranous, long ciliate."

Dennstaedtia intermedia sp. nov.

Fronde teste lectore 2–3 m. alta, stipite metrale; rhachi straminea haud rubescente, inferne glabra fere inerme, superne sulcata breviter sordide furfuracea; pinnis ca. 8-paribus fere oppositis, subsessilibus, infimis maximis 70 cm. vel. ultra longis; pinnulis etiam oppositis, infimis (pinnarum majorum) plus minus reductis, sequentibus usque ad 25 cm. longis, acuminatis, herbaceis, glabris, vix bipinnatis; pinnulis^{ii} usque ad 4 cm. longis, acuminatis; pinnulis^{iii} ala angusta confluentibus, oblongis, incisis, 2 mm. latis; soris parvis (ca. 0.6 mm. latis).

VITI LEVU: Mba: Valley of Nggaliwana Creek, north of the sawmill at Navai, alt. 725–850 m., in dense forest, July 21, 1947, *Smith 5373* (TYPE in herb. Univ. Calif.).

This genus was overlooked in my Ferns of Fiji (Bishop Mus. Bull. 59: 1929), although *Dicksonia incurvata* (miscited by Christensen, in Bishop Mus. Bull. 177: 33. 1943, as *D. involucrata*) had been described from Fiji. This species has since been collected by Degener, no. *14701*, from the vicinity of Nandarivatu, alt. 790–900 m. Christensen (Ind. Fil. Suppl. 3: 70. 1934, and Dansk Bot. Ark. 9, No. 3: 42. 1937) has reduced *D. incurvata* (Baker) C. Chr. to *D. glabrata* (Ces.) C. Chr., but it seems to me to be a related but easily distinguishable species.

Dennstaedtia intermedia is probably the plant referred to by Christensen (in Bishop Mus. Bull. 177: 34. 1943), "which Baker named *Dicksonia moluccana* var. *inermis,* but it is neither *D. moluccana* nor *D. scandens.*" It is intermediate between the group of *D. glabrata* and the body of the genus, being glabrous (except in the groove of the rachis), but without the rough, maroon axes of *D. glabrata.*

SCHIZOLOMA ENSIFOLIUM (Sw.) J. Sm. is certainly no *Schizoloma;* it was better placed when first named, as **Lindsaea ensifolia** Sw.

PTERIS DECUSSATA J. Sm. = **Pteris mertensioides** Willd.

NOTHOLAENA HIRSUTA (Poiret) Desv. is a *Cheilanthes,* apparently best to be known as **Cheilanthes javensis** Moore.

ARTHROPTERIS OBLITERATA (R. Br.) J. Sm., more strictly construed, does not occur in Fiji. The common local plant is **Arthropteris repens** (Brack.) C. Chr. in Bishop Mus. Bull. 177: 48. 1943.

Arthropteris Archboldiae Copel. in Sargentia 1: 3. 1942, from Viti Levu, is an indusiate relative of *A. tenella* (Forst.) J. Sm., of New Zealand, Norfolk Island, and Australia.

LASTREA ARTICULATA Brack. = **Arthropteris articulata** (Brack.) C. Chr.

OLEANDRA WHITMEEI Baker = **Oleandra Sibbaldii** Grev.

HUMATA GAIMARDIANA (Gaud.) J. Sm., as to the Fijian plant, = **Humata Banksii** Alston (in Philip. Jour. Sci. 50: 176. 1933). Typical *H. Gaimardiana,* of the East Indies, is *H. pectinata* (J. Sm.) Desv.

POLYPODIUM ACCEDENS Blume = **Weatherbya accedens** (Blume) Copel. Gen. Fil. 191, *pl. 6.* 1947.

POLYPODIUM BROWNII Wikstr. = **Dictymia Brownii** (Wikstr.) Copel.

POLYPODIUM LINGUAEFORME Mett. = **Microsorium linguaeforme** (Mett.) Copel.

POLYPODIUM PUNCTATUM (L.) Sw. = **Microsorium punctatum** (L.) Copel.

POLYPODIUM PARKSII Copel. = **Microsorium Parksii** (Copel.) Copel. Gen. Fil. 196. 1947.

POLYPODIUM NIGRESCENS Blume = **Microsorium alternifolium** (Willd.) Copel. Gen. Fil. 197. 1947.

POLYPODIUM SCOLOPENDRIA Burm. = **Microsorium Scolopendria** (Burm.) Copel.

POLYPODIUM VITIENSE Baker = **Microsorium sylvaticum** (Brack.) Copel. Gen. Fil. 196. 1947. Still another name for this is *Polypodium polynesicum* C. Chr. (in Bishop Mus. Bull. 177: 116. 1943).

POLYPODIUM WILKESII C. Chr. = **Microsorium alatum** (Brack.) Copel. Gen. Fil. 196. 1947.

CAMPIUM PALUSTRE (Brack.) Copel. = **Bolbitis lonchophora** (Kunze) C. Chr.

CAMPIUM QUOYANUM (Gaud.) Copel. = **Bolbitis quoyana** (Gaud.) Ching.

