

MATERIALS FOR A MONOGRAPH OF THE MELIACEAE¹⁾

I. A REVISION OF THE GENUS VAVAEA

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SUMMARY

Of the genus *Vavaea*, occurring from Sumatra to Fiji, 356 collections were studied for taxonomical purpose, some collected in spirit by the author himself. Pollen (31 collections) and wood (12 collections) were also studied.

Sex dimorphism occurs in *V. amicorum*, three sorts of plants being distinguished.

The systematic position within *Meliaceae* comes in the *Melioideae*, between tribes *Turraeae* and *Trichilieae*, more closely related to the latter.

Within *Vavaea* two sections are distinguished, one of which is new.

Four species are distinguished, among which is one new species, *V. tubiflora*, from New Guinea.

A detailed study revealed that one of them, the type species *V. amicorum*, is an extremely polymorphic species with about 20 synonyms; a special chapter is dedicated to explain this variation pattern.

A key to the species, descriptions of genus and species, and an enumeration of specimens is given.

INTRODUCTION

Vavaea was described by Bentham in 1843 and based on *V. amicorum*, a species collected in Tonga by Barclay. More than fifty years later, at the turn of the century, the genus was still thought to be confined to a few islands in the South Pacific, but in the meantime three additional species, *V. harveyi* Seem., *V. vitiensis* Seem., and *V. megaphylla* Wright, had been described from the Fiji Islands.

After this date, the known range of *Vavaea* was rapidly extended westwards. In 1898 Bailey described *V. papuana* from New Guinea, in 1902 Volkens described *V. pauciflora* from the Caroline Islands, and in 1914 Koorders and Merrill referred a previously described species of *Vitex* (*V. bantamensis*) from Java to this genus. Sumatra represents the westernmost limit of the known range of *Vavaea* and since 1914 various species have been recorded or described from most of the larger islands lying between it and Fiji.

Six species have been described from the Philippines and seven (including *V. papuana*) from New Guinea. Other species have been described from the Solomon Islands and the New Hebrides. Although *Vavaea* was collected in Australia by Robert Brown as early as 1804, the first published record was in Merrill's 'Plant Life of the Pacific World' (1945). The species referred to was later described as *V. australiana* by Blake in 1954.

In all, 26 species have been described and most of their names are in current use. The differences separating many species are slight and previous workers (e.g. Harms, 1940) have suggested that some reduction may be necessary. No comprehensive, critical study has previously been made, although A. C. Smith (1952) has published a study of the

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genus in Fiji and Tonga. Van Steenis has discussed the distribution of the genus (1952) and van Balgooy has mapped it (in van Steenis en van Balgooy, 1966).

This investigation is based on the study of 356 collections of *Vavaea* from all parts of its range. While on a collecting trip in the Far East, I was able to study in the field three of the four species that I recognize, namely *V. amicorum*, *V. megaphylla*, and *V. tubiflora*.

The fruit of *Vavaea* is a fleshy or sometimes leathery berry which can be adequately studied only when fresh or preserved in spirit. At the outset of this investigation no fresh or spirit material was available, but during my own fieldwork in South East Asia and the Pacific, and since then through the co-operation of botanists in New Guinea and Fiji, I have assembled a good collection of *Vavaea* fruit in spirit.

12 different wood collections have been examined from material collected in Borneo, New Guinea, the Solomon Islands, and Fiji, representing *V. amicorum*, *V. megaphylla*, and *V. tubiflora*. All collections except one are correlated with herbarium specimens. Microscope slides were prepared from each collection, 6 from each of 5 Fijian collections, so that individual variation could be studied, and one only from each of the remainder. The terms used to describe the secondary xylem are to be found in the International Glossary of Terms used in Wood Anatomy (Tropical Woods 107, 1957, 1—36) except for the ray types which are described by Kribs (1950).

Pollen preparations were made from 31 collections representing all species of the genus and all parts of its range. This formed part of a more comprehensive study in the course of which the pollen grains of a further 190 species of *Meliaceae*, representing the majority of the genera, were examined. The pollen grains were prepared by the usual acetolysis method (Faegri and Iversen, 1964); the terminology used is that of Erdtman (1952), in some cases slightly modified (Erdtman, personal communication).

The field characteristics of bark and wood are not often recorded, but the information available suggests they are uniform throughout the genus. The bark is smooth or occasionally with minute cracks, rarely peeling in small scales, pale greyish-brown in colour and with conspicuous lenticels. The twigs are also generally lenticellate. The inner bark and sapwood are dirty white or cream and there is no coloured exudate. The heartwood is similar to the sapwood in colour and is often highly scented. In Sabah where it is known as incense wood, it is used for rubbing the bodies of the dead before burial, and in the Caroline Islands the dried wood is burnt as incense. In the Fiji Islands, *V. amicorum* is known as 'false sandalwood' on account of its fragrance. It is used locally in Fiji for house posts, but is otherwise of no commercial importance (Smith, 1952).

The flowers of *Vavaea* are generally white or yellow, with the staminal tube tinged purple, and frequently heavily scented. *V. tubiflora* is not scented by day, and the structure of the long tubular flowers of this species and *V. papuana* suggest that nightflying moths effect pollination but no observations confirming this have been recorded. The pollinating agents of *V. amicorum* and *V. megaphylla* are also unknown.

Asa Gray (1855) first discussed sex dimorphism in *Vavaea* and suggested that anther number and shape in *V. amicorum* differs according to sex. It has been possible partially to confirm these conclusions. My own observations can be summarised as follows.

1) Some flowers are functionally female, having anthers which are narrow, rather shrunken, and without good pollen.

2) Some plants appear to be entirely female; in these the inflorescence may be reduced to a few flowers, containing fewer sterile or at least non-functional anthers (10—12) than hermaphrodite flowers.

3) Other plants bear flowers with dehiscent anthers and young fruit on the same inflorescence. The ovary is well developed in these flowers and they are probably hermaphrodite.

The above remarks apply to *V. amicorum* only. There is no evidence of sex dimorphism in the remaining species which appear to have hermaphrodite flowers.

THE POSITION OF VAVAEA IN THE MELIACEAE

In external appearance *Vavaea* does not look like other *Meliaceae*, chiefly because of its dense terminal clusters of simple leaves and its sympodial (*Terminalia*) branching, so-called because of its frequency in the genus *Terminalia*. It is characterised by lateral twigs that grow out horizontally from the main stems and then turn up at the end. This turning up is accompanied by a decrease in growth rate and shortening of the internodes. This manner of growth gives rise to a horizontal twig with long internodes and few leaves, terminated by a short vertical twig with a dense rosette of leaves. Further elongation of this twig soon stops and another axillary shoot is then produced at the bend, which grows out horizontally producing in a similar way another terminal rosette of leaves by shortening of the internodes. In this way a succession of rosettes is formed, linked by horizontal, slender, and largely leafless twigs. This character is not always easy to see in herbarium specimens, particularly if they are small, but it appears to be present in all species of *Vavaea* and is unknown elsewhere in the *Meliaceae*.

Some time elapsed after its discovery before it was generally agreed that *Vavaea* correctly belongs to the *Meliaceae*. Three species were originally described in other families: *V. bantamensis* in *Verbenaceae* (*Vitex*), *V. lamii* in *Rutaceae* (as *Lamiofrutex papuanus*), and a synonym of *V. megaphylla* in *Euphorbiaceae* (*Trigonostemon voratus* Croizat). Bentham considered *Vavaea* to be allied to *Ixonanthes* (*Linaceae*) which at that time was placed doubtfully after *Cedrelaceae*. Other nineteenth century authors (e.g. Endlicher, 1843) assigned it to *Cedrelaceae* at that time kept separate from *Meliaceae*, or (e.g. Roemer, 1846) placed it there with some doubt.

In 1855 Asa Gray published a most instructive paper entitled 'On the affinities of the Genus *Vavaea* Benth.' On the basis of material collected by the U.S. Exploring Expedition in Fiji and Tonga, he assigned it to the *Meliaceae*. Within the family he placed it in the *Trichilieae* on account of the exalbuminous embryo. Among much interesting information, he noted that the number of stamens varies from 10—15, and sometimes to 20; this he attributed to sex differences, the female flower having fewer anthers which are smaller and contain little good pollen, one of the first recorded observations of sex dimorphism in the family.

