

THE TAXONOMIC STATUS OF THE GENUS *BAUERELLA* (RUTACEAE) *

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IN THE COURSE OF a recent study of the genus *Acronychia* (Jour. Arnold Arb. 55: 469–567. 1974), it became apparent to me that its generic limits were never very clearly established and that as a result an unusually diverse assemblage of plants have been included in it—some having bisexual flowers, others having unisexual flowers; some with eight stamens, others with four; and some having drupaceous fruits, others having capsular fruits. Such diversity may not necessarily be excessive in tropical genera (see, for example, Gillett's discussion of the generic limits of *Cyrtandra*, 1970), but in this instance I believe it is.

I have found that *Acronychia*, when rather narrowly interpreted around the type species, *A. laevis* J. R. & G. Forst., comprises a clearly monophyletic genus of 42 species distributed from India south and east to New Caledonia and Australia. The majority of the species are endemic to either Australia or New Guinea and a number of them, having narrow distributions and, in some cases, being geographically disjunct vicarious species, appear to be relicts. The major unifying characteristics of these plants are opposite leaves, bisexual flowers, and drupaceous fruits. As far as I have been able to determine, this combination of characters serves to distinguish the species from all of the other genera of the Rutaceae in the Indo-Pacific region.

If broader generic limits are accepted for *Acronychia*, such as those presented by Engler (1931: 309, *figs.* 140 and 141), in the standard major work for the Rutaceae of the Indo-Pacific region, then the mutually close relationships of the species, and their apparent phylogeny, would be obscured. Also, the genus would then be indistinguishable, taxonomically, from several other genera, including *Melicope*, *Euodia*, and *Evodiella*.

Among the plants which I have excluded from *Acronychia* is *A. baueri* Schott, the type species of the genus *Bauerella* Borzi. In carrying out his work on the floras of Norfolk and Lord Howe Islands, Peter Green (1970) made a thorough study of this species, the type of which may have come from Norfolk Island. He determined that it is conspecific with *A. simplicifolia* (Endl.) McGillivray & Green and recognized therein three geographical subspecies: one from eastern Australia (from northeastern Queensland south, quite continuously, to southeastern New South Wales)

* This is the sixth in a series of papers on the Rutaceae. The series was initially restricted in its coverage to genera of the Malesian region, but, as I am finding it increasingly evident that Australian genera often hold the key to the understanding of Malesian genera, I would now like to expand its coverage to include the Australasian region (Australia, New Zealand, New Caledonia, and Papuasia).

and Lord Howe and Norfolk Islands; one from New Caledonia and the New Hebrides; and one from Fiji. He also described an additional, closely related species from New Caledonia, *A. leiocarpa* P. S. Green. I agree with Green's delimitations of the species and subspecies of these plants, but I am of the opinion that they are more correctly placed in *Bauerella* than in *Acronychia*.

Bauerella has been recognized as being distinct from *Acronychia* by Engler (1900: 35 and 1931: 310) — on the basis, however, of characters that are hardly diagnostic, considering the broad range of plants he included in the latter — and, in recent years, by students of the New Caledonian flora, including Däniker (1932) and Guillaumin (1948). Australian botanists, on the other hand, have preferred to include the genus in *Acronychia*, one reason being, perhaps, that Bentham (1863) accepted *A. baueri* without giving any indication that it might be generically distinct from *A. laevis* and *A. imperforata* F. Muell., both of which belong to *Acronychia sensu stricto*.

With the exception of *Acronychia* and *Phellodendron*, the drupaceous fruits and opposite leaves of *Bauerella* serve to distinguish it from all of the recognized genera of the Rutaceae in the Indo-Pacific region. The three species from northwestern Malesia and adjacent mainland Asia which I have excluded from *Acronychia*, but have not yet placed generically (*A. obovata* Merr., *A. oligophlebia* Merr., and *A. porteri* Hook. f.), are similar to *Bauerella* in having unisexual flowers and drupaceous fruits, but differ in having petals that are deciduous in fruit and stamens with narrow, geniculate filaments. *Phellodendron*, a genus of possibly a dozen species distributed in subtropical and temperate eastern Asia, also has opposite leaves and drupaceous fruits, but differs from *Bauerella* in several floral characters and in its pinnately compound, as opposed to simple, leaves.