CAMPIUM RIVULARE (Brack.) Copel. = **Bolbitis rivularis** (Brack.) Ching.

Lomagramma cordipinna Holttum in Gard. Bull. Straits Settlem. 9: 202. 1937.

This is a second species of *Lomagramma* occurring in Fiji, with simply pinnate fronds, the sterile pinnae with obliquely cordate pinnae or the acroscopic side truncate. The type is from Samoa, but Holttum cited *Meebold 16856* from Fiji, and a later collection is *Degener 14565,* from the vicinity of Nandarivatu, Mba, Viti Levu.

From the group of *Elaphoglossum conforme,* Krajina (in Studia Bot. Cech. 1: 63–70. 1938) has described five species from Fiji, as follows:

Elaphogossum vanuaense Krajina, typified by *Smith 675* and also represented by *Smith 454,* both from Thakaundrove, Vanua Levu.

Elaphoglossum Dominii Krajina, typified by a Horne specimen from Ovalau; this seems to be another name for *E. obtusifolium* Brack.

Elaphoglossum ovalauense Krajina, typified by a Brackenridge specimen from Ovalau distributed as *E. obtusifolium.*

Elaphoglossum Milnei Krajina, typified by *Milne 318,* from Viti Levu without precise locality, and also represented by *Horne 808,* from the province of Namosi, Viti Levu.

Elaphoglossum Imthurnii Krajina, typified by *im Thurn 315,* from Nandrau, Province of Nandronga & Navosa [formerly Tholo North], Viti Levu, and also represented by *im Thurn 368,* from southeastern Viti Levu.

HYMENOLEPIS MUCRONATA Fée = **Belvisia mucronata** (Fée) Copel. Gen. Fil. 192. 1947. *Smith 6093,* from northern portion of Rairaimatuku Plateau, Naitasiri, Viti Levu, is aberrant, or it may represent a new species.

POLYPODIUM CONFORME Brack., P. LIGULATUM Baker, P. HIRTELLOIDES Copel., and P. HOOKERI Brack. are all species of **Grammitis.**

POLYPODIUM PURPURASCENS Nad. (Enum. Pl. Indig. Tahiti 26. 1873) = **Ctenopteris purpurascens** (Nad.) comb. nov.

POLYPODIUM BLECHNOIDES (Grev.) Hook., as to all the Fijian specimens at hand, = **Ctenopteris Seemannii** (J. Sm.) comb. nov. (*Cryptosorus Seemannii* J. Sm. in Bonplandia 9: 262. 1861).

PROSAPTIA CONTIGUA Presl, as to the Fijian specimens only, = **Prosaptia pubipes** Copel., an endemic species.

MONOGRAMMA PARADOXA (Fée) Bedd., as to the Fijian specimens, = **Vaginularia angustissima** (Brack.) Mett.

Antrophyum plantagineum (Cav.) Kaulf. *Smith 6279,* from the escarpment north of Nandarivatu, Mba, Viti Levu, is a small plant with short stipes. It may be a distinct species.

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ADDITIONAL NOTES ON THE FIJIAN SPECIES OF PEPEROMIA

T. G. Yuncker

Since my previous publications dealing with the genus *Peperomia* in Fiji,[1] new collections have resulted in the discovery of noteworthy material. Most of the specimens mentioned in the present paper were collected in 1947 by Dr. A. C. Smith,[2] but one new species is based upon a collection by Mr. B. E. V. Parham, of the Department of Agriculture, Suva. It seems advisable at this time to propose a revised key to the species known to occur in Fiji; following this, the recently available material is detailed and three species and three varieties are described as new. Types of novelties are deposited in the herbarium of the Arnold Arboretum, and duplicates of Dr. Smith's collections of *Peperomia* are in the herbarium of DePauw University.

Key to the Fijian Species of Peperomia

Leaves predominantly opposite or verticillate.
  Leaves moderately to densely hirtellous. . . . . *P. leptostachya.*
  Leaves glabrous or at most with only a few hairs.
    Stems with nodal thickenings: leaves 1.2 cm. wide × 3 cm. long. . . . . *P. nodosa.*
    Stems without nodal thickenings: leaves mostly more than 2.5 × 3 cm. . . . . *P. pilostigma.*
Leaves predominantly alternate.
  Spikes sympodial (leaf-opposed).
    Plants glabrous. . . . . *P. flexuosa.*
    Plants densely hirtellous. . . . . *P. vitilevuensis.*
  Spikes axillary and/or terminal.
    Plants obviously and mostly more or less completely hairy.
      Plants mostly 5 cm. or less tall; petioles up to 2–2.5 cm. long. . . . . *P. orbiculimba.*
      Plants much larger; petioles shorter.
        Spikes mostly solitary (not in branching axillary clusters).
          Leaves palmately 3-nerved, oval or obovate.
            Leaves up to 2 × 3.5 cm.; stem densely hairy, the hairs up to 1 mm. long; spikes up to 7 cm. long; peduncle 12 mm. long. . . . . . *P. nandarivatensis.*
            Leaves 1.1 × 1.7 cm.; stem minutely puberulent; spikes up to 1.4 cm. long; peduncle 3 mm. long. . . . . *P. curtispica.*

[1] Bishop Mus. Bull. 141: 25–47. *fig. 8–20.* 1936; Bishop Mus. Occ. Pap. 17: 215–220. *fig. 1–3.* 1943.

