

FOUR NEW SPECIES OF POLYALTHIA (ANNONACEAE) FROM BORNEO AND THEIR RELATIONSHIP TO POLYALTHIA INSIGNIS

David M. Johnson and Nancy A. Murray
Department of Botany-Microbiology
Ohio Wesleyan University
Delaware, Ohio 43015

Polyalthia Blume is a widespread paleotropical tree and shrub genus of 120–150 species with flowers bearing six similar petals in two whorls and an aggregate fruit of stalked berrylike monocarps. Its range extends from eastern Africa as far east as Fiji and Tonga, but its center of diversity is in the Malay Peninsula, where 30 species, including a number of common forest trees, are known to occur (Sinclair 1955; Kochummen 1972).

In the course of identifying material of Annonaceae from Borneo we encountered several *Polyalthia* specimens that could not be assigned to described species. All, however, bore a resemblance to the striking *Polyalthia insignis* (J. D. Hooker) Airy Shaw, an understory treelet with large racketlike leaves and showy orange-red flowers. Upon further study, we found that four undescribed species were represented, and that they consistently share with *P. insignis* a number of characteristics. All are shrubs or small trees up to ten meters tall. The leaves are oblique and subcordate or auriculate at the base, and have an opaque gray adaxial surface and pale brown abaxial surface. The inflorescences are internodal to leaf-opposed, or occasionally cauliflorous. The petals are orange or red, and may be quite large. The apex of the ovary is woody and persists as a short beak on the monocarp; the stigmas are capitate and cohere to drop as a cap at the end of anthesis. There are several ovules per carpel, and these are attached laterally in a vertical row. The seeds, where known, are wrinkled rather than strongly pitted on the outside, and lack a pronounced encircling groove. Several species have bristle-like golden trichomes, which are at present unknown elsewhere in the genus. A sixth species from Borneo, *P. microtus* Miquel, also shares many of these character states (Airy Shaw 1939; P. Keßler, pers. comm.), as do the species numbered 9–17 in Sinclair's treatment of *Polyalthia* for the Malay Peninsula (Sinclair 1955), namely *Polyalthia dumosa* King, *P. suberosa* (Roxb.) Thwaites, *P. evecta* (Pierre) Finet & Gagnep., *P. parviflora* Ridley, *P. hirtifolia* J. Sinclair, *P. bullata* King, *P. brunneifolia* J. Sinclair, *P. chrysotricha* Ridley, and *P. motleyana* (J. D. Hooker) Airy Shaw.

Workers on the Annonaceae recognize that *Polyalthia*, as circumscribed at present, is heterogeneous, and suspect that it is paraphyletic or polyphyletic (Setten & Koek-Noorman 1992; Rogstad & Le Thomas 1989; Doyle & Le Thomas 1994). The character states that define the genus, i.e., tree or shrub habit, petals in two whorls more or less alike and valvate in aestivation, numerous stamens with truncate connectives, numerous carpels with one basal or several lateral ovules, and indehiscent stipitate berrylike monocarps with one to several seeds, are largely considered plesiomorphic in the Annonaceae. The genus has never been monographed, and it appears that *Polyalthia* is a "default" genus defined only by an absence of conspicuous apomorphies.

Two recent revisionary papers have, however, identified and characterized groups of related *Polyalthia* species. Members of the *P. hypoleuca* complex from Malesia are large trees with white to yellow axillary flowers and a single basal seed in each monocarp (Rogstad 1989); those of a second species-group, which is from East Africa and Madagascar, can be compared to the *P. hypoleuca* group, but are shrubs to medium-sized trees (Schatz & Le Thomas 1990). Both groups are manifestly unlike the *Polyalthia insignis* species-group, as defined above. Heusden (1992) has suggested that *P. insignis* be returned to the monotypic genus *Sphaerotheranthus* in which it was first described. Although *P. insignis* is a distinctive species, we suggest that, in light of our results, such reorganization be postponed until the limits of the *P. insignis* species-group are better defined.

Polyalthia igniflora D. M. Johnson, sp. nov.—TYPE: BORNEO. Sabah (East Malaysia): Mt. Nunkok, 2500–3500 ft, 13 Apr 1933 (fl), *Clemens & Clemens* 32841 (holotype: A!; isotypes: L! NY!). Fig. 1.

Species *P. insigni* (J. D. Hooker) Airy Shaw proxima, cujus sepala magna imbricata chartacea persistentis, petala magna aurantiaca, apex ovarii lignosum, et stigmata cohaerentia ergo conjuncta cadentia habet. Differt lamina folii basi cuneata vel subcordata et petalis brevioribus 2.1–3.9 cm longis plusminusve lanceolatis et acutioribus. Species aequae *P. microto* Miquel similis, sepalis magnis 11–23 mm longis et 10–14.5 mm latis recedit.