Authors subsequent to Asa Gray have retained *Vavaea* in the *Meliaceae*, though they have differed as to its exact relationships within the family. Hooker (1862) transferred it to the tribe *Melieae*, where he placed it next to *Turraea*, presumably on account of its simple leaves. Baillon (1874), who expressed unorthodox views about the status of several *Meliaceous* genera, reduced it to synonymy with *Quivisia*, a Madagascan genus, which he placed in the tribe *Melieae*. C. de Candolle (1878) reinstated *Vavaea* and placed it between *Ekebergia* and *Trichilia* in the *Trichilieae*. Harms, in his first account of the family (1896) was the first to recognise that *Vavaea* has no close relation in the family and assigned it to its own tribe, the *Vavaeae*, in the subfamily *Melioideae*, giving it a rank equal to the *Turraeae*, *Melieae*, and *Trichilieae*. He maintained this opinion in the second edition of his work (1940).

My own study of the secondary xylem and the pollen grain confirms that *Vavaea* belongs to the *Meliaceae* but occupies an isolated position within it.

All the important characters of the secondary xylem of *Vavaea* are found individually

elsewhere in the family, but it possesses a distinctive combination of characters enabling it to be easily distinguished from all other genera. These are:

- 1) a high proportion of solitary vessels;
- 2) very heterogeneous ray tissue (Kribs Type 1, 2, and 3);
- 3) septate or partially septate fibres.¹

In wood anatomy *Vavaea* resembles *Sandoricum* most closely, sharing with this genus the predominantly solitary vessels and very heterogeneous ray tissue. It differs, however, in having narrower rays and septate fibres.

The majority of *Meliaceae* have 4-colporate pollen grains, but *Vavaea*, together with *Aglaia*, *Sandoricum*, and certain species of a few other genera, differs in having 3-colporate grains. The pollen grains of *Aglaia* and some species of *Trichilia* are similar in shape to those of *V. amicum* and *V. megaphylla*, but much smaller. Those of *Sandoricum* are similar to these species in being 3-colporate and of similar dimensions. The pollen grains of *V. papuana* and *V. tubiflora* are much larger and differ from all others in the *Meliaceae* in being zonorate.

Vavaea possesses most of the individual morphological, anatomical, and palynological features of the subfamily *Melioidae* and clearly belongs there but is nevertheless rather isolated within it. Its best position appears to be between the tribes *Turraeeae* and *Trichilieae* but it is more closely related to the latter. It shares the simple leaves of the *Turraeeae*, but has the baccate fruit, seed with sarcotesta, and embryo structure of some *Trichilieae*. The poorly developed disk of *Vavaea* is shared by both these tribes.

The sympodial 'Terminalia' branching and partially fused filaments lacking terminal appendages immediately set it apart from both these tribes and from the remainder of the *Melioidae*. The features of the secondary xylem and pollen grain as outlined above, also confirm this isolation.

THE SECTIONS OF VAVAEA

The two large-flowered species *V. papuana* and *V. tubiflora* (section *Grandiflorae*) differ from *V. amicum* and *V. megaphylla* (section *Vavaea*) in a number of mainly quantitative characters. Their flowers are considerably larger; their anthers more numerous and are long and slender whereas those of *V. amicum* and *V. megaphylla* are nearly always ovoid or subspherical; their loculi are multiovulate whereas those of *V. amicum* and *V. megaphylla* are 1—2(—3)-ovulate; their pollen grains are larger (115—130 μ compared with 45—80 μ) and are zonorate; those of *V. amicum* are lalongate.

All these features combined give *V. papuana* and *V. tubiflora* a most distinctive appearance, so much so that a superficial inspection suggests that they should constitute a separate genus. There are, however, a number of important reasons against splitting *Vavaea* in this way.

- 1) Both pairs of species share the sympodial 'Terminalia' branching habit which is unknown elsewhere in the family.
- 2) Both have simple leaves. In the vegetative state specimens of *V. papuana* are sometimes mistakenly identified as *V. amicum*.
- 3) Both have a baccate fruit.
- 4) The secondary xylem of both groups is not only extremely similar, but possesses a distinctive combination of characters which is found nowhere else.

¹) One sample of *V. megaphylla* seen by me has non-septate fibres.

5) Some specimens of *V. amicorum* from New Guinea have pollen grains in which the ora are very distinctly elongated along the equator. The pollen grains of these species are therefore intermediate in all respects except size between typical *V. amicorum* and *V. papuana*.

These similarities outweigh the quantitative differences and show clearly that *Vavaea* is a very natural group of plants divisible into 2 well-defined sections, which receive formal recognition at the appropriate places further on in the text.

THE VARIATION PATTERN OF VAVAEA AMICORUM

I have found it necessary to include under *V. amicorum* 21 species described by previous workers, the majority of which have restricted geographical distributions. Many of these were originally described on slender evidence and often form incomplete material; a cursory inspection suggests that many are no more than ill-defined geographical variants. A careful examination of the floral and vegetative features of this group has confirmed this.

Three important facts are revealed by a study of the variation pattern of this group.

1) Many species have been described on vegetative features alone, and it is apparent that the major part of the variability concerns vegetative features.

2) Variation in floral structure is either too sporadic or too insignificant to be of taxonomic value.

3) There are four main centres of variation, the Philippine Islands, New Guinea, the Solomon Islands, and the Fiji Islands. In each of these regions variation is similar, and principally involves leaf shape, indumentum of lower lamina, length of petiole, and length of inflorescence. These characters will now be considered individually.

Leaf shape. The leaves vary from almost orbicular with a truncate or retuse apex to narrowly oblanceolate with a long tapering base and acuminate apex; the most characteristic shape is narrowly obovate. This range of leaf shape occurs in the the Philippines, New Guinea, and Fiji, and to a lesser extent in the Solomon Islands. In the Philippines, the extremes are not connected by intermediates and this probably explains why a number of species have been described on leaf shape alone, e.g. *V. pachyphylla* and *V. retusa*. In contrast, in New Guinea, the Solomon Islands, and Fiji the extremes, which in many ways are similar to the 'species' of the Philippines, are connected by many intermediates. There is no evidence that variation in leaf shape is correlated with difference in altitude, and the, albeit incomplete, information on field labels does not indicate that there is any correlation with other habitat differences.

Indumentum of lower leaf surface. Many species were formerly based on the variations of this feature e.g. *V. pilosa* (Philippines), *V. bougainvillensis* (Solomon Islands). The indumentum consists of appressed or spreading hairs, which may be fine and soft or coarse and stiff. The extremes of indumentum type, glabrous and densely spreading, are very different, but in the Philippines and elsewhere there are many intermediates.

In New Guinea and the Solomon Islands both extremes are found but without the intermediates. New Guinea specimens with a spreading indumentum were formerly regarded as conspecific with the Philippine *V. pilosa*. It is apparent, however, that this resemblance is due to convergence since in all other features they closely resemble the local New Guinea form of *V. amicorum*. Among these resemblances are some minor characteristics such as the thick pericarp of the fruit, which are not present in Philippine specimens.

From the Solomon Islands Burt (1935) described a new species *V. bougainvillensis* from two specimens with a spreading indumentum. He considered that his new species had more in common with the Philippine *V. pilosa* than with other specimens from New Guinea or the Solomon Islands. More recently extensive collections have been made in the Solomon Islands of an almost glabrous plant described (1940) as *V. kajewskii*. This is identical in all respects except indumentum with *V. bougainvillensis* and shares with it certain minor characters such as thin leaf texture, leaf shape, and calyx lobing which are unusual in Philippine *V. pilosa*.

The resemblance between specimens with a spreading indumentum in the Philippines, New Guinea, and the Solomon Islands, is most likely to be due to convergence, the character having arisen independently in the three regions.

In Australia, Fiji, and Tonga both appressed and spreading indumentum are represented, but in these regions the spreading hairs are rather finer and softer than in typical Philippine *V. pilosa*. In Fiji the spreading indumentum is correlated with a shorter petiole in the variant formerly described as *V. harveyi*, but in Australia and Tonga both indumentum types occur at random and are uncorrelated with other features.

Petiole length. Several variants, which were formerly regarded as species, are characterised by a short petiole, e.g. *V. vidalii* (Philippines), *V. oligantha* (New Guinea), *V. kajewskii* (Solomon Islands), and *V. harveyi* (Fiji). In these forms this feature appears to be partly correlated with a particular leaf shape, but elsewhere petiole length is very variable and uncorrelated.

Inflorescence length. Some Philippine and New Guinea specimens have a very short inflorescence correlated with rather narrow leaves e.g. *V. vidalii* (Philippines), *V. oligantha* and *V. brevipedunculata* (New Guinea). The short inflorescence is, however, frequent throughout the range of *V. amicum*, and elsewhere shows no correlation with other features.

All other characters studied are too sporadic in their occurrence or are insufficiently correlated to be of taxonomic importance.