[2] Dr. Smith's collections were made under the auspices of the Arnold Arboretum of Harvard University and the John Simon Guggenheim Memorial Foundation, with the aid of grants from the Penrose Fund of the American Philosophical Society and the Bache Fund of the National Academy of Sciences.

Leaves palmately 5-nerved.
Leaf apex acute to narrowly acuminate.
Stem hairs erect. . . . . *P. Parhamii.*
Stem hairs appressed. . . . . *P. vitiana.*
Leaf apex obtuse to acutish; plants appressed-hirsute. . . . . *P. ciliifolia.*
Spikes in branching axillary clusters, occasionally solitary.
Stems long-villous; inflorescence usually of 3 umbellately clustered spikes. . . . . *P. naitasiriensis.*
Stems hirtellous; inflorescence not umbellate. . . . . *P. nandalana.*
Plants essentially glabrous or at most with only a few hairs.
Leaves cordate-ovate; fruit longitudinally ribbed. . . *P. pellucida.*
Leaves and fruit not as above.
Leaves palmately 3–5-nerved, essentially glabrous.
Spikes mostly solitary; leaves not exceeding 4 cm. in length.
Plants suberect, glabrous; leaves briefly attenuate, mostly more than 2.5 cm. long. . . . . *P. Endlicheri* var. *fijiana.*
Plants decumbent, spreading, minutely puberulent; leaves not attenuate, less than 1.5 cm. long. . . . . *P. curtispica.*
Spikes mostly in branching axillary clusters; leaves mostly larger.
Leaves mostly less than 2.5 cm. wide and 3 or more times longer than wide (less in var. *microlimba*) . . . . *P. lasiostigma.*
Leaves up to 4 cm. wide and mostly less than 3 times longer than wide. . . . . *P. kandavuana.*
Leaves mostly plinerved, glabrous or sparingly hairy.
Leaves plinerved within the lowermost 5 mm.
Leaves narrowly and attenuately acuminate, the upper surface glabrous; inflorescence branched and disposed along the stem. . . . . . . *P. attenuata.*
Leaves acute to acuminate, hirtellous along the nerves on the upper surface; inflorescence mostly in the upper leaf axils. . . . . . . *P. flavida.*
Leaves with the main lateral nerves branching off the midrib 5–10 mm. above the base.
Stems with many branches; leaves mostly about twice as long as wide. . . . . *P. Albertiana.*
Stems mostly unbranched; leaves 3–5 times longer than wide. . . . . *P. laevilimba.*

Peperomia leptostachya Hooker & Arnott in Bot. Beechey 96. 1832.

VITI LEVU: Mba: Vicinity of Nalotawa, eastern base of Mt. Evans Range, epiphyte in forest along creek, alt. 550–600 m., *Smith 4433;* northern portion of Mt. Evans Range, between Mt. Vatuyanitu and Mt. Natondra, on boulders in crest thickets, alt. 700–900 m., *Smith 4296.*

VANUA LEVU: Mathuata: Mt. Uluimbau ["The Three Sisters"], south of Lambasa, stems pink to red, on cliffs and boulders on exposed summit, alt. 150–369 m., *Smith 6605.*

This species is widely distributed on the islands of the Pacific area. It is found most commonly on rocks and cliffs at low to moderate altitudes.

Peperomia vitilevuensis sp. nov.

Herba sat parva epiphytica; caule ad 15 cm. alto, conferte hirtulo; foliis alternis, ellipticis, ca. 1.5 cm. latis, 1.5–4 cm. longis, apice truncato-acutis, basi acutis, utrinque puberulis, ciliolatis, palmatim 3–5-nerviis; petiolo 3–5 mm. longo, hirtulo; spicis oppositifoliis; pedunculo gracili, 3–5 mm. longo, hirtulo; drupa globosa, stigmate subapicali.

A rather small, epiphytic herb; stem up to 15 cm. tall, branching, suberect, 2 mm. thick at the base when dry, densely hirtellous, the internodes mostly 10–15 mm. long; leaves alternate, elliptic, mostly 1.2–1.8 cm. wide × 1.5–4 cm. long, the apex bluntly acute, the base acute, puberulent on both sides, ciliolate, palmately 3–5-nerved, the nerves branched upward, moderately dark-glandular dotted, drying membranous, translucent; petiole about 5 mm. long, hirtellous; spikes leaf-opposed, 1 mm. thick × 15–20 mm. long, moderately to loosely flowered; peduncle slender, 3–5 mm. long, hirtellous; rachis glabrous; bracts round-peltate; drupe globose, about 0.5 mm. long, the apex oblique, the stigma slightly subapical.