Treelet or shrub 2–6 m tall, DBH 6–23 cm. Twigs 1.4–5 mm thick, longitudinally ridged or wrinkled, gray-brown to orange-brown, glabrous or hispid-pubescent with golden-brown to brown acicular hairs 0.5–0.7 mm long, eventually glabrate, occasionally sparsely lenticellate. Lamina of larger leaves 18.3–38+ cm long, 5.1–14 cm wide, chartaceous, olive-gray adaxially, usually paler and tan-colored abaxially, oblanceolate or oblong-oblanceolate (less commonly elliptic, oblong-elliptic, elliptic-oblanceolate, or obovate), acute to acuminate at the apex, obliquely rounded to subcordate at the base, glabrate or sparsely pubescent on both surfaces, midrib flat to impressed adaxially but with a longitudinal groove running along either side, raised abaxially; secondary veins 14–21 (–24) per side, departing at 45–65° from midrib, brochidodromous, the loops joining 4–10 mm in from margin, occasionally forming a continuous vein commissure, impressed adaxially, raised abaxially; intersecondaries and higher-order veins occasionally evident, indistinct adaxially, raised abaxially. Petiole 3.5–8 (–12) mm long, 2.2–4.7 mm wide, sparsely pubescent or glabrous, shallowly canaliculate adaxially. Inflorescence internodal, occasionally subopposite to the leaves, frequently on leafless segments of twigs; pedicels 1–2, arising from a tubercle, 7–27 mm long, 1.3–1.8 mm thick at midpoint, minutely pubescent with a small basal bract. Sepals brown, orange suffused with green, or dull orange-yellow, 11–23 mm long, 10–14.5 mm wide, chartaceous, ovate to triangular-ovate, acute, obtuse, or apiculate at apex, cordate and slightly imbricate at base, verrucose, glabrous adaxially, sparsely appressed-pubescent abaxially, often persistent after fall of other flower parts. Petals of both whorls orange, yellow, or dull red, fleshy, acute to obtuse at the apex, glabrous adaxially, sparsely appressed-pubescent abaxially; outer petals 2.1–3.6 cm long, 6.5–11.5 mm wide, lanceolate or oblong, occasionally grooved at the base adaxially; inner petals 2.5–3.9 cm long, 3.5–8 mm wide, always narrower than outer petals, linear-lanceolate, ligulate, oblanceolate, or lanceolate. Stamens numerous, the stamen boss 9–9.7 mm in diameter, stamens 1.8–2.7 mm long, clavate or oblong, glabrous; apex of