The variation of each of the characters discussed above is, at least in certain geographical areas, continuous. The combined variation in all these characters shows a similar lack of discontinuity. Where there are correlations, these are confined to only a pair or at the most three characters, and they are of restricted geographical occurrence and produce only partial discontinuities. These local correlations could be used to define taxa which are relatively easy to distinguish within a small geographical area, but whose limits are obscured when the whole range of the species is examined. The only reasonable conclusion is that these taxa, formerly given specific rank, are merely local variants of the single widely distributed and variable species *V. amicum*.

In my opinion it would not be profitable to recognise subspecies or varieties within *V. amicum*, despite its great variability. A botanist who was acquainted with *Vavaea* only in part of its range, e.g. in New Guinea, in the Solomon Islands, or in the Fiji Islands, would be justified in assuming that distinct subspecies or even species could be recognised. For example, in the Solomon Islands there are three fairly distinct forms, viz. typical '*amicum*' (\pm glabrous), '*kajewskii*' (\pm glabrous, large leaves tapering to a short petiole), and '*bougainvillensis*' (large leaves, dense spreading hairs). But elsewhere, especially in the Philippines, these distinctions break down, since the characters vary independently there giving rise to many intermediates.

The chief reasons against recognising subspecies or varieties within *V. amicum* may be summarised as follows:

1) None of the variants is sufficiently well correlated with geography. None are restricted to a single geographical region, and any subspecies recognised would therefore have a disjunct distribution, e.g. '*harveyi*' occurs in Fiji and the Philippines, '*pilosa*' in the Philippines, New Guinea, and the Solomon Islands; typical '*amicum*' occurs throughout the entire range of the species — interpreted in a wide sense — from Java eastwards to Tonga. There is no true geographical replacement.

2) Different variants frequently occupy not only the same locality but also the same habitats.

3) Most variants are based on slight, often single, vegetative differences.

4) Reasons have been given earlier for believing that some at least of the most striking variants have arisen independently in different places; if this is so subspecies based on them would represent unnatural assemblages of plants, and would obscure their true relationships.

For these reasons I regard *V. amicum* as a single polymorphic species which cannot be profitably subdivided.

VAVAEA

Benth. in Hook., Lond. Journ. Bot. 2 (1843) 212; A. Gray, U.S. Expl. Exped., Bot., Phanerogamia 1 (1854) 244, t. 16 fig. B; Mem. Amer. Acad. Arts & Sci. n.s. 5 (1855) 329; Harms in E. & P., Nat. Pfl. Fam. 3, 4 (1896) 286, t. 158 fig. J, K; *ibid.* ed. 2, 19b, 1 (1940) 97, t. 21 fig. J, K, t. 25. — *Lamiofrutex* Lauterbach, Nova Guinea 14 (1924) 147.

Treelets or small or large trees with sympodial ('*Terminalia*') branching. Bark smooth; lenticels prominent. *Leaves* simple, spirally arranged, usually clustered at ends of branchlets, occasionally with obscure pellucid dots; margin entire. Indumentum of simple hairs. *Inflorescence* usually axillary, rarely extra-axillary, sometimes subtended by few or many subulate reduced leaves, usually a panicle with cymose branches, less frequently a few-flowered cyme, rarely the flowers are solitary. Bracts usually small, linear or linear-lanceolate, occasionally enlarged and foliaceous. Pedicels articulate. *Calyx* almost truncate or shallowly or deeply 4—5(—7)-lobed, with open or rarely imbricate aestivation; lobes occasionally enlarged and foliaceous; usually persistent in fruit, but less frequently circumscissile at the base and caducous. *Petals* (3—)4—6, free, imbricate or rarely contorted, rather fleshy, minutely sericeous without, minutely sericeous or puberulous within, reflexed when mature. *Filaments* fused for one fifth of their length to almost completely. Appendages normally absent, but rarely represented by a pair of short rounded lobes; staminal tubes cyathiform or shortly tubular, or long tubular and then sometimes slightly curved, often with a dense, barbate indumentum at the throat. Anthers 9—23, orbicular, ovate, oblong, or linear, rarely apiculate, hairy or glabrous, insertion basal or dorsal toward the base, often arranged in 2 alternating rows in the young flower, but in a single irregular whorl at maturity. *Disk* patelliform or cyathiform, fused to the base of the staminal tube, or forming androecial ribs, or absent. *Ovary* densely hairy, usually partly sunken in the disk, 2—6-locular; loculi uniovulate or with 2(—3) collateral ovules or with 4—10 ovules in 2 rows, placentation axile. Style slender or stout, rarely distinctly swollen at the base; style-head capitate or discoid, the stigmatic surface generally bearing a small depression on the upper surface and sometimes papillose. *Fruit* a globose berry, sometimes with a small beak, 0.8—3 cm in diameter, with a thin and fleshy, or thick and rather woody pericarp, containing 1—3(—7) seeds. *Seed* ovoid or plano-convex, exarillate;

seed coat cartilaginous, surrounded by a thin sarcotesta. Embryo sometimes surrounded by a thin layer of residual endosperm; cotyledons plano-convex, rather thick, collateral; radicle superior, small, included or extending to the surface.

Germination epigeal; cotyledons retained within the seed coat and not expanding; first leaves simple and opposite.

Secondary xylem diffuse porous. Vessels: solitary and in radial pairs, rarely with pore clusters, rarely showing local oblique patterning; tangential diameter 40—160 μ ; intervascular pits 3.75—6 μ ; gum absent. Ray tissue: heterogeneous Kribs Type 1, 2, or 3; rays 1—2-seriate, up to 40 cells high, the heterocellular with 1—3 marginal rows. Fibres septate or partially septate, very rarely non-septate. Paratracheal parenchyma vasicentric, aliform, confluent, with crystals. Apotracheal parenchyma with terminal bands rarely present. Diffuse crystalliferous parenchyma is frequent.

Pollen grains 3(—4)-colporate, prolate-spheroidal, subprolate or prolate (longest axis 45—130 μ ; amb rounded to triangular). Apocolpium diameter 30—90 μ . Ora lalongate to zonorate. Exine usually scabrous, less frequently smooth, thickened at the apertures.

KEY TO THE SPECIES

1. Petals 0.4—0.95 cm long; staminal tube 0.2—0.55 cm long, barbate at the throat; anthers 0.03—0.12 cm long; loculi 1—2(—3)-ovulate. **Section 1. Vavaea**
2. Branchlets slender, 0.2—0.5(—1) cm diameter; leaves 5—22(—27) cm long; petiole 0.3—2.25(—3.75) cm long; inflorescence usually without subtending scale leaves but rarely with one or a few; calyx 0.1—0.35(—0.5) cm long **1. V. amicum**
2. Branchlets stout, (0.5—)0.7—1.2 cm diameter; leaves (13.7—)16—30(—37.5) cm long; petiole (2—)3.25—6 cm long; inflorescence subtended by a cluster of scale-leaves; calyx 0.4—0.8 cm long. **2. V. megaphylla**
1. Petals 3.5—8 cm long; staminal tube 3.5—6.7 cm long, not barbate at the throat; anthers 0.25—0.65 cm long; loculi 4—10-ovulate **Section 2. Grandiflorae**
3. Calyx persistent in fruit; petals 4; staminal tube glabrous or rarely sparsely hairy outside; filaments fused to about half of length; ovary 4-locular; fruit with a thin soft pericarp, 1.2—1.8 cm long. **3. V. papuana**
3. Calyx circumscissile at the base and not persistent in fruit; petals 5(—6); staminal tube densely appressed hairy outside; filaments fused to near the apex, the free portion 0.5—0.9 cm long; ovary 5—6-locular; fruit with a thick hard pericarp, 2.3—3 cm long. **4. V. tubiflora**

Section 1. Vavaea

Petals 0.4—0.95 cm long. Staminal tube cyathiform or shortly tubular, 0.2—0.55 cm long, barbate at the throat; anthers 9—17, nearly always ovate or orbicular, 0.03—0.12 cm long. Loculi 1—2(—3)-ovulate. Pollen grains 45—80 μ long; ora lalongate.

1. Vavaea amicum Benth. in Hook., Lond. Journ. Bot. 2 (1843) 212; A. Gray, U.S. Expl. Exped., Bot., Phanerogamia 1 (1854) 244, t. 16 fig. B. — Type: Tonga, Vavau, fl. May 1840, *Barclay s.n.* (K, holotype). — Fig. 1 a—e.

V. harveyi Seem., Fl. Vitiensis (1865) 35. — Type: Fiji, fl., *Harvey s.n.* (GH; K, holotype).

V. vitiensis Seem., Fl. Vitiensis (1865) 35. — Type: Fiji, Vanua Levu, Mathuata coast, fl. 1860, *Seemann 63* (BM, GH, K, OXF, P).