VITI LEVU: Mba [formerly Tholo North]: Summit of Mt. Nanggaranambuluta [Lomalangi], east of Nandarivatu, epiphyte in dense forest, alt. 1100–1120 m., June 23, 1947, *Smith 4862* (TYPE, in Arnold Arb. herbarium). Ra [formerly Tholo North]: Ridge from Mt. Namama (east of Nandarivatu) toward Mt. Tomanivi [Mt. Victoria], stem and leaves frequently reddish-mottled, epiphyte in dense forest, alt. 1050–1120 m., *Smith 5711.*

The comparatively small, densely hirtellous plants, and especially the sympodial spikes distinguish this species. From *P. flexuosa,* which also has leaf-opposed spikes, it differs because of its densely hirtellous stems.

Peperomia orbiculimba Yuncker var. **mathuataensis** var. nov.

Foliis orbicularibus vel elliptico-obovatis, 1–2.5 cm. latis, 1–3 cm. longis, apice rotundatis, obtusis, basi obtusis vel acutis; petiolo gracili, ad 6 cm. longo (pro more 1–2.5 cm.); pedunculo ad 2 cm. long.

Leaves from orbicular to elliptic-obovate, 1–2.5 cm. wide × 1–3 cm. long, the apex rounded, the base obtuse to acute; petioles slender, mostly 1–2.5 cm. or rarely up to 6 cm. long; peduncle up to 2 cm. long.

VANUA LEVU: Mathuata: Southern base of Mathuata Range, north of Natua, on rocky banks along stream in dense forest, alt. 100–250 m., Dec. 4, 1947, *Smith 6859* (TYPE, in Arnold Arb. herbarium); southern slopes of Mt. Numbuiloa, east of Lambasa, leaf-blades reddish purple beneath, on cliffs in steep open forest, alt. 350–500 m., *Smith 6569.*

There is great variation in the size and shape of the leaves on the specimens included here. The leaves on the type specimen of the species, collected near Levuka on Ovalau, are only about 1 cm. long and orbicular or nearly so. Some leaves on the type specimen of this variety resemble those of the species but most of them are much larger and somewhat obovate while those on no. *6569* are mostly elliptic-obovate. All agree, however, in being small plants with villous stems and leaves, and in having long, slender petioles and peduncles, and somewhat pointed fruits.

Peperomia nandarivatensis Yuncker in Bishop Mus. Occ. Pap. 17: 216, *fig. 1.* 1943.

VITI LEVU: Mba [formerly Nandi]: Upper slopes of Mt. Koromba [Pickering Peak], on boulders in dense forest, alt. 800–1075 m., *Smith 4670.*

Peperomia curtispica C. DC. in Jour. Linn. Soc. 39: 166. 1909.

VITI LEVU: Mba [formerly Tholo North]: Summit of Mt. Nanggaranambuluta [Lomalangi], east of Nandarivatu, epiphyte in dense forest, alt. 1100–1120 m., *Smith 4861;* hills east of Nandala Creek, about 3 miles south of Nandarivatu, epiphyte in dense mossy forest on ridge, alt. 850–970 m., *Smith 5948.* Nandronga & Navosa [formerly Tholo North]: Northern portion of Rairaimatuku Plateau, between Nandrau and Nanga, epiphyte in dense forest, alt. 725–825 m., *Smith 5515.* Ra [formerly Tholo North]: Ridge from Mt. Namama (east of Nandarivatu) toward Mt. Tomanivi [Mt. Victoria], epiphyte in dense forest, alt. 1050–1120 m., *Smith 5710.* Naitasiri [formerly Tholo North]: Northern portion of Rairaimatuku Plateau, between Mt. Tomanivi [Mt. Victoria] and Nasonggo, nodes deep red, epiphyte in dense forest, alt. 870–970 m., *Smith 5772.*

This is a small, decumbent, epiphytic species rather common in densely forested areas. Considerable variation is shown in the size and shape of the leaves on individual plants.

Peperomia Parhamii sp. nov.

Herba epiphytica statura modica erecta vel suberecta; caulis conferte hirtulis; foliis alternis vel infimis oppositis vel verticillatis, ellipticis, elliptico-lanceolatis vel subobovatis, infimis obovatis, apice angustatis acutis vel infimis obtusis, palmatim 5-nerviis, utrinque hirtulis (ad venas saltem); petiolo 3–10 mm. longo, conferte hirtulo; spicis terminalibus et axillaribus; pedunculo dissite hirtulo; ovario ovoideo, apice obliquo, stigmate subapicali.

A moderate-sized erect or suberect epiphytic herb: stem succulent, 5 mm. thick when dry, up to 30 cm. or more tall, strongly branched upward, densely hirtellous, hairs erect, the internodes 1 cm. long above, up to 4 cm. downward; leaves alternate or those on the lower nodes opposite or whorled, the upper leaves elliptic, lance-elliptic or subobovate, the lower whorled leaves obovate, quite variable in size, the upper leaves about 1.2 cm. wide × 2.5 cm. long, the lower leaves up to 2–2.5 cm. wide × 3–4 cm. long, the apex narrowed, acute, or lower obovate leaves scarcely pointed and obtuse, palmately 5-nerved, hirtellous on both sides, especially along the nerves, dark above, paler and strongly dark-glandular-dotted beneath, ciliolate above the middle, drying rather thin, translucent; petioles mostly 3–5 mm. long above, up to 1 cm. on the larger lower leaves, densely hirtellous; spikes axillary and terminal, moderately flowered, 1 mm. thick

$\times$ 3 cm. long; peduncle about 5 mm. long, loosely hirtellous; bracts round-peltate; ovary ovoid, the apex oblique, the stigma subapical; fruit not present.