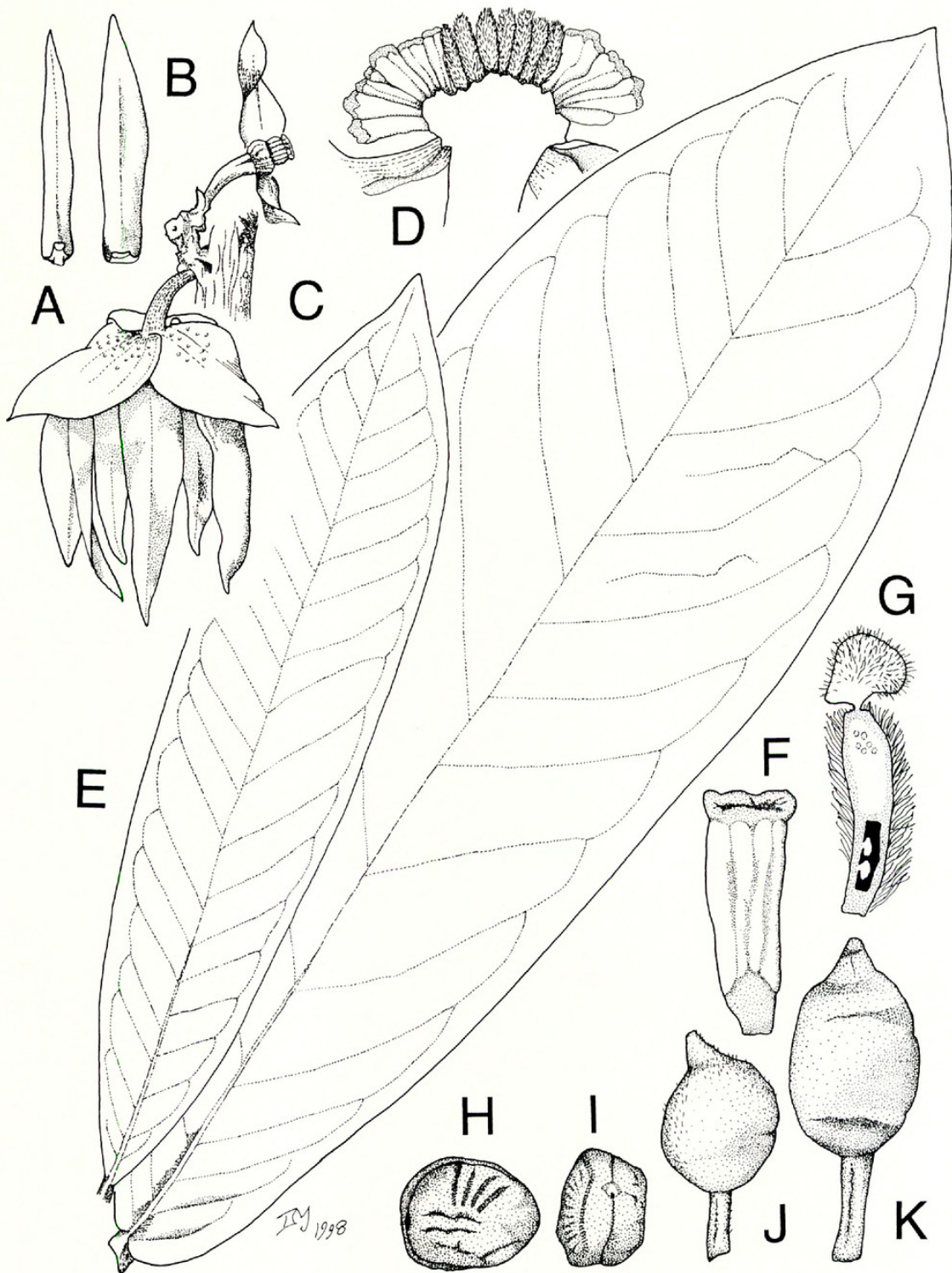


FIG. 1. *Polyalthia igniflora*. A. Inner petal, adaxial view, $\times 1$. B. Outer petal, adaxial view, $\times 1$. C. Inflorescence, $\times 1$. D. Longitudinal section of flower, showing depressed-globose torus, $\times 5$; the stigmas and petals have already fallen. E. Leaves, $\times 0.5$. F. Stamen, abaxial view, $\times 12.5$. G. Carpel, lateral view with ovary wall cut away to show ovule attachment, $\times 12.5$. H. Seed, lateral view, $\times 2.5$. I. Seed, end view, $\times 2.5$. J, K. Monocarps, lateral view, $\times 2.5$. Based on: A–G, Clemens & Clemens 32841 (A); H–K, Buntar SAN 27400 (L).

connective truncate, glabrous; filament 0.3–0.6 mm long. Carpels 30–50, densely pubescent to setose; ovaries 2–2.3 mm long, ovary locule small, surmounted by a solid woody apex ca. 1 mm long; ovules 2–4, attached laterally in a vertical row; stigmas ca. 1.2 mm long, capitate, connected to the ovary by a narrow stylar neck, coherent and falling as a unit after anthesis, densely white- or golden-hispidulous. Torus 4–6.3 mm in diameter, depressed-globose, often constricted between petals and androecium, setose on both staminate and carpellate portions. Fruit of 13–40 stipitate monocarps, borne on a pedicel 10 mm long, 1.7 mm thick at midpoint; torus of fruit 5–9 mm in diameter; monocarps 7.3–16.5 mm long, 6–6.8 mm thick, broadly ellipsoid to oblong, verrucose, sparsely appressed-pubescent; stipe 4.9–7.4 mm long, 0.8–1.2 mm thick, sparsely appressed-pubescent; apex rostrate, the beak 0.7–2 mm long; pericarp 0.2–0.3 mm thick. Seeds 2–4, attached vertically in a row at 75–90° to long axis of monocarp, roughly circular, 5.5–6 mm in diameter, 2.7–4.7 mm thick, elliptic in cross section, tan to golden-brown, smooth or lightly pitted and wrinkled; endosperm ruminations spinelike.

Local names: *andudong* (Buntar SAN 27352), *balentudong* (Buntar SAN 27400), *balinturun* (Murut Tenom, Angian 10305), *limpanas* (Malay, Bakar BNB 2373), *sipak-sipak* (Dyak, Howroyd SAN 29354).

ADDITIONAL SPECIMENS EXAMINED. **Borneo.** SABAH (EAST MALAYSIA): Bukit Oeloe Sebu, *Amdjah* 384 (K, L), 423 (L, U), 435 (L); G. Tenampak, *Amdjah* 602 (L, U); Bukit Sungei Tempilan, *Amdjah* 701 (L); Ranau District, Nobutan, *Amin et al.* SAN 129322 (K); Jesselton District, P. Sipanggar, *Ampuria* SAN 43576 (K); Tenom, *Angian* 10305 (K); Kulam Hill, Tenom, *Bakar BNB* 2373 (K); Kota Belud District, S side of Saduk-Saduk W of Mt. Kinabalu, 6°05'N, 116°29'E, *Beaman* 9971 (K, MSC, NY); Tenom, Pael Sapong, *Buntar* SAN 27352 (K, L); Tenom, Mandalom, *Buntar* SAN 27400 (K, L); Dallas, Mt. Kinabalu, *Clemens & Clemens* 26617 (A, K-2 sheets, L, NY), *Clemens & Clemens* 29086 (K, L, NY); Tenompok, *Clemens & Clemens* 29645 (A, K, L, NY); Tenom, *Cox* 1046 (L); Batu Puteh, *Creagh s.n. in 1895* (K); Tenom, *Gibbs* 2685 (K, MO); Beluran, 2 km S of Bt. Monkobo, *Gibot* SAN 94532 (L); Sandakan District, Sg. Kun-Kun, path to Sg. Tangkulap, *Gibot* SAN 97213 (K); Lahad Datu, Block 43 Bagahak, *Howroyd* SAN 29354 (K, L); Lahad Datu, F. R. Sg. Segama, *Madani & Ismail* SAN 108655 (K, L); Kota Kitabatangan, Projek Segeliud Lokan, *Majawat et al.* SAN 102416 (K); Keningau, near Billan logging area, Kg. Biah, *Mikil* SAN 42071 (K, L); Lahad Datu District, Block 61/11 Silabukan F. R., *Pereira* SAN 29762 (K); Kalabakan District, Ulu Sungai Kalabakan, *Pikkoh* SAN 103675 (K); Sandakan District, Ulu Sg. Pinangah, *Sigin G. & Lideh S.* SAN 107182 (K); Sandakan, Sg. Tabing, *Wing* SAN 34968 (K, L); Kuala Belait, Compartment 8, Andalau Forest Reserve, *Wood* SAN 17569 (K); Kota Belud, on hill S of Tabilong, Mile 18 on path from Kota Belud to Kudat, *Wood & Wyatt-Smith* SAN A4327 (L); without definite locality, *Yates* 20 (K, US).—BRUNEI: Tutong, Layong-Gedong Pipeline track, Lamunin, 4°42'N, 114°45'E, *Kirkup* 230 (K), 285 (K).—KALIMANTAN (INDONESIA): East Borneo, Central Kutei, Belajan R., G. Kelepok near Tabang, *Kostermans* 10453 (L); E. Borneo, Berau, Tdg. Redeb, Kelai River near Long Lanuk, *Kostermans* 21108 (L).