V. pauciflora Volkens, Bot. Jahrb. 31 (1901) 465. — Type: Caroline Islands, *Volkens 336* (B, destroyed).

V. chalmersii C. DC., Bull. Herb. Boiss. II, 3 (1903) 177. — Type: New Guinea, *Chalmers s.n.* (G, n.v.).

Vitex bantamensis Koord. & Valet., Bijdr. Booms. Java 7 (1910) 210. — *V. bantamensis* (Koord. & Valet.) Koord. & Merr. in Koorders & Valeton, Atlas Baumart. Java 2 (1914) t. 298. — Type: Java, Bantam, Tjimara, fr. June 1892, *Koorders 9810β* (K, L).

V. ardisioides Elmer, Leaf. Philip. Bot. 8 (1915) 2767. — Type: Philippines, Mindanao, Agusan, Cabadbaran, fr. Oct. 1912, *Elmer 13974* (BM, F, GH, K, L, P).

V. surigaoense Elmer, Leaf. Philip. Bot. 8 (1915) 2768. — Syntypes: Philippines, Mindanao, Agusan, Cabadbaran, fr. Aug. 1912, *Elmer 13636* (BM, GH, K, L, P); ster. Sept. 1912, *Elmer 13940* (BM, L).

V. pauciflora Ridley, Trans. Linn. Soc. Lond. II, Bot. 9 (1) (1916) 26, *nom. illegit., non V. pauciflora* Volkens. — *V. oligantha* B. L. Burtt, Kew Bull. (1933) 304. — Type: West New Guinea, *Kloss s.n.* (BM, K).

V. retusa Merr., Philip. J. Sc. 13 (1918) Bot. 301. — Type: Philippines, Negros, Malabunhao, near San Carlos, July 1914, *Contreras 23402* (PNH, destroyed).

V. heterophylla Merr., Philip. J. Sc. 13 (1918) Bot. 303. — Type: Philippines, Luzon, Camarines, Paracale, fl. May 1917, *Magistrado 27062* (K, P).

V. pachyphylla Merr., Philip. J. Sc. 13 (1918) Bot. 304. — Type: Philippines, Luzon, Tayabas, Mt Binuang, fr. May 1917, *Ramos & Edaño 28816* (A, K).

V. pilosa Merr., Philip. J. Sc. 13 (1918) Bot. 302. — Type: Philippines, Luzon, Rizal, *Ahern's Collector 3094* (BR).

V. sorsogonensis Elmer in Merr., En. Philip. Fl. Pl. 2 (1923) 359, *nom. nud., in obs. pro syn.* *V. amicorum* Benth.

Lamiofrutex papuanus Lauterbach, Nova Guinea 14 (1924) 147. — *V. lamii* van Steenis, Act. Bot. Neerl. 1 (1952) 93. — Type: West New Guinea, Mamberano River, Mt Doorman, fl. Oct. 1920, *Lam 1529* (L).

V. bougainvillensis B. L. Burtt, Kew Bull. (1935) 303. — Type: Solomon Islands, Bougainville, Siwai, fl. Nov. 1932, *Waterhouse B 803* (K).

V. luzonensis Elmer, Leaf. Philip. Bot. 9 (1937) 3390, *nom. nud. in obs. pro syn.* *V. amicorum* Benth.

V. scaevoloides Guillaumin, J. Linn. Soc. Lond., Bot. 51 (1938) 550. — Type: New Hebrides, Hog Harbour, fl. Jan. 1934, *Baker 236* (BM).

V. archboldiana Merr. & Perry, J. Arn. Arb. 21 (1940) 298. — Type: West New Guinea, Idenburg River, fl. Jan. 1939, *Brass & Versteegh 11974* (A, L, LAE).

V. kajewskii Merr. & Perry, J. Arn. Arb. 21 (1940) 298. — Type: Solomon Islands, Bougainville, Kupei Gold Field, fl. April 1930, *Kajewski 1690* (A, L, P, SING).

V. chalmersii C. DC. var. *angustifolia* Merr. & Perry, J. Arn. Arb. 21 (1940) 297. — Type: Solomon Islands, Ysabel, Tatamba, fl. fr. Jan. 1933, *Brass 3439* (A, BM, L, SING).

V. ledermannii Harms [in E. & P., Nat. Pfl. Fam. ed. 2, 19b, 1 (1940) 98, t. 25, *nom. in obs.*] Bot. Jahrb. 72 (1942) 159. — Type: Territory of New Guinea, Etappenberg, Oct. 1912, *Ledermann 8975* (B, destroyed).

V. brevipedunculata Kurata, Bull. Tokyo Imp. Un. For. 35 (1947) 198, t. 1. — Type: West New Guinea, Dallmann, Nabire, April 1939, *Inokuma & Hara 395* (TOFO, *n.v.*).

V. australiana S.T. Blake, Aust. J. Bot. 2 (1954) 122, t. 4. — Type: Australia, Northern Territory, between Gerowie Creek and Mary River, fl. Oct. 1946, *Blake 17168* (BRI, holotype).

? *Beilschmiedia brassii* Allen, J. Arn. Arb. 23 (1942) 130. — *V. brassii* Kostermans, Reinwardtia 5 (1961) 377. — Type: Papua, Diene, with unripe fruit, April-May 1933, *Brass 3930* (A).

Treelets, small or medium-sized trees, or rarely up to 30 m high. Ultimate branchlets slender, 0.2–0.5(–1) cm in diameter below the terminal cluster of leaves. *Leaves* 5 by

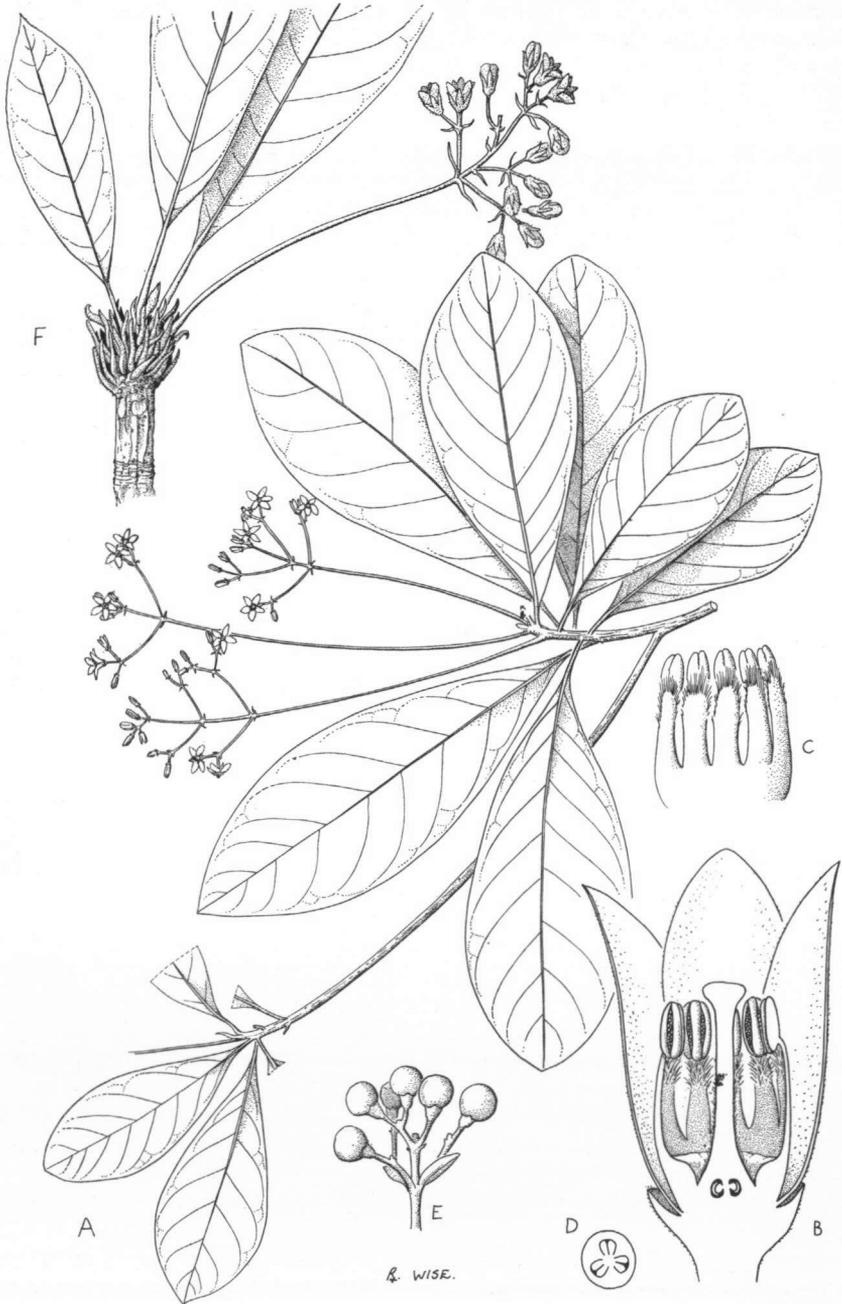


Fig. 1. *Vavaea amicorum* Benth. a. Flowering branchlet, $\times \frac{1}{2}$; b. flower, $\times 8\frac{1}{2}$; c. outside of staminal tube, $\times 8\frac{1}{2}$; d. ovary, $\times 8\frac{1}{2}$; e. infructescence, $\times \frac{1}{2}$. — *V. megaphylla* Wright. f. Flowering branchlet, $\times \frac{1}{2}$ (a—d Pennington 8122, e. Parham s.n., f. Gillespie 3487).