VITI LEVU: Namosi: Korombasambasanga Mt., alt. 1050 m., Mar. 24, 1940, *B. E. Parham 2187* (TYPE, in Arnold Arb. herbarium).

This species resembles *P. nandarivatensis* to some extent but differs because of the larger size of the plants, shorter pubescence, leaf shape and pubescence, shorter peduncles, etc. From *P. vitiana* it differs in the size and shape of the leaves and the character of the pubescence.

Peperomia naitasiriensis sp. nov.

Herba epiphytica; ramis e basi decumbente radicante ad 35 cm. vel ultra sat conferte albo-villosis, pilis ad 1 mm. vel ultra longis erectis; foliis alternis distichis ellipticis vel elliptico-lanceolatis, apice acutis acuminatis, basi acutis, utrinque dissite villosis, palmatim 5-nerviis; petiolo conferte villoso; inflorescentia umbellata; spicis 5–10 mm. longis; pedunculo gracili glabro vel dissite villoso.

An epiphytic herb, branching from the rooting, decumbent base, the branches simple, virgate, 3 mm. thick at the base when dry, up to 35 cm. or more long, rather densely white-villous, the hairs erect, up to 1 mm. or more long, the internodes about 1 cm. long; leaves alternate, distichous, elliptic or lance-elliptic, 1–1.4 cm. wide $\times$ 3–4.5 cm. long, gradually reduced upward, the apex acute to acuminate, the base acute, loosely villous on both sides, ciliate, palmately 5-nerved, the lateral nerves slender, dark above, pale beneath, drying thin and membranous; petiole 2–3 mm. long, densely villous; spikes as yet young, scarcely 1 mm. thick $\times$ 5–10 mm. long, moderately flowered, mostly in umbellate clusters of three, subtended by a lanceolate bract with an apical tuft of hairs, on slender, axillary, loosely villous stalks about 3 mm. long, or uppermost spikes may be solitary; peduncle slender, up to 5 mm. long, glabrous or sparsely villous; bracts round-peltate; ovary turbinate (?), the stigma apical (?); fruit not present.

VITI LEVU: Naitasiri [formerly Tholo North]: Northern portion of Rairaimatuku Plateau, between Mt. Tomanivi [Mt. Victoria] and Nasonggo, apparently rare and seen only once, stems and lower leaf-surfaces reddish-tinged, epiphyte in dense forest, alt. 870–970 m., Sept. 18, 1947, *Smith 6144* (TYPE, unicate in Arnold Arb. herbarium).

The long-villous stems and leaves and the umbellate inflorescence distinguish this species from other known Fijian species.

Peperomia nandalana Yuncker var. **nudipeduncula** var. nov.

Foliis ellipticis, obovato-ellipticis rhombeisve, ca. 1.5 cm. latis, 2.5–4 cm. longis, apice acutis vel subobtusis, basi acutis, utrinque sat crispo-puberulis; spicis 5–10 mm. longis; pedunculo glabro.

Leaves elliptic or elliptic-obovate or rhomboidal, 1.2–1.7 cm. wide $\times$ 2.5–4 cm. long, the apex acute or obtusish, the base acute, moderately to sparingly crisp-puberulent on both sides; spikes 1 mm. thick $\times$ 5–10 mm. long; peduncle glabrous.

VANUA LEVU: Mathuata: Southern base of Mathuata Range, north of Natua, on rocky banks along stream in dense forest, alt. 100–250 m., Dec. 4, 1947, *Smith 6862* (TYPE, in Arnold Arb. herbarium).

This variety resembles the species in many respects but differs because of the smaller size of the plants, shape and size of the leaves, and glabrous peduncles. It differs from *P. vitiana* because of the erect stem hairs, less pointed leaves and shorter spikes which are commonly multiple on axillary stalks.

Peperomia lasiostigma C. DC. in Jour. Linn. Soc. **39**: 165. 1909.