Specimens with flowers have been collected from March to June, August, and from September to January; specimens with fruits were collected in May and October. *Polyalthia igniflora* occurs on slopes and ridgetops in primary lower montane forest throughout northern Borneo in the Malaysian state of Sabah, in Brunei, and also in northeastern Kalimantan. The species is most common at elevations of 500–1600 m, although it has been collected at elevations as low as 20 m. Climbing bamboos were noted at one locality, dipterocarps at two others; substrates of black soil, clay loam, and a red-brown clay-loam soil were mentioned by one collector each.

This species shares a number of characteristics with *P. insignis*, with which it has been confused: the sepals are large, chartaceous, imbricate in bud, and persistent after anthesis; the petals are large and brightly colored (various shades of yellow, orange, or red); the upper part of the ovary is solid and woody, a characteristic of

P. insignis remarked upon in Hooker's protologue; and the stigmas abscise as a group and fall from the flower in a coherent mass. The leaves of *P. igniflora*, however, are oblanceolate or oblong-oblanceolate, tapering to a cuneate or subcordate base, while the leaves of *P. insignis* are characteristically panduriform, terminating in a strongly auriculate base that often clasps the stem. The petals of *P. igniflora* are lanceolate and reach a maximum length of 3.9 cm; both whorls of petals in *P. insignis* are spatulate, a characteristic noted and clearly illustrated by both Hooker (1860) and Beccari (1871), commonly 4–7.5 cm long, and obtuse at the apex. Furthermore, *P. insignis* is found primarily at low elevations (0–500 m); Beccari (1871) noted that *P. insignis* in Sarawak is commonest in the humid lowlands, and that in hilly sites it is usually confined to streambanks. Beccari and several subsequent collectors have also reported that *P. insignis* forms thickets in certain localities. In contrast, *P. igniflora* is a montane species, does not occur along streams, and is not known to form thickets.

Polyalthia igniflora can also be compared to *P. microtus*, described by Miquel from Korthals specimens collected on Mt. Sakumbang in southern Borneo. The most easily measured difference between the two species are the longer and wider sepals of *P. igniflora*, which persist after anthesis; those of *P. microtus*, including those of the type specimens, rarely reach 10 mm in length, are usually narrower, and abscise immediately following anthesis.

Airy Shaw (1939) drew attention to the wide variability of *P. insignis*, and also to a number of its synonyms, *Unona miniata* Elmer, *Polyalthia dolichophylla* Merrill, and *P. elmeri* Merrill, and given the similarity of *P. igniflora* it seemed advisable to examine type material of those names. All are, however, identical with *P. insignis* in its strict sense.

Also involved is *Unona jambosifolia* Ridley (Bull. Misc. Inform. 1912: 384. 1912). We have seen the two syntypes at K, *Fraser s. n.* in 1885 from Kudat, British North Borneo [Sabah], and *Creagh s.n.* in 1895 from Batu Puteh [Putik], British North Borneo [Sabah], which represent two different species of *Polyalthia*. The Creagh specimen does not match Ridley's protologue and is identified here as *P. igniflora*; the Fraser specimen, in contrast, corresponds closely to Ridley's protologue in details of leaf size and shape, pedicel length, sepal shape, and petal length. The species represented by the Fraser specimen does not appear to have any other published name, and the combination ***Polyalthia jambosifolia*** (Ridley) D. M. Johnson is therefore proposed here.

Polyalthia igniflora is named for the color of the flowers, which exhibit a variety of fire-colored hues.

Polyalthia tipuliflora D. M. Johnson, sp. nov.—TYPE: BORNEO. Kalimantan (Indonesia): Berouw, Mt. Ilas Bunga, 16 Sep 1957 (fl), *Kostermans 13902* (holotype: L!).

Fig. 2.

Species petalis angustis *P. bullatae* King similis, sed laminis foliorum laevibus basi subcordato-cordatis, floribus caulinis brevipedicellatis, sepalis 6.5–11.3 mm longis caudatis, et petalis 4.2–6.1 cm longis differt.