The taxonomic differences between *Acronychia* and *Bauerella* are summarized in the following table, and the comparative floral morphology is illustrated in FIGURE 1.

Acronychia	Bauerella
Plants with bisexual flowers	Plants apparently always dioecious, with functionally unisexual flowers
Flower buds longer than wide	Flower buds globose or subglobose
Sepals usually imbricate	Sepals usually valvate
Petals valvate	Petals narrowly imbricate in bud
Petals deciduous or rarely semipersistent in fruit	Petals persistent in fruit
Stigma scarcely differentiated from the style	Stigma (in functionally carpellate flowers) broadly 4-lobed, peltate

An amplified generic description of *Bauerella* and an enumeration of the known species and subspecies are included in this paper.

A large number of herbarium specimens were examined in this study, but only a few are cited, since the majority were previously cited by Green. The contributing herbaria are listed below, however, with abbreviations

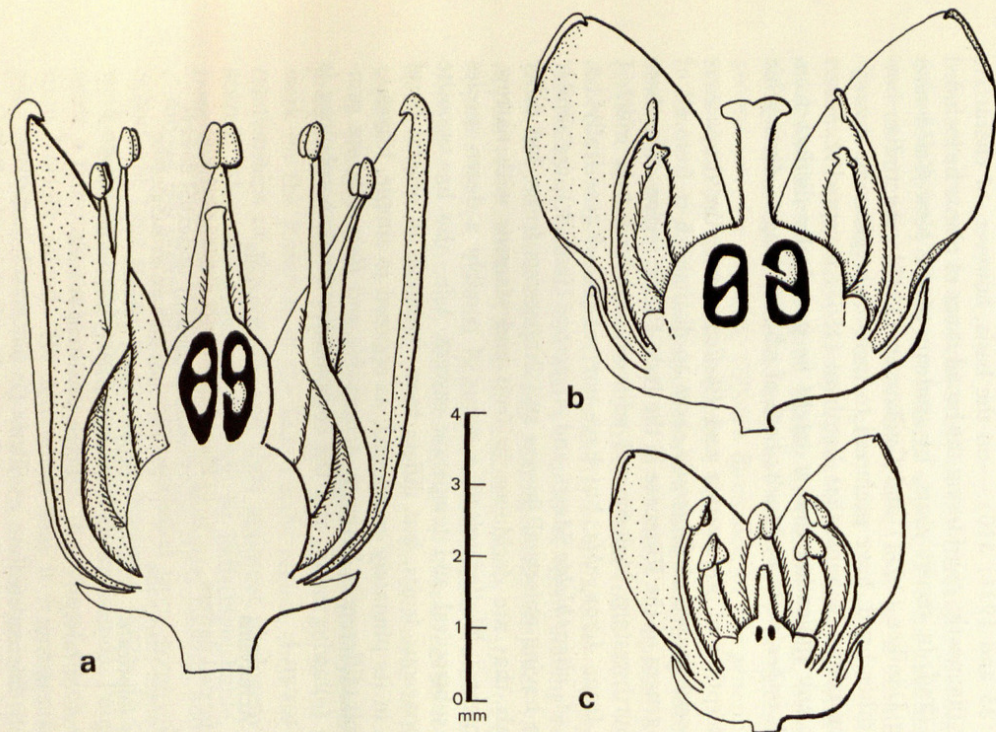


FIGURE 1. Comparative floral morphology of *Acronychia* and *Bauerella*, all drawn to the same scale from preserved flowers: a, bisexual flower of *Acronychia murina* (Pullen 5290) — the enlarged disc is characteristic of this species, but in some other species of *Acronychia* it is similar to that of *Bauerella simplicifolia*; b, functionally carpellate flower of *Bauerella simplicifolia* (Moriarty 1510) — note the poorly developed anthers and peltate stigma; c, functionally staminate flower of *Bauerella simplicifolia* (Moriarty 1511) — note the reduced ovary, lacking ovules, and the undifferentiated stigma.

from Lanjouw and Stafleu's *Index Herbariorum*, Part I. ed. 5 (Regnum Vegetabile 31. 1964).