VITI LEVU: Mba [formerly Tholo North]: Hills between Nggaliwana and Nandala Creeks, south of Nauwanga, nodes deep red, internodes green or sometimes reddish-flecked, on trees and boulders in dense forest, alt. 725–850 m., *Smith 5810;* hills between Nandala and Nukunuku Creeks, along trail from Nandarivatu toward Lewa, nodes purplish, internodes reddish-tinged, spikes dull red, epiphyte in dense forest, alt. 750–850 m., *Smith 6191;* slopes of the escarpment north of Nandarivatu, nodes purplish, spikes red-tinged, on rocks in woods along stream, alt. 550–800 m., *Smith 6266* (some leaves and parts of the stems are minutely hirtellous); valley of Nggaliwana Creek, north of the sawmill at Navai, nodes and spikes red, internodes and petioles red-tinged, epiphyte in dense forest, alt. 725–850 m., *Smith 5347;* western and southern slopes of Mt. Tomanivi [Mt. Victoria], branches reddish, epiphyte in dense forest, alt. 850–1150 m., *Smith 5268;* summit of Mt. Tomanivi [Mt. Victoria], branches pale green with faint red longitudinal stripes, epiphyte in dense mossy forest, alt. 1290–1323 m., *Smith 5197;* western slopes of Mt. Nanggaranambuluta [Lomalangi], east of Nandarivatu, nodes dull red, internodes, leaves, and spikes green, sometimes reddish-tinged, epiphyte in dense forest, alt. 850–1000 m., *Smith 6306a;* same locality, alt. 1000–1100 m., *Smith 4896;* eastern slopes of Mt. Koroyanitu, Mt. Evans Range, epiphyte in dense low forest, alt. 950–1050 m., *Smith 4145.* Mba [formerly Nandi]: Upper slopes of Mt. Koromba [Pickering Peak], on rocks in dense forest at crest, alt. 800–1075 m., *Smith 4699.* Nandronga & Navosa [formerly Tholo North]: Northern portion of Rairaimatuku Plateau, between Nandrau and Rewasau, nodes swollen, deep red, epiphyte in dense forest, alt. 725–825 m., *Smith 5596.* Naitasiri [formerly Tholo North]: Northern portion of Rairaimatuku Plateau, between Mt. Tomanivi [Mt. Victoria] and Nasonggo, nodes, internodes and sometimes lower leaf-surfaces reddish-streaked, epiphyte in dense forest, alt. 870–970 m., *Smith 5773, 6107.*

Peperomia lasiostigma var. carnosa (C. DC.) Yuncker in Bishop Mus. Bull. **141**: 36. 1936.

VITI LEVU: Ra [formerly Tholo North]: Ridge from Mt. Namama (east of Nandarivatu) toward Mt. Tomanivi [Mt. Victoria], stems often deep red, up to 1 cm. diameter near the base, epiphyte in dense forest, alt. 1050–1120 m., *Smith 5720.* Mba [formerly Tholo North]: Ridge between Mt. Nanggaranambuluta [Lomalangi] and Mt. Namama, east of Nandarivatu, stems reddish, epiphyte in dense forest, alt. 1050–1120 m., *Smith 4985;* western slopes of Mt. Nanggaranambuluta [Lomalangi], east of Nandarivatu, nodes dull red, internodes, leaves, and spikes green, sometimes reddish-tinged, epiphyte in dense forest, alt. 850–1000 m., *Smith 6306;* summit of Mt. Tomanivi [Mt. Victoria], stems and branches deep red, succulent, epiphyte in dense mossy forest, alt. 1290–1323 m., *Smith 5148.*

There is some question whether the specimens listed above as variety *carnosa* are identical with the original *P. carnosa* C. DC. or not. They appear to agree sufficiently well with the original description and a photograph of the type, however, to warrant placing them here, at least questionably.

Peperomia lasiostigma var. **tomaniviensis** var. nov.

Herba divaricatim ramosa; caule ad 40 cm. adscendente; foliis ellipticis vel inferis elliptico-subobovatis, 1–1.5 cm. latis, 2.5–3 cm. longis, apice abrupte brevi-acutis; petiolo gracili, ca. 5 mm. longo.

Stems divaricately branched upward, up to 30 cm. tall; leaves elliptic or lower leaves elliptic-subobovate, 1–1.5 cm. wide × 2.5–3 cm. long, the apex abruptly short-acute; petioles slender, about 5 mm. long.

VITI LEVU: Mba [formerly Tholo North]: Western and southern slopes of Mt. Tomanivi [Mt. Victoria], epiphyte in dense forest, alt. 850–1150 m., July 7, 1947, *Smith 5114* (TYPE, Arnold Arb. herbarium); hills east of Nandala Creek, about 3 miles south of Nandarivatu, epiphyte in dense forest, alt. 850–970 m., *Smith 6242.*

These specimens resemble *P. lasiostigma* in being glabrous and having axillary, compound inflorescences. They differ because of the shape and smaller size of the leaves and more slender petioles. The stems are also more erect and more widely branched upward.

Peperomia kandavuana Yuncker in Bishop Mus. Bull. **141**: 39, *fig. 15.* 1936.

VITI LEVU: Mba [formerly Tholo North]: Hills between Nggaliwana and Tumbeindreketi Creeks, east of the sawmill at Navai, internodes pinkish, nodes purplish red, young spikes reddish, on humus-covered boulders in dense forest, alt. 725–800 m., *Smith 5885.* Naitasiri [formerly Tholo North]: Northern portion of Rairaimatuku Plateau, between Mt. Tomanivi [Mt. Victoria] and Nasonggo, internodes green, nodes deep red, epiphyte in dense forest, alt. 870–970 m., *Smith 5782.*

The fruit on the type specimen of this species is well developed with the stigma appearing to be nearly apical. The fruit on no. *5885* is immature but the ovaries show an oblique apex with the stigma somewhat subapical. No other difference has been noted, however, and it is believed that it is the same as this species.

