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A REVIEW OF BORNEAN ZINGIBERACEAE: V (ZINGIBER)

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ABSTRACT. The Bornean members of the genus *Zingiber* are reviewed and a key to the species is given. Two new species are proposed: *Z. pseudopungens* and *Z. martinii*; also a new variety: *Z. puberulum* var. *borneense*.

The genus *Zingiber* is readily recognized by the character of the more or less sessile anther, the apical portion of which is prolonged into an elongated crest which embraces the upper part of the style. With rare exceptions, the usually fusiform to cylindric inflorescence arises at the base of the leafy shoots, often on a long, sometimes subterranean, peduncle. The large overlapping bracts each subtend a non-tubular bracteole and a single flower. The labellum is usually prominently 3-lobed, more rarely obscurely so; the lateral lobes are generally taken to represent the lateral staminodes. The corolla tube is often thickened to a marked degree, the style hidden within a groove throughout its length.

Zingiber is also easily distinguished in the vegetative state. Between the base of the lamina and the ligule lies a swollen area or pulvinus; anatomically this is caused by the collenchymatous thickening of the cells of the vascular bundle sheaths (Tomlinson in *J. Linn. Soc. Bot.* 55:568, 1956; Olatunji—unpublished Ph.D. Thesis). In other zingiberaceous genera the sheaths are sclerenchymatous.

At specific level the picture is very different, and the difficulties encountered when trying to elucidate the genus as it occurs in Borneo are enormous. Ten species and two varieties of Javan natives have been described, often very badly and, occasionally, from material that lacked complete flowers. Valeton (*Bull. Jard. Buitenz.* sér. 2, 27:118–148, 1918), who unfortunately had little knowledge of the Bornean species, suggested a classification based on labellum shape, and also showed that bracteole length, in relation to that of the calyx, might be of importance. A further useful character may lie in the lateral petals which are, in most species, joined by their adjacent sides to each other and to the centre of the labellum (Fig. 1); hitherto, this feature has rarely been accurately described. In order to assess the usefulness of such a character, and those suggested by Valeton, first-class material is of the essence; at the present time this is not

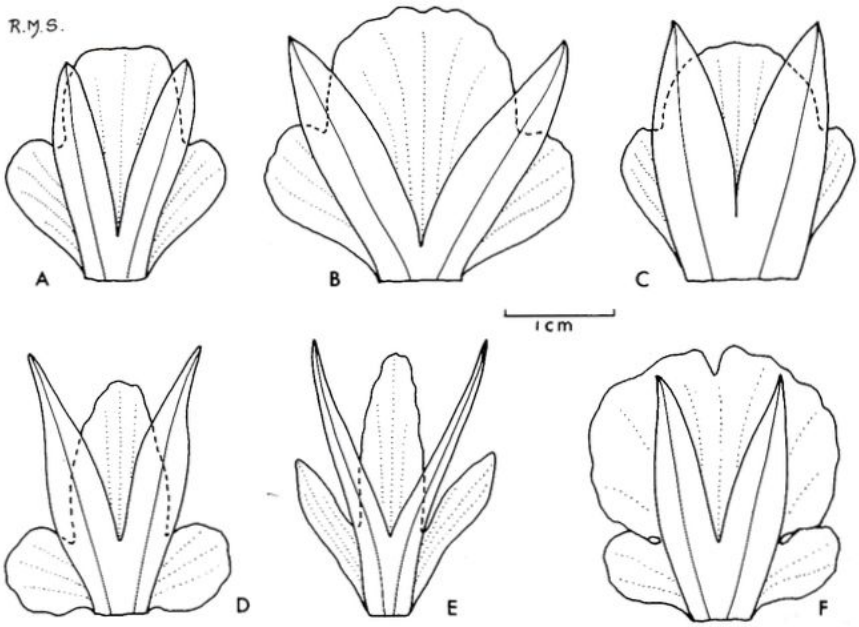

FIG. 1. Labellum shape and lateral petals in some species of *Zingiber*. A, *Z. coloratum*; B, *Z. albiflorum*; C, *Z. pachysiphon*; D, *Z. incomptum*; E, *Z. puberulum* var. *borneense* Vel. aff. (*Gardner* 83); F, *Z. zerumbet*.

available. The following observations are of interest, but relate to little more than half the known taxa.

In *Z. pachysiphon, Z. albiflorum, Z. acuminatum* var. *borneense* and *Z. coloratum* the petals are connate well below the shallow sinuses of the lateral lobes of the labellum, and in *Z. pachysiphon*