A	Arnold Arboretum of Harvard University, Cambridge
AD	State Herbarium of South Australia, Adelaide
BISH	Bernice P. Bishop Museum, Honolulu
BM	British Museum (Natural History), London
BRI	Queensland Herbarium, Brisbane
CANB	Herbarium Australiense, C.S.I.R.O., Canberra
GH	Gray Herbarium of Harvard University, Cambridge
K	Royal Botanic Gardens, Kew
MEL	National Herbarium of Victoria, Melbourne
MICH	University Herbarium, University of Michigan, Ann Arbor
NSW	National Herbarium of New South Wales, Sydney
NY	New York Botanical Garden, New York
P	Muséum National d'Histoire Naturelle, Paris
PR	Botanical Department, National Museum, Prague
UC	Herbarium of the University of California, Berkeley
US	National Museum of Natural History (Department of Botany), Smithsonian Institution, Washington, D.C.
W	Naturhistorisches Museum, Wien

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Bauerella Borzi, Bol. Orto Bot. Palermo 1: 155. 1897. TYPE SPECIES: *Bauerella australiana* Borzi, *nomen illegit.* (\equiv *Bauerella baueri* (Schott) Däniker, \equiv *Acronychia baueri* Schott).

Shrubs or small to medium trees; apparently always dioecious; indumentum of minute, simple trichomes. Leaves opposite or rarely in whorls of three, simple, petiolate; leaf blades pellucid-dotted, entire, pinnately veined. Inflorescences axillary, pedunculate, narrowly paniculate to subracemose. Flowers functionally unisexual, small and inconspicuous, globose or subglobose in bud; sepals 4, distinct or basally connate, valvate or rarely basally imbricate, persistent in fruit; petals 4, distinct, narrowly imbricate in bud, persistent in fruit; stamens 8, distinct, shorter than the petals, the antesealous slightly longer than the antepetalous, filaments flat, elliptic-oblong, ciliate, anthers 2-celled, obtuse or obtusely apiculate, dorsifixed, without pollen in functionally carpellate flowers; disc intrastaminal, pulvinate; gynoecium a single, 4-carpellate, 4-loculate pistil, rudimentary (reduced in size and without fully differentiated stigma or functional ovules; the latter usually not visible with $10\times$ magnification) in functionally staminate flowers, ovules 2 per locule, subcollateral or superposed, style short, stigma peltate, broadly 4-lobed. Fruit a 4-loculate drupe; mesocarp drying spongy-crustaceous to subwoody, endocarp car-

tilaginous. Seeds carunculate, 2 or (by abortion) 1 per locule; testa longitudinally roughened, with a thin, crustaceous outer layer (often not completely covering the seed) and a thick, bony inner layer; endosperm fleshy; embryo straight, cotyledons flattened, hypocotyl terminal.

The leaves range in length from about 3 to 20 cm. The leaf blades vary from chartaceous to subcoriaceous and range in shape from narrowly elliptic to obovate. The petioles are usually about one-third the length of the leaf blades. Inflorescences range in size from one-half to one and one-half times the length of the subtending petiole and tend to be narrowly paniculate, with a relatively large number of sessile or subsessile flowers, when functionally staminate, or subracemose, with relatively fewer pedicellate flowers, when functionally carpellate. Also, as is shown in FIGURE 1, there is a considerable size difference between the sexes of the flowers. Variations in size and shape of the drupes are shown by Green (1970: 212, fig. 1).

Collections and field observations made of *Bauerella simplicifolia* subsp. *simplicifolia* in Brisbane (Moriarty 1510 and 1511, both CANB) and on Mt. Dromedary, in southeastern New South Wales (Craven 2583 and 2588, both CANB), have shown that the plants are dioecious. This is almost certainly the condition throughout the genus, because, in over 250 different collections examined, I have not found any single specimen bearing flowers of both sexes or both fruits and male flowers.

In its distribution, *Bauerella* demonstrates, as do a significant number of other eastern Australian rain forest genera, a strong phytogeographic link between Australia and New Caledonia. Its further eastward presence in the New Hebrides and Fiji, however, coupled with its absence in New Guinea, is quite unusual. Interestingly, this distribution closely parallels that of the curious amentiferous genus *Balanops* (Balanopaceae).