DEPT. OF BOTANY,
DEPAUW UNIVERSITY.

THE ARNOLD ARBORETUM DURING THE FISCAL YEAR ENDED JUNE 30, 1949

Horticulture. — The Arnold Arboretum plantings have been kept in good condition during the past year. Extensive pruning work has been done and weed trees and shrubs have been removed on the South Street bank in the juniper and yew collections. Commercial fertilizer was applied to the collections of magnolias, Japanese maples, elms, euonymus, sorbus, rhododendrons, and to the shrub collection. Mulching of trees and shrubs with hops has been continued, and has been very effective in promoting growth, suppressing weeds and preventing grass fires from killing shrubs and small trees. The control of grass growth by constant mowing with the "blitzer" has also reduced fire hazards and improved the appearance of the grounds. Various weed killers, Solvasol, Ammate, Esteron 44, and Dow 2-4-5 T have been used in an effort to eliminate poison ivy and shrubby weeds, and to control weeds in the cultivated areas.

Two of the major projects supported by funds from the Friends of the Arnold Arboretum are nearly completed. More than three hundred azaleas and other ericaceous shrubs have been planted in the new border along the Meadow Road. Several hundred ground cover plants were planted in adjacent areas.

The vine collection has been moved to the Arborway wall, and the unsightly trellis in the shrub collection has been removed. A new tree peony collection was planted near the Wisteria arbor, and includes thirty varieties not previously grown in the Arboretum.

The rehabilitation of the Peters Hill area, made possible by contributions from John Ames, is progressing satisfactorily. More than two thousand superfluous or decrepit trees have been removed, and the small shrubs and seedlings were sprayed with weed killers. A soil improvement program was started to insure an adequate sod cover which would prevent erosion and excessive invasion of weed trees. The hiring of heavy equipment for much of this work was necessary and the cost has been excessive. Other methods will be used on the alternate contour strips. We hope to establish a good grass cover and begin a planting program in 1950.

A number of surplus plants were given to Harvard University and Radcliffe College, and several truck loads of surplus nursery stock were given to the Massachusetts State Hospital for Crippled Children. More than 60 plants of new varieties originating in the Arnold Arboretum were distributed to cooperating nurserymen. Plants, and seeds of woody plants have been received from nurserymen and from botanic gardens.

The Case estates in Weston have been of great value in our nursery trials, testing plots, and for permanent nurseries of surplus stock. Various types of horticultural experiments are conducted here. About seven acres are devoted to a forest tree test plot under the auspices of the Cabot Foundation. The Weston Garden Club did the major work in maintaining the perennial garden, and distributed the flowers to the Veterans' and the Waltham Hospitals. The Division of Landscape Architecture continues to use some of the Case land for demonstration work.

The bulletin of popular information, "Arnoldia" was continued as usual. A new Guide, "Through the Arnold Arboretum" was written, and five thousand copies were printed. Dr. Wyman's new book, "Shrubs and Vines for American Gardens" was published by the Macmillan Company in May 1949. The field class held in the fall attracted thirty-five members, while the spring class held on Saturday mornings drew about thirty students.

Several hundred apple and cherry hybrids have been grown and are now in test plots. Several of the new apple hybrids selected for further trial have been found to be apomictic and breed true from seed. New triploid forsythia hybrids appear to be very promising. Few of the rose hybrids have been of value. Work on dwarfing rootstocks is being continued.

Comparative Morphology. — Professor Bailey and his co-workers have continued their investigations of the comparative morphology of various dicotyledonous families. Carefully preserved material of *Austrobaileya* collected by Mr. L. J. Brass and Mr. S. E. Stephens in Queensland enabled Professor Bailey and Dr. Swamy to make a thorough study of this phylogenetically significant genus. Its secondary phloem is remarkable in being composed of sieve cells and phloem parenchyma strands, and in having *no companion cells.* Its nodal anatomy is of an unusual type resembling that which occurs in *Trimenia* and *Piptocalyx* of the Monimiaceae. Its summation of vegetative and floral characters indicates that it is closely related to, if not actually a member of this family. Dr. Swamy has found two vesselless representatives of the Chloranthaceae. These plants, together with *Amborella* described earlier in the year, raise the number of surviving primitive, vesselless, dicotyledonous genera to ten in five families. It is evident that considerable floral diversification in dicotyledons occurred before the evolution of vessels in the xylem.

The Herbarium. — During the past year 11,282 specimens were mounted and added to the herbarium. The organized herbarium now contains 645,770 mounted specimens.