Treelet 3–5 m tall, trunk 5 cm in diameter, bark smooth. Twigs 4.5–6 mm in diameter, light brown to gray-brown, densely covered with a pale yellow to pale brown tomentum formed of matted and twisted hairs 1.5–3 mm long. Lamina of larger leaves 36–61+ cm long, 11–12 cm wide, chartaceous, oblanceolate, olive-gray adaxially, tan abaxially, intact apices not seen, cordate to subcordate at the

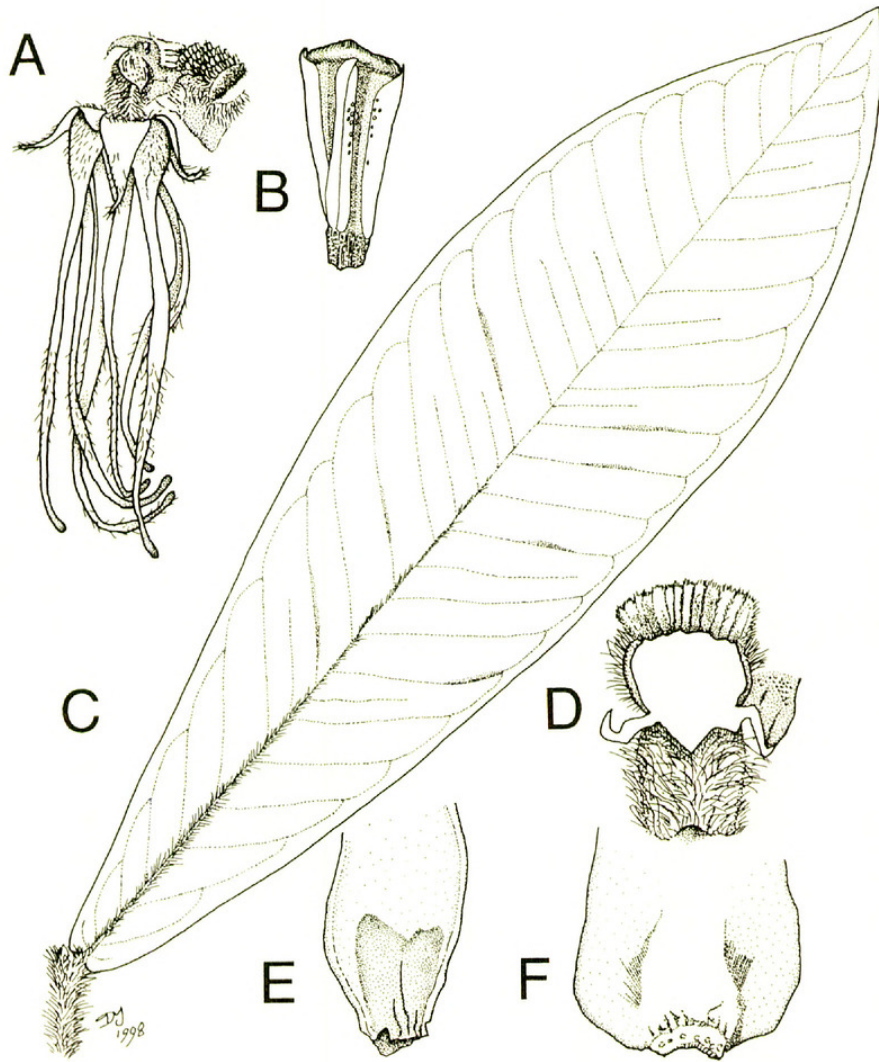


FIG. 2. *Polyalthia tipuliflora*. A. Flower, lateral view, $\times 1.5$. B. Stamen, abaxial view, $\times 12.5$. C. Leaf, $\times 0.5$. D. Receptacle, longitudinal section with ovaries and sepals still attached, $\times 5$. E. Adaxial base of inner petal, $\times 6.7$. F. Adaxial base of outer petal, $\times 6.7$. Based on: A, C, *Kostermans 13902* (L); B, D–F, *Kostermans 13940* (L).

base, with persistent erect hairs along midrib toward the base adaxially, with dense hairs along midrib and blade itself with a few scattered hairs abaxially; midrib impressed adaxially, raised abaxially; secondary veins 21–24 per side, departing at 60° from midrib, impressed adaxially, raised abaxially, brochidodromous, loops joining 4–6 mm in from margin; intersecondaries and other higher-order veins raised and distinct abaxially. Petiole 12–13 mm long, 7–8 mm wide, terete, persistently tomentose. Flowers arising from woody tubercles on trunk or leafless twigs; pedicel 5–6 mm long, 2.5 mm thick at midpoint, hirsute; bracts not evident. Sepals 6.5–11.3 mm long, 4.5–5.5 mm wide at base, triangular, caudate, densely hirsute. Petals dirty-orange to orange, slightly fleshy, filiform, sparsely pilose to glabrous adaxially, sparsely pubescent to glabrous abaxially; outer petals 4.5–6.1 cm long, 5–6 mm wide, acute, subauriculate at base because of short inflexed claw; inner petals 4.2–5.9 cm long, 3–3.5 mm wide, acute. Stamens numerous, 2 mm long, glabrous; apex of connective truncate; filament 0.2 mm long. Carpels 80–100; ovaries ca. 1.5 mm long, oblong, densely pubescent; ovules 2, attached laterally one above the other in the lower one-half of ovary; stigmas connivent and deciduous,

0.7 mm long, fine-pubescent at apex. Torus 3–4.5 mm in diameter, depressed globose, with persistent hairs on staminate and carpellate portions. Fruit unknown.