(2.2—)3 cm to 22(—27) by 9(—13) cm, usually oblanceolate or obovate, less frequently orbicular, apex usually obtuse with or without an acute or obtuse acumen, less frequently truncate or retuse, base usually cuneate or attenuate, rarely truncate; usually glabrous except for some short appressed hairs confined to the nerves and midrib beneath, or less frequently with sparse appressed and spreading hairs, or with rather dense, soft, crisped hairs, or sparsely or densely hispid; lateral nerves 6—11(—16) pairs, venation sometimes strongly reticulate; petiole (0.2—)0.3—2.25(—4.5) cm long. *Inflorescence* (1.5—)2—13(—15) cm long, axillary or occasionally extra-axillary, rarely subtended by a solitary or a few subulate reduced leaves; indumentum of short appressed, or short or long spreading hairs; bracts subtending the paniclebranches 0.1—0.4(—4) cm long, linear, lanceolate, or occasionally foliaceous; pedicel 0.1—0.5 cm long above the articulation. *Calyx* 0.1—0.35(—0.5) cm long, shallowly or deeply 4—6(—7)-lobed, the lobes deltate, ovate or oblong, with open aestivation, rarely foliaceous and slightly imbricate at the base. *Petals* (3—)4—6, 0.4—0.95 cm long, oblong, oblanceolate, or rarely spatulate, rather fleshy, imbricate or rarely contorted. *Filaments* partly fused for one fifth of their length to almost completely fused, the staminal tube cyathiform or short tubular, 0.2 by 0.1 to 0.55 by 0.25(—0.3) cm; appendages normally absent, but rarely represented by a pair of short rounded lobes; staminal tube glabrous in the lower half, hirsute in the upper half externally and densely barbate at the throat; anthers 9—17, 0.03—0.12 cm long, ovoid or subspherical, rarely elongate, glabrous or with a few hairs on the connective. *Disk* 0.05—0.2 cm long, 0.075—0.2 cm broad, patelliform, cyathiform, or shortly tubular, glabrous or hairy. *Ovary* 2—4-locular; loculi with 1—2(—3) collateral ovules; style 0.25—0.5 cm long, stout, occasionally swollen at the base. *Berry* 0.8—2 cm in diameter, usually globose, rarely with a small beak; pericarp usually thin and fleshy, rarely thickened and woody. *Seeds* 1—4. *Seedling* with epigeal germination; cotyledons retained in the seed coat and not unfolding; first pair of leaves simple and opposite.

SUMATRA. Central Sumatra: Batta Lands, *Junghuhn s.n.* (L).

WEST JAVA. *Van Borssum Waalkes* 313 (L), *Koorders* 9810f (K, L), *Kostermans & Kuswata* 75 (BM, L, LAE, KEP), *Neth. Ind. For. Serv. Ja.* 2637 (L), *Soepadmo* 308 (L, LAE, SAR), *Wirawan* 365 (L).

BORNEO. E. Borneo: *Kostermans* 5958 (A, K, L, LAE, PNH, SING). — Sabah: *Agama* 9225 (K, L, SING), *Cabiling* 3695 (UC), *Cuadra A2445* (K, L, SING), *Goklin* 3352 (K), *Kamis* 2948 (K), *Keith A* 1537 (K, L, SING), *6212* (K, L, SING), *6213* (K, L, SING), *7378* (K, L), *Oroflo* 5222 (K, L, SING), *5223* (A, K, L), *7125* (K, L, SING), *Rahman* 6752 (K, L, SING), *Singh SAN* 26307 (K, L).

PHILIPPINE ISLANDS. Palawan: *Elmer* 12970 (BM, E, K, L, P), *Sulit* 12463 (A, L, PNH). — Batanes Islands: *Ramos* 80448 (K, SING). — Luzon: *Aguilar* 20189 (K), *Ahern's collector* 3094 (BR), 3391 (K), *s.n.* (SING), *Alvarez* 22354 (BM, K, P), *Canicosa* 30298 (BM, UC), *Edaño* 78545 (K, NY, SING), *Elmer* 14941 (BM, K, L, P, UC), 16475 (A, K, L, NY, P, UC, US), *Escritor* 20846 (BM, K), *Fénix* 28365 (K), *Hallier* 4293 (L), *Lagrimas & Rojo* 41834 (L, PNH), *Loher* 5140 (K), 5575 (K, M), 6172 (K), 12464 (UC), 13291 (P, UC), 13395 (A, UC), 14951 (UC), *s.n.* (UC), *Mabesa* 28028 (K), *Magistrado* 27062 (K, P), *Merrill* 2329 (K), 2652 (BM, K), 9647 (BM, K, L, P), *Quisumbing* 2441 (PNH), *Ramos* 1589 (BM, L, P, SING), 19414 (K), 22302 (K, P), 27346 (K), 41890 (BM, K, L, SING), *Ramos & Edaño* 28757 (A, BM, K, P), 28816 (A, K, P), 33844 (SING), 48199 (UC), 48224 (BM, K, UC, US), *Sulit* 2762 (L, SING), 30325 (UC), *Vidal* 937 (K), 937A (K), 2375 (A, K), 2377 (A, K), 3191 (K). — Catanduanes: *Ramos & Edaño* 75225 (SING, UC). — Masbate: *Angeles* 22944 (K, P). — Samar: *Ramos* 17482 (K), 17574 (K). — Leyte: *Elmer* 7186 (K, L). — Panay: *Martellino & Edaño* 35472 (BM, L), *Ramos & Edaño* 31046 (BM, P), 31047 (K, UC), *Vidal* 2376 (K). — Sulu Islands: *Reyes* 27351 (BM). — Basilan: *Reillo* 16312 (BM, K, P). — Mindanao: *Elmer* 13636 (BM, GH, K, L, P), 13940 (BM, L), 13974 (BM, F, GH, K, L, P), *Frake* PNH 38382 (PNH), *Mendoza & Convozar* 10543 (L), 10593 (PNH), *Ramos & Convozar* 83694 (NY), 83989 (NY), *Somonte* 25287 (A, K, P), *Wenzel* 2746 (A, BR, K, UC), 2929 (UC), 3313 (UC), 3337 (UC), 3472 (BR, K, UC).

CELEBES. *Teysmann* 11866 (L), 12308 (L).

MOLUCCAS. Ceram: *Kornassi* 1023 (L). — Talaud: *Lam* 3322 (K, L), 3417 (K, L). — Tanimbar: *Buwalda* 4486 (L), *Neth. Ind. For. Serv. bh.* 24364 (L).