Accessions during the fiscal year numbered 46,111 specimens, of which 15,545 came in exchange, 25,016 through purchase or subsidy, 3429 by gifts, and 2121 in return for identification. Most of this material comes from southeastern Asia and the Pacific area, or more precisely from continental Asia (10,629 specimens), northern Australia (12,295 specimens), and Polynesia, Micronesia, and Malaysia (10,708 specimens). It very greatly enriches the superb facilities for botanical research on the Pacific and Asiatic floras already available at the Arboretum. Among the more important individual accessions are the 11,928 specimens from northern Australia made by L. J. Brass on the 1948 Richard Archbold Expedition to Cape York; 2233 plants of Hosokawa collections in Micronesia received through Dr. H. L. Li from the National Taiwan University; 1338 photographs of types and other critical specimens in Formosan herbaria obtained through the courtesy of Prof. Ying Tsiang; 1200 of Mrs. Clemens' collections from Papua received from the Botanical Museum, Berlin-Dahlem; 1447 chiefly classic Malaysian collections received from the Rijksherbarium, Leiden, and 2115 photographs of South American types received from the Chicago Museum of Natural History. Some other important accessions are 2784 Polynesian plants from the Bernice P. Bishop Museum, Honolulu; 2985 plants of Yunnan from the Fan Memorial Institute, Peiping; and 650 plants of Szechuan from the University of Chengtu, Szechuan.

A total of 30,591 specimens were sent out from the herbarium during the year, of which nearly half (6684 mounted and 6992 unmounted specimens) consisted of American tropical material transferred to the Gray Herbarium. In exchange, 2892 specimens were sent to American and 6932 to foreign institutions.

The Arboretum received thirty-five requests for the loan of its herbarium material. Of these twenty-six came from a total of 14 American institutions and nine from six foreign botanical establishments. A total of 7031 specimens was involved. For the use of the Arboretum staff 6776 specimens were borrowed from other institutions, constituting seventeen loans from seven American and twelve loans from seven foreign institutions.

Professor Rehder completed the proof reading for his monumental "Bibliography of Cultivated Trees and Shrubs," which was finally printed and issued in the closing fortnight of the fiscal year. The work represents about ten years of bibliographic research and will long remain an indispensable tool in horticultural and herbarium taxonomy.

Dr. Merrill completed the final proof reading of his definitive catalogue of the botanical work of Rafinesque. With his work on this large project finished, he turned to herbarium studies, and especially to the organization and identification of large collections recently received from the Philippines. Dr. Johnston worked on West Indian and Central American Boraginaceae and prepared an account of the family for the "Flora of Trinidad and Tobago." Dr. Kobuski has progressed in his studies of the Theaceae despite very heavy editorial duties. Dr. Perry has organized the very large collections made by Brass on Cape York and now has readied for distribution many of the named duplicates now on hand from New Guinea.

Overshadowing in importance all other activities of the herbarium staff has been the formulation of final plans for the new building in Cambridge which is to house the combined herbaria and libraries of the Arnold Arboretum and the Gray Herbarium. Dr. Johnston, Dr. Kobuski, and Mrs. Schwarten have been particularly active in this project. Their routine work has tended more and more to be directed towards readying the herbarium and library for the anticipated move to Cambridge.

Two members of the herbarium staff resigned during the fiscal year. Dr. Allen left in August 1948 because of illness in her family. Dr. Smith terminated his appointment in September to assume a curatorial post at the U. S. National Museum.

The Library. — During the fiscal year ended June 30, 1949, 267 bound volumes were added to the library, bringing the total up to 47,033; 207 pamphlets were catalogued and filed, bringing that total to 14,355. Five hundred and thirty catalogue cards were added to the main catalogue; 4,885 to the Gray Herbarium new species cards. A shelf list was made for the monograph section of the library.

The monographs have been reclassified and rearranged according to the Dalla Torre & Harms system, thus enabling taxonomists to find the necessary work filed under the same number as the herbarium specimen is filed in the herbarium.

A high school student has worked in the library after school hours and on Saturdays, dusting the books and shelves with a vacuum cleaner. Minor book repairs were made at this time; major ones going to the bindery (some seventy volumes were restored or repaired by the binder).

The photograph collection has been enriched by about 275 pictures taken in the Arnold Arboretum by the Horticulturist and his assistant.

Inter-library loans have been about the same as in previous years; numerous requests for typed descriptions, microfilms and photostats, as well as prints from our collection of Microfilms of war-lost German periodicals.

Financial report. — The Arnold Arboretum received during the year $3,333.33 from the Georgiana Wells Sargent bequest, $63,198.45 from the Louisa W. Case estate, and $1,379.78 from the Marian R. Case estate. These funds were added to endowment. Gifts for current use included $8,969.00 from the Friends of the Arnold Arboretum, $340.00 for the Rafinesque Publication Fund, $2,000.00 for the Chinese Exploration Fund, and $100.00 for special travel funds.

The total income for the year was $179,328.41 and total expenditures were $193,897.28. The apparent deficit was due to the fact that special grants for horticulture and publications built up in former years were drawn on heavily during the past year.

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KARL SAX,
Director

Staff of the Arnold Arboretum

1948—49

KARL SAX, S.D., Professor of Botany and Director.

IVAN MURRAY JOHNSTON, Ph.D., Associate Professor of Botany and Associate Director. Supervisor of the Library and Herbarium.

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* Deceased, May 20, 1949.

† Deceased, July 21, 1949.

INDEX