ADDITIONAL SPECIMEN EXAMINED. **Borneo.** KALIMANTAN (INDONESIA): East Borneo, Berouw, Mt. Ila Bunga, *Kostermans 13940* (L).

The two flowering specimens were both collected in mid-September. This species is known only from forested limestone rocks and sandstone ridges in eastern Borneo at an elevation of about 400 m. *Polyalthia tipuliflora* has very large leaves like those of *P. insignis*, but the leaf is gradually narrowed toward the base rather than panduriform, and the base itself is cordate or subcordate rather than auriculate. The flowers resemble most closely those of *P. bullata* because of the small sepals and exceedingly long and narrow petals, the latter giving the flower a resemblance to a crane-fly; *P. tipuliflora* differs from *P. bullata*, however, in having short pedicels borne on leafless twigs, longer sepals that are caudate at the apex, longer petals, and hairs that form a matted tomentum rather than lines of spreading bristles.

Polyalthia montis-silam D. M. Johnson, sp. nov.—TYPE: BORNEO. Sabah (East Malaysia): Lahad Datu, Mt. Silam, ca. 900 ft, 23 Apr 1962 (fl), *Chai SAN 29400* (holotype: L!). Fig. 3A–E.

Species forsan *P. microto* Miquel proxima, sed foliis pallidis nervis lateralibus adaxialiter indistinctis, pedicellis brevibus 2.6–4 mm longis, et petalis 1.4–3.3 cm longis et 5–6.5 mm latis differt.

Shrub or small tree 2–10 m high, trunk up to 22 cm in diameter. Twigs 1.7–3.4 mm thick, somewhat ridged or fluted longitudinally, orange-brown, brown, or black, at first with spreading short (ca. 0.5 mm long) golden to rufous hairs, eventually glabrate. Lamina of larger leaves 17.2–34+ cm long, 3.8–9.2 cm wide, chartaceous, narrowly elliptic or oblanceolate, occasionally oblong-elliptic, oblong-oblanceolate, or even linear, acuminate, acute, or obtuse at the apex, broadly cuneate and obliquely subcordate at the base, at length glabrate on both surfaces; midrib slightly impressed to plane adaxially, raised abaxially; secondary veins 15–22 per side, departing at 60–75° from midrib, arcuate, indistinct adaxially, slightly raised abaxially, weakly brochidodromous, the loops joining 5–8 mm in from margin; higher-order veins indistinct. Petiole 1.5–8 mm long, 2.5–4 mm wide, terete, pubescent. Inflorescence internodal, flowers usually arising singly; pedicel 2.6–5 mm long, 1.5–2 mm thick at midpoint, pubescent, articulate with a 1 mm long bract toward base. Sepals free and imbricate or connate at base, 5–7.5 mm long, 4.5–6.5 mm wide, ovate-triangular, acuminate at apex, chartaceous, glabrous and verrucose adaxially, pubescent abaxially. Petals yellow to orange, fleshy, subequal, free or connate at base, 1.4–3.3 cm long, 5–6.5 mm wide, lanceolate, acute to obtuse at apex, glabrous adaxially, glabrous to sparsely pubescent abaxially. Boss of stamens 7 mm in diameter, stamens ca. 2 mm long; apex of anther connective truncate, glabrous; filament minute. Carpels 20–30, sericeous; stigmas pubescent. Monocarps of immature fruit ca. 6 mm long, pubescent, short-stipitate, apiculate.

ADDITIONAL SPECIMENS EXAMINED. **Borneo.** SABAH (EAST MALAYSIA): Lahad Datu, Silam, Block 8, *Ambullah SAN 31461* (L); Lahad Datu District, Gunung Silam, 4°58'N, 118°10'E, *Beaman et al. 10057* (K, MSC, NY); Lahad Datu District, Gunung Silam, *Gambating SAN 95537* (K).