NEW GUINEA. West New Guinea: *Branderhorst* 137 (K, L), 362 (L), *Brass & Versteegh* 11974 (A, L, LAE),

13511 (L, LAE) 13582 (L, LAE), *Iwanggin* BW 5709 (L, LAE), BW 5718 (L, LAE), BW 5732 (L, LAE), BW 9033 (L, LAE), BW 9100 (L, LAE), BW 9106 (L, LAE), BW 10133 (L, LAE), *Kalkman* BW 3747 (L, LAE), *Kloss* s.n. (BM, K), *Koster* BW 1107 (K, L, LAE, PNH), BW 6830 (K, L, LAE), BW 7109 (KEP, L, LAE), BW 8110 (L), BW 11049 (L), *Lam* 1529 (L), *Lundquist* bb. 32940 (L), *Mangold* 67 (L), BW 2123 (BR, K, LAE), *Moll* BW 9773 (L, LAE), BW 9838 (L), BW 9936 (L), BW 12841 (L) BW 13252 (L), *Pleyte* 586 (L), 641 (K, L, SING), 687 (K, L, SING), *Pulle* 314 (K, L), *Schram* BW 2674 (L, LAE), BW 2714 (L, LAE), BW 2996 (L, LAE), *Versteegh* BW 4818 (BM, KEP, L, LAE), BW 10286 (LAE), *W. & M. Vink* BW 15251 (L), BW 15386 (L, LAE). — Japen: *Iwanggin* BW 10071 (L, LAE), *Schram* BW 10557 (L, LAE). — Salawati: *Koster* BW 1448 (L, LAE). — Misool: *Pleyte* 1089 (A, K, L). — Papua: *Brass* 7431 (L, LAE), 8217 (A, L), 8497 (K, L), 24800 (L, LAE), *Carr* 13171 (K, L), 16481 (K, L), *Hartley* 10697 (LAE), 10801 (LAE), *Schodde* 2247 (L, LAE), *L. S. Smith* NGF 1294 (L, LAE), *White & Gray* NGF 10441 (K, L, LAE). — Territory of New Guinea: *Brass* 32098 (K, L, LAE, NY), *Floyd* NGF 7434 (L, LAE), *Hartley* 12621 (L, LAE), *Streimann & Kairo* NGF 21130 (L), *Womersley* NGF 17722 (L), NGF 17725 (L). — New Britain: *Floyd* 6655 (K, L, LAE), 6676 (K, L, LAE), *Womersley* NGF 7952 (HONIARA, L, LAE).

AUSTRALIA. Northern Territory: *Blake* 17168 (BRI), *R. Brown* 5490 (BM), *Gilruth* 25231 (BRI, K). — Queensland: *Thorne* 22985 (BRI).

CAROLINE ISLANDS. Yap: *Hosokawa* 8848 (BISH), *Kanehira* 1231 (NY).

SOLOMON ISLANDS. Bougainville: *Craven & Schodde* 101 (L), *Kajewski* 1690 (A, L, P, SING), *van Royen* NGF 16439 (L, LAE), *Waterhouse* Y. 157 (K), B. 803 (K). — Choiseul: *Whitmore* BSIP 3987 (HONIARA, L, LAE), BSIP 5205 (HONIARA, L, LAE), *Whitmore's collectors* BSIP 5391a (HONIARA, L, LAE). — Rob Roy: *Whitmore's collectors* BSIP 5357 (HONIARA, L, LAE). — Wagina: *Whitmore's collectors* BSIP 5454 (HONIARA, L, LAE). — New Georgia: *Burn-Murdoch's collectors* BSIP 6853 (L), *Whitmore's collectors* BSIP 3160 (HONIARA, L, LAE). — Baga: *Whitmore* BSIP 1367 (L), *Whitmore's collectors* BSIP 2898 (HONIARA, K, L, LAE), BSIP 5556 (HONIARA, L, LAE). — Santa Ysabel: *Beer's collectors* BSIP 6718 (L), BSIP 6767 (L), BSIP 7391 (L), BSIP 7800 (L), *Brass* 3420 (A, BM, HONIARA, L, SING), 3439 (A, BM, L, SING), *Royal Society* Exp. 2786 (K), *Whitmore* BSIP 2207 (HONIARA, K, L, LAE), BSIP 4056 (HONIARA, L, LAE). — Guadalcanal: *Kere* BSIP 4922 (L), *Royal Society* Exp. 2074 (K), 6033 (K), *Whitmore* BSIP 678 (HONIARA, L, LAE), *Womersley & Whitmore* 1103 (HONIARA, L, LAE), 1142 (HONIARA, L). — Malaita: *Royal Society* Exp. 257 (K), 259 (K). — San Cristoval: *Brass* 3111 (BISH, L), *Whitmore* BSIP 4241 (HONIARA, L, LAE).

NEW HEBRIDES. *Baker* 236 (BM).

FIJI ISLANDS. Viti Levu: *Bola* 3 (K), *Damanu* 68 (K), *Degener* 14283 (K), 14385 (F, K, L), 15070 (K, L), *Degener & Ordonez* 13697 (BISH, K), *Drova* 4 (A), *Gillespie* 2995 (K), *Greenwood* 16 (K), 16A (K), 647A (K), 895 (K), *Horne* 1050 (K), *Johns* 7 (K), *Kuruvoli* 13339 (K), *MacDaniels* 59 (K), *McKee* 2815 (K, US), *Meebold* 16881 (M), *Parks* 20699 (BISH), *Pennington* 8122 (FHO, K, SUVA), 8124 (FHO), 8126 (FHO), *A. C. Smith* 4511 (BISH, K), 4635 (BISH, K, L), 4789 (K, L), 4900 (BISH, K, L), 5211 (K, L), 5457 (K, L), 5617 (BISH, K, L), 5940 (K, L), *Mr & Mrs J. D. Tohill* 60 (K), 191 (K), *Mrs J. D. Tohill* 596 (K), 192 (K), *Vaughan* 3155 (BM), *Vetawa* 1 (K). — Vanua Levu: *Degener & Ordonez* 14158 (K), 14195 (K), *Greenwood* 647 (K), *Horne* 639 (K), 667 (K), *Mrs C. J. Parham* 89 (K), *H. B. R. Parham* 333 (K), 340 (K), 374 (K), *Mrs H. B. R. Parham* 19 (BM), 40 (K), 391 (BM), *J. W. Parham et al.* 13438 (K), 13439 (K), *Qoro* 12893 (K), 13411 (K), 13439 (K), *Seemann* 63 (BM, GH, K, OXF, P), *A. C. Smith* 476 (K, P), 816 (K), 1538 (K, P), 1755 (BISH, K), 6332 (K, L), 6527 (K, L), 6559 (BISH, K, L), 6695 (K, L), 6905 (A, BISH, K, L). — Koro: *A. C. Smith* 1042 (BISH, K, P). — Makondronga: *Degener & Ordonez* 13807 (F, K, L). — Nairai: *Milne* 177 (K). — Kandavu: *A. C. Smith* 99 (KMP), 231 (K, P). — Thikombia-i-lau: *Mr & Mrs J. D. Tohill* 59c (K). — Vanua Mbalavu: *A. C. Smith* 1429 (K, P), 1452 (K, P), *Mr & Mrs J. D. Tohill* 59a (K). — Tavunasi: *Bryan* 518 (BISH). — Kambara: *A. C. Smith* 1278 (BISH, K, P). — Fulanga: *Bryan* 442 (BISH), *A. C. Smith* 1110 (K, P), 1156 (K), 1225 (K, P). — Ongea Ndriki: *Bryan* 395 (BISH, K). — Taveuni: *A. C. Smith* 840 (K). — Fiji without exact locality: *Bola* 89 (K), *Harvey* s.n. (GH, K), *Horne* 359 (K), 568 (K), 574 (K), *U.S. Exploring Expedition* s.n. (GH, K, P), *Mrs J. D. Tohill* 61 (K).

TONGA. Vavau: *Banks & Solander* s.n. (BM, P), *Barclay* 3368 (BM, P), s.n. (K), *Crosby* 9 (K), *MacDaniels* 1094 (BISH), *Soakai* 891 (K), *Yuncker* 16126 (BISH). — Tongatabu: *Cartwright* s.n. (K, OXF), *Forster* s.n. (BM), *Graeffe* 1366 (GH), 1520 (K), 1570 (K), *Lawrence* 44 (K, L), *Lister* s.n. (K), *MacDaniels* 1086 (BISH), *Moseley* s.n. (K), *Setchell & Parks* 15270 (K), 15380 (K), 15513 (K, P), *Soakai* 210 (K), 486 (K). — Eua: *Parks* 16150 (K, P), 16183 (BISH, K), 16217 (BM, K), 16299 (K), *Yuncker* 15353 (GH, US), 15674 (BISH, BM). — Kao: *Yuncker* 15971 (BISH).

2. *Vavaea megaphylla* Wright, *Kew Bull.* (1895) 103; *Oliver in Hook., Ic. Pl.* 25 (1896) t. 2438. — Type: Fiji, Viti Levu, Naitasiri, Tamavua; fl. June 1894, *Yeoward* 37 (K, holotype). — **Fig. 1 f.**

Trigonostemon ? *voratus* Croizat, *Sargentia* 1 (1942) 52. — Type: Fiji, Viti Levu, near Namboutini, Mbuyombuyo, ster. June 1941, *Tabualewa* 15569 (K).

V. degeneri A. C. Smith, *Contr. U.S. Nat. Herb.* 30 (1952) 475. — Type: Fiji, Vanua Levu, Thakaundrove, eastern drainage of Yanawai River, fl. Jan. 1941, *Degener & Ordonez* 14099 (A, BISH, K).