ENUMERATION OF THE SPECIES AND SUBSPECIES

1. *Bauerella simplicifolia* (Endl.) Hartley, comb. nov.

Vepris simplicifolia Endl. Prodr. Fl. Norfolk 89. 1833. TYPE: *Bauer*, December 5, 1804, Norfolk Island [w (sterile specimen and original *Bauer* pencil sketch of a flowering and fruiting specimen), holotype].

Acronychia simplicifolia (Endl.) McGillivray & Green, Jour. Arnold Arb. 51: 209. 1970.

1a. *Bauerella simplicifolia* (Endl.) Hartley subsp. *simplicifolia*.

Acronychia simplicifolia (Endl.) McGillivray & Green subsp. *simplicifolia*, Jour. Arnold Arb. 51: 209, fig. 1a. 1970.

Acronychia endlicheri Schott, Rutaceae. Frag. Bot. 3, t. 2. 1834, *nomen illegit.*, based on *Vepris simplicifolia* Endl.

Acronychia baueri Schott, Rutaceae. Frag. Bot. 5, t. 3. 1834. TYPE: *Bauer*, locality unknown, possibly Norfolk Island (not seen).

Acronychia hillii F. Muell. Frag. Phytogr. Austral. 1: 26. 1858. SYNTYPES:

Hill, Queensland, Brisbane River (MEL); *Mueller*, July, 1855, Queensland, Brisbane River (BM, GH, K, MEL, P).

Bauerella australiana Borzi, Bol. Orto Bot. Palermo 1: 155. 1897, *nomen illegit.*, based on *Acronychia baueri* Schott.

Bauerella baueri (Schott) Däniker, Viert. Naturf. Ges. Zürich 77 (Beibl. 19): 202. 1932.

1b. *Bauerella simplicifolia* (Endl.) Hartley subsp. *neo-scotica* (P. S. Green) Hartley, comb. nov.

Acronychia simplicifolia (Endl.) McGillivray & Green subsp. *neo-scotica* P. S. Green, Jour. Arnold Arb. 51: 211, fig. 1b. 1970. TYPE: *Deplanche 511*, New Caledonia, Port-Boisé (K, holotype).

1c. *Bauerella simplicifolia* (Endl.) Hartley subsp. *petiolaris* (A. Gray) Hartley, comb. nov.

Acronychia petiolaris A. Gray, U. S. Expl. Exped. (Wilkes Exped.) 14 (Bot. 1): 335. 1854 & Atlas, t. 33A. 1857. TYPE: *U. S. Expl. Exped.*, Fiji, Ma-thuata (GH, holotype; US, isotype).

Acronychia simplicifolia (Endl.) McGillivray & Green subsp. *petiolaris* (A. Gray) P. S. Green, Jour. Arnold Arb. 51: 212, fig. 1c. 1970.

2. *Bauerella leiocarpa* (P. S. Green) Hartley, comb. nov.

Acronychia leiocarpa P. S. Green, Jour. Arnold Arb. 51: 213, fig. 1d. 1970. TYPE: *Green 1211*, New Caledonia, NE slope of Ouen Toro, Nouméa (K, holotype).

Although it probably never will be settled, there is some question as to whether or not it is correct to treat *Bauerella baueri* as a synonym of *B. simplicifolia*. Schott described *Acronychia baueri* as being distinct from *Vepris simplicifolia* (as *Acronychia endlicheri*) mainly on the basis of its having staminal filaments that were eglandular, those of *V. simplicifolia* having been described as glandular. Unfortunately, I have not been able to check the accuracy of the descriptions of these species, because the only authentic (and probably the only extant) plant material at hand is a single, sterile sheet of *V. simplicifolia*. However, all of the flowering specimens I have seen, including several from Norfolk Island, the type locality of *V. simplicifolia*, agree with the description of *A. baueri* in having eglandular filaments. I suspect that the condition described for *V. simplicifolia* may have been the result of a misinterpretation of the material by Bauer and subsequently by Endlicher; the glands shown on the filaments in Bauer's sketch (w) are sessile and possibly are "blisters" caused by boiling the flowers. I do not think it is at all likely that two distinct species are involved.

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