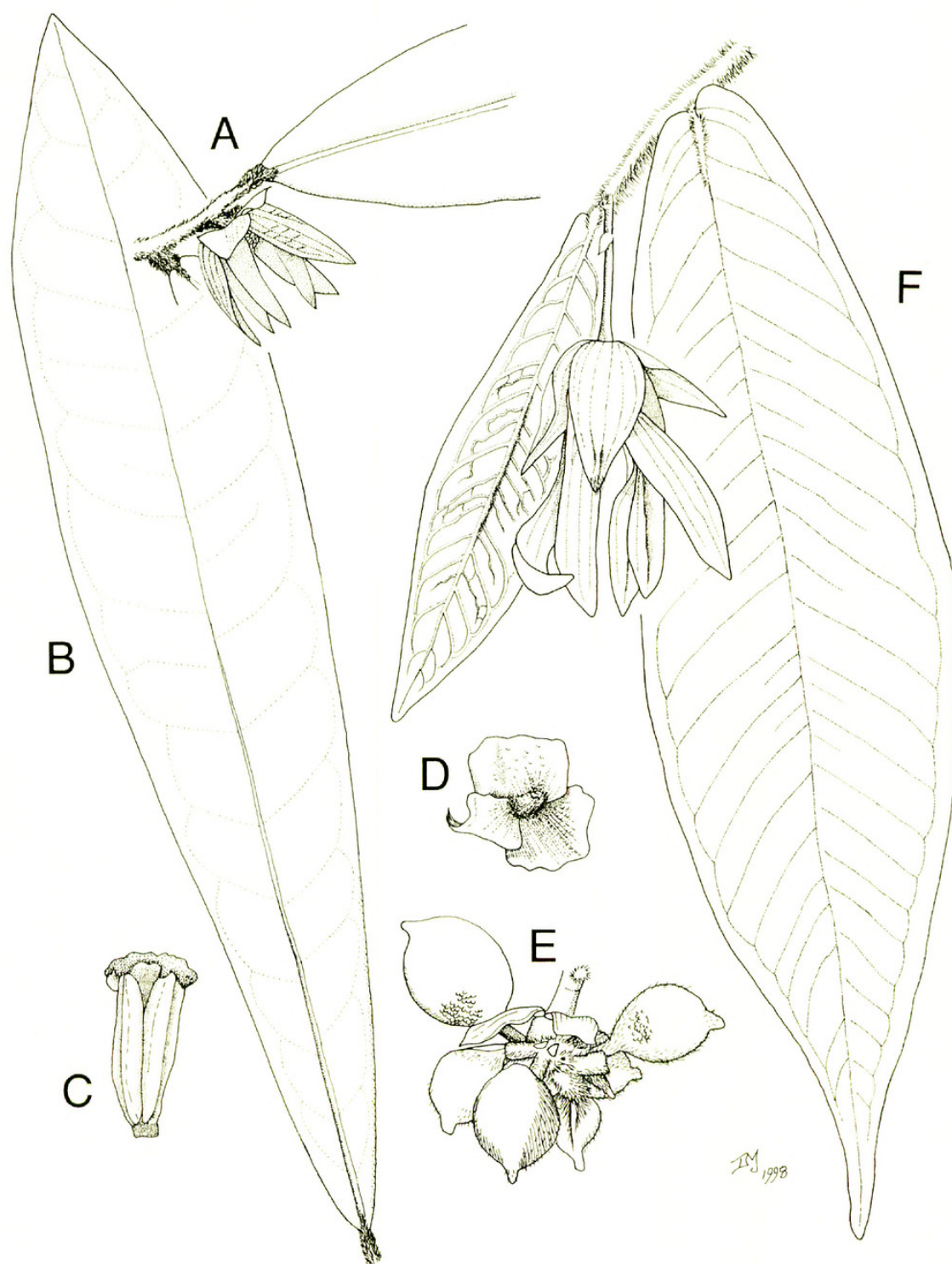


FIG. 3. *Polyalthia montis-silam* and *P. endertii*. A-E, *P. montis-silam*. A. Flower on shoot, $\times 1$. B. Leaf, $\times 1$. C. Stamen, abaxial view, $\times 12.5$. D. Sepals, abaxial view to show aestivation, $\times 2.4$. E. Fruit with young monocarps and persistent sepals, $\times 2.4$. F. *Polyalthia endertii*, habit. Based on: A-D, Chai SAN 29400 (L); E, Beaman 10057 (NY); F, Endert 4777 (L).

Flowering specimens have been collected from April through June; immature fruits were collected in June. The label of *Ambullah* SAN 31461 describes one individual as having a clear bole to 4.5 m, green bark, yellow inner bark, and a white cambium. This species is known from primary forest on Gunung Silam in eastern Sabah, where it grows on ultramafic soil at elevations between 120 and 300 m. Its distinctive features are the pallid leaves and short pedicels. The local name *pisang pisang* reported by one collector is widely used in Malaysia for species of *Polyalthia*.

Polyalthia endertii D. M. Johnson, sp. nov.—TYPE: BORNEO. Kalimantan (Indonesia): W. Koetai, no. 24, L. Iboet, 10 Nov 1925 (fl), *Endert 4777* (holotype: L!).

Fig. 3F.

Species *P. bullatae* King ramulis setosis, foliis basi auriculatis, et pedicellis longis similis, sed laminis foliorum laevibus, sepalis magnis chartaceis, et petalis latioribus 7 mm latis differt.