Treelet 4–5 m high, rarely a tall tree. Ultimate branchlets stout, (0.5–)0.7–1.2 cm in diameter below the terminal cluster of leaves. *Leaves* (13.7–)16 by 6.6 to 30(–37.5) by 16.5 cm, oblong, obovate, or oblanceolate, apex acute or obtuse with or without an acute or obtuse acumen, base attenuate, acute, or obtuse, sometimes shortly decurrent; almost glabrous with sparse short appressed or spreading hairs confined to the lower midrib and lateral nerves, or pilose with short soft spreading hairs on the upper and lower midribs and lateral nerves, and sometimes extending over the lower lamina; lateral nerves in (12–)14–16 pairs; petiole (1.8–)3–6(–7) cm long. *Inflorescence* 4–12 cm long at anthesis, elongating to 15 cm in fruit, indumentum of sparse or dense, rather coarse, spreading hairs; terminal cluster of leaves and inflorescences subtended by and sometimes interspersed with many subulate reduced leaves; bracts 0.5–2.5 cm long, linear-lanceolate or foliaceous; pedicel 0.1–0.3 cm long at anthesis, elongating to 0.4–0.5 cm in fruit. *Calyx* 0.4–0.8 cm long, shallowly or deeply 4–7-lobed, the lobes deltate or irregularly lanceolate-oblong. *Petals* 5–6, 0.65–0.9 cm long, oblong, obtuse, rather fleshy, imbricate or contorted. *Filaments* fused for one half to three quarters of their length to form a cyathiform or shortly tubular staminal tube 0.3–0.4 cm long and 0.15–0.3 cm broad; glabrous below, the upper half hirsute externally and densely barbate at the throat; anthers 11–16, 0.07–0.1 cm long, ovoid or subspherical, glabrous or with a few hairs on the connective. *Disk* 0.1–0.15 cm long, 0.15–0.2 cm broad, cyathiform, sometimes ribbed, hairy. *Ovary* 4–5 locular; loculi with 1–2 collateral ovules; style 0.3–0.5 cm long, stout. *Berry* 1–1.3 cm in diameter, globose; pericarp thin and fleshy. *Seeds* 2–7.

FIJI ISLANDS. Viti Levu: Serua near Ngaloa, fr. April 1941, *Degener* 15098 (A, K, NY); id., May 1941, *Degener* 15188 (A, K); Tholo West near Mbalo, near Vatukarasa, fr. May 1941, *Degener* 15265 (K, L); Naitasiri, near Nasinu, fl. Oct. 1927, *Gillespie* 3487 (K); Rewa, near Waitolu Village, ster. Feb. 1964, *Pennington* 8123 (FHO, K, SUVA); id., *Pennington* 8123a (FHO, K, SUVA); Tholo West, Mbuyombuyo, near Namboutini, ster. June 1941, *Tabualewa* 15569 (K); Suva, ster. Dec. 1927, *Mr and Mrs J. D. Tothill* 190 (K); Naitasiri, Tamavua, fl. June 1894, *Yeoward* 37 (K, holotype). — Vanua Levu: Thakaundrove, eastern drainage of Yanawai River, fl. Jan. 1941, *Degener & Ordonez* 14099 (A, BISH, K). — Rambi: fr. 1877–8, *Horne* 477 (K). — Fiji, without exact locality: fl., *Storck* VI (K).

Section 2. *Grandiflorae*, *sect. nov.*

Petala 3.5–8 cm longa. Tubus stamineus cylindricus et leviter arcuatus, 3.5–6.7 cm longus, fauce non barbatus; antherae 12–23, elongatae, 0.25–0.65 cm longae. Loculi 4–10-ovulati. Pollinis grana 115–130 μ longa, zonorata.

Type species: *V. papuana* F. M. Bailey.

3. *Vavaea papuana* F. M. Bailey, *Queensl. Agr. J.* 3 (1898) 282, t. 53. — Type: Papua, Northern Div., foot of Mt Trafalgar, April 1898, *Lord Lamington's party* 37 (holotype BRI, fr.; isotypes BM, K, fl.). — Fig. 2 e–g.

Treelet or small or medium-sized tree. *Leaves* 9.5 by 4.2 to 31 by 12.1 cm, oblanceolate or obovate, apex acuminate or obtuse with an obtuse acumen, base usually cordate or obtuse, rarely acute or cuneate, glabrous or with a few short appressed hairs on the lower midrib; lateral nerves in (7–)9–14 pairs; petiole 0.2–0.5(–1.5) cm long. *Inflorescence* 4.5–20 cm, long, usually a few-flowered axillary or extra-axillary panicle, sometimes

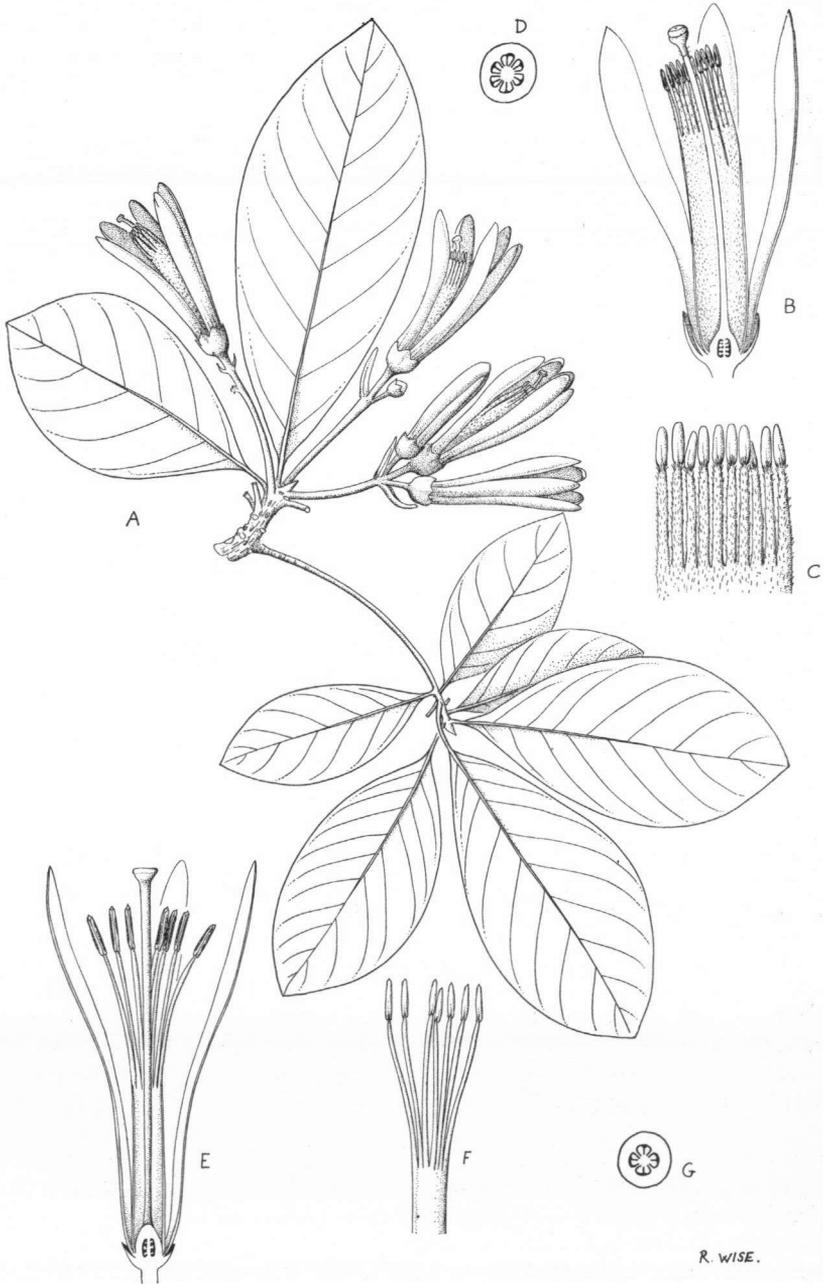


Fig. 2. *Vavaea tubiflora* Pennington. a. Flowering branchlet, $\times \frac{1}{2}$; b. flower, $\times \frac{2}{3}$; c. outside of staminal tube, $\times 1\frac{1}{2}$; d. ovary, $\times 1\frac{1}{2}$. — *Vavaea papuana* F. M. Bailey. e. Flower, $\times \frac{2}{3}$; f. outside of staminal tube, $\times \frac{2}{3}$; g. ovary, $\times 1\frac{1}{2}$ (a—d Pennington 8050, e—g Brass 25848).

subtended by a minute bract, or rarely flowers solitary; indumentum consisting of a few appressed or spreading hairs or absent; bracts 0.2—0.5(—1.2) cm long, linear, lanceolate or rarely foliaceous; pedicels (0.5—)0.8—1.9 cm long above the articulation. *Calyx* (0.25—)0.3—0.6 cm long, truncate or shallowly 4(—5)-lobed, lobes deltate or obtuse, aestivation open, persistent in fruit. *Petals* 4, 4—8 cm long, ligulate, imbricate. *Filaments* fused to about halfway, forming an incomplete, cylindrical staminal tube 3.6—6.7 cm long, 0.1—0.3 cm broad, externally glabrous or rarely sparsely hairy, inside hairy in the lower half and hairy or glabrous in the upper half; anthers 12—15(—23), 0.3—0.65 cm long, 0.05—0.1 cm broad, slender, glabrous. *Disk* 0.05—0.15 cm long, 0.2 cm broad, patelliform or cyathiform, glabrous or hairy. *Ovary* 4-locular; loculi with 4—8 ovules in 2 vertical rows; style 3.5—7.1 cm long, slender, style-head capitate. *Berry* 1.2—1.8 cm, long, globose or ovoid with a small beak, often constricted between the seeds; pericarp thin and fleshy. *Seeds* 2—5.