Treelet 3–5 m tall. Twigs 3–6 mm in diameter, brown, densely covered with yellowish gray to brown tomentum formed of erect acicular hairs ca. 1 mm long. Lamina of larger leaves 16.8–32+ cm long, 4.8–8 cm wide, chartaceous, oblanceolate and somewhat panduriform, olive-gray adaxially, tan-colored abaxially, acuminate at the apex with an acumen 18 mm long, obliquely auriculate at the base, the obtuse auricles 7 mm long and 7 mm wide, both surfaces of lamina with persistent hairs toward base of midrib; midrib impressed adaxially, raised abaxially; secondary veins 20–27 per side, departing at 70–80° from midrib, slightly impressed adaxially, raised abaxially, brochidodromous, forming a vein commissure 4–5 mm in from margin; intersecondaries and other higher-order veins indistinct adaxially, raised abaxially. Petiole 5 mm long, 2.7 mm wide, terete, persistently tomentose. Inflorescence internodal from leafy shoot, the pedicel 20 mm long, 1.5 mm thick at midpoint, sparsely pubescent, with an ovate acuminate pubescent bract 2.5 mm long and 1.8 mm wide and attached 6 mm above pedicel base. Sepals 20–21 mm long, 11 mm wide, lanceolate-ovate, chartaceous, imbricate at base, apex acute, with 7–8 evident parallel veins, sparsely pubescent on both surfaces. Petals subequal, slightly fleshy, 2.7 cm long, 7 mm wide, oblanceolate, bluntly acute at apex, sparsely pubescent on both surfaces. Stamens numerous, apex of connective expanded over anther locules. Details of androecium and gynoecium not observed. Fruit unknown.

This species, known from a single specimen, was collected in forested hilly country of eastern Borneo at an elevation of 150 m. It is similar to *P. bullata*, which occurs in peninsular Malaysia, Sumatra, and Borneo, sharing with that species the setose twigs and abaxial midrib of the leaves, the large number of secondary veins, the relatively long flower pedicels, and the auriculate bases of the larger leaves. The leaves of *P. endertii*, however, lack a pronounced bullate surface, the lanceolate-ovate sepals are 20–21 mm long, and the petals are oblanceolate, 2.7 cm long, and 7 mm wide. The flowers of *P. bullata*, in contrast, have lanceolate sepals 3–7 mm long, and linear petals 2.5–4 cm long and 2.5–3 mm wide.

ACKNOWLEDGMENTS

We thank the curators of the following herbaria for making specimens available for this study: A, ASU, F, GH, K, L, MICH, MSC, NY, U, US. We also thank Paul Keßler for helpful suggestions and for assistance in selecting appropriate specimens at L for our study.

LITERATURE CITED

- Airy Shaw, H. K. 1939. Additions to the flora of Borneo and other Malay islands. Kew Bull. 1939: 275–290.
- Beccari, O. 1871. Illustrazione di nuove o rare specie di piante bornensi. Nuov. Giorn. Bot. Ital. 3: 177–193 + pl. 2–6.
- Doyle, J. A., and A. Le Thomas. 1994. Cladistic analysis and pollen evolution in Annonaceae. Acta bot. Gallica 141(2): 149–170.
- Heusden, E. C. H. van. 1992. Flowers of Annonaceae: morphology, classification, and evolution. Blumea, Suppl. 7: 1–218.
- Hooker, J. D. 1860. Illustrations of the Floras of the Malayan Archipelago and of Tropical Africa. Trans. Linn. Soc. London 23: 155–156.
- Kochummen, K. H. 1972. Annonaceae. In *Tree flora of Malaya*, ed. T. C. Whitmore, vol. 1. Kuala Lumpur: Longman.
- Rogstad, S. H. 1989. The biosystematics and evolution of the *Polyalthia hypoleuca* complex (Annonaceae) in Malesia, I. Systematic treatment. J. Arnold Arbor. 70: 153–246.
- Rogstad, S. H., and A. Le Thomas. 1989. Pollen characters of the *Polyalthia hypoleuca* complex (Annonaceae): their significance in establishing monophyly and candidate outgroups. Bull. Mus. Natl. Hist. Nat. Paris, sect. B, Adansonia 11: 257–278.
- Schatz, G. E., and A. Le Thomas. 1990. The genus *Polyalthia* Blume (Annonaceae) in Madagascar. Bull. Mus. Natl. Hist. Nat. Paris, sect. B, Adansonia 12: 113–130.
- Setten, A. K. van, and J. Koek-Noorman. 1992. Fruits and seeds of Annonaceae: morphology and its significance for classification and identification. Biblioth. Bot. 142: 1–101.
- Sinclair, J. 1955. A revision of Malayan Annonaceae. Gard. Bull. Straits Settle. 14(2): 149–516.



Johnson, David M. and Murray, Nancy A. 1999. "FOUR NEW SPECIES OF POLYALTHIA (ANNONACEAE) FROM BORNEO AND THEIR RELATIONSHIP TO POLYALTHIA INSIGNIS." *Contributions from the University of Michigan Herbarium* 22, 95–104.

View This Item Online: <https://www.biodiversitylibrary.org/item/45698>

Permalink: <https://www.biodiversitylibrary.org/partpdf/186219>

Holding Institution

Missouri Botanical Garden, Peter H. Raven Library

Sponsored by

Missouri Botanical Garden

Copyright & Reuse

Copyright Status: In copyright. Digitized with the permission of the rights holder.

License: <http://creativecommons.org/licenses/by-nc-sa/3.0/>

Rights: <https://biodiversitylibrary.org/permissions>

This document was created from content at the **Biodiversity Heritage Library**, the world's largest open access digital library for biodiversity literature and archives. Visit BHL at <https://www.biodiversitylibrary.org>.