NEW GUINEA. Papua: Northern Div., foot of Mount Trafalgar, April 1898, *Lord Lamington's party* 37 (BRI, fr.; BM, K, fl.); Central Div., Lower Mori River, fr. May 1926, *Brass 1550* (A, K); Milne Bay Dist., Modewa Bay, Gara River, fl. Dec. 1956, *Brass 28899* (A, K, L, LAE); Milne Bay Dist., Borovia, fl. April 1955, *Crutwell 606* (K); Milne Bay Dist., Sagarai Valley, inland from Mullins harbour, fl. fr. June 1964, *Womersley NGF 19290* (L, LAE). — D'Entrecasteaux Islands: Normanby I., Waikaiuna, fl. April 1956, *Brass 25428* (L, LAE); id., fl. April 1956, *Brass 25492* (K, L, LAE); Normanby I., Lebudowa River, fl. fr. April 1956, *Brass 25531* (L, LAE); fl. fr. April 1956, *Brass 25608* (K, L, LAE); Normanby I., Mount Pabinama fl. May 1956, *Brass 25848* (K, L, LAE); Fergusson I., Niubuwo, fl. fr. June 1956, *Brass 27309* (L, LAE); Normanby I., Waikaiuna Bay, fl. April 1956, *Womersley & Brass NGF 8626* (A, K, LAE); id., fr. April 1956, *Womersley & Brass NGF 8667* (K, LAE).

4. *Vavaea tubiflora* Pennington, *sp. nov.* — Type: New Guinea, Morobe, Lae, Bumbu area, fl. fr. Jan. 1964, *Pennington 8050* (FHO; K, holotype; L, LAE). — **Fig. 2 a—d.**

Affinis *V. papuanae* Bailey sed calyce basi circumscisso, ad maturitatem fructus non persistente; petalis 5(—6) non 4; filamentis extra pilis adpressis confertis, non glabris; filamentis fere usque ad apicem coalitis, haud ad dimidium longitudinis coalitis; ovario 5—6-loculare, non 4-loculare; pericarpio crasso et duro, non tenui et carnosio; fructu diametro 2.3—3 cm, non 1.2—1.8 cm.

Arbor parva vel procera usque ad 30 m alta. *Folia* (5.1—)10 × (2.1—)4.5 cm ad 23.5 × 11 cm, obovata vel elliptica, apice acuto vel obtuso, interdum acumine acuto vel obtuso, basi acuta vel cuneata, glabra sed costa pilis adpressis utrinque paucis obsita; nervi laterales 9—13; petiolus 0.9—3 cm longus. *Inflorescentia* 5—14 cm longa, axillaris vel extra-axillaris, pauciflora, plerumque cymosa, raro paniculata, indumento pilorum adpressorum brevium sparso vel denso; bractae 0.9—2 cm, longae, lineari — lanceolatae vel aliquantum foliaceae; pedicelli supra articulum 0.5—1.1 cm longi. *Calyx* 0.5—0.9 cm longus, basi circumscissus et maturitate fructus non persistens, obscure 5—6-lobatus, lobis acutis vel obtusis, aestivatione aperta. *Petala* 5(—6), 3.5—6.5 cm, longa, ligulata, imbricata. *Filamenta* fere usque ad apicem coalita, tubum stamineum cylindricum leviter arcuatum, 3.5—5.3 cm longum, 0.4—0.8 cm latum praebentia, parte filamentorum libero 0.5—0.9 cm longo, tubo per 0.9—2 cm latere uno interdum fisso, utrinque pilis confertis instructum, pilis parte tubi inferiore adpressis, parte superiore patentibus; antheris 18—21, 0.25—0.3 cm longis, 0.05—0.075 cm latis, elongatis, glabris vel connectivo paucepilosis. *Discus* 0.1—0.15 cm longus, 0.25—0.6 cm latus, hirsutus, patelliformis vel cyathiformis, vel nullus. *Ovarium* 5—6-loculare, loculis intra interdum hirsutis, 8—10-ovulatis, ovulis superpositis biseriatis; stylus longus 3.5—5.9 cm, crassus, apice in discum tenuem stigmatibus crasso discoideo superatum expansus. *Bacca* (immutata tantum cognita) 2.3—3 cm diam., rostro parvo globosa vel ovoidea; pericarpio crasso duro. *Semina* 2.

NEW GUINEA. Territory of New Guinea: Morobe, near the Butibum R. about 7 miles N. of Lae, 200 ft alt., fl. May 1962, *Hartley 10171* (L); Morobe, S. of the Busu R. about 10 miles N. of Lae, 500 ft alt., fr. Dec. 1962, *Hartley 11056* (L); Morobe, about 15 miles N.E. of Lae, Burep R., 50 ft alt., fl. May, 1963, *Hartley 11859* (L); Morobe, Lae, Busu Road, fl., Feb. 1960, *Henty NGF 11915* (K, L, LAE, PNH); Morobe, Bumbu Forest, fl. May 1962, *Miller NGF 14542* (L, LAE); Morobe, Lae, Busu area, Jan. 1945, *NGF 151* (LAE); Morobe, Lae, Bumbu area, fl. fr. Jan. 1964, *Pennington 8050* (FHO, K, L, LAE); Morobe, Gualangumbum, 100 ft alt., fr. July 1966, *Streimann & Kairo NGF 27839* (L); Morobe, Lae, fr. Aug. 1948, *Womersley NGF 3241* (L, LAE); Morobe, Trans Busu Timber Area, fr. Feb. 1957, *Womersley NGF 9073* (L, LAE); Rossel Island, Jinju, fl. Oct. 1956, *Brass 28502* (A, K, L, LAE, PNH).

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BIBLIOGRAPHY

- BAILLON, H. 1874. *Histoire des Plantes* 5: 495.
 BENTHAM, G. 1843. In Hooker, Lond. Journ. Bot. 2: 212.
 CANDOLLE, C. D. C. DE. 1878. In A. & C. de Candolle, *Monographiae Phanerogamarum* 1: 645—646.
 ENDLICHER, S. L. 1843. *Genera Plantarum*, Suppl. 3, *Mantissa Botanica Altera*: 95.
 ERDTMAN, G. 1952. *Pollen Morphology and Plant Taxonomy*. Uppsala.
 FABRI, K., & J. IVERSEN. 1964. *Textbook of Pollen Analysis*. Oxford.
 GRAY, A. 1855. On the affinities of the genus *Vavaea* Benth. *Mem. Amer. Acad. Arts & Sci. n.s.* 5: 329—336.
 HARMS, H. 1896. In Engler & Prantl, *Nat. Pfl. Fam.* 3, 4: 286.
 ——— 1940. In Engler & Prantl, *Nat. Pfl. Fam. ed. 2*, 19b, 1: 97.
 HOOKER, J. D. 1862. In Bentham & Hooker, *Genera Plantarum* 1: 331.
 KRIBS, D. A. 1950. *Commercial Foreign Woods in the American Market*. Edward Brothers, Ann Arbor.
 ROEMER, M. J. 1846. *Synopses Monographicae* 1, *Hesperides*: 132, 141.
 SMITH, A. C. 1952. The Meliaceae of Fiji, Samoa & Tonga. *Contr. U.S. Nat. Herb.* 30: 470—476.
 STEENIS, C. G. G. J. VAN. 1952. Reduction of two endemic Papuan genera. *Act. Bot. Neerl.* 1: 93.
 ——— 1966. In Van Steenis & Van Balgooy, *Pacific Plant Areas* 2 (*Blumea* Suppl. 5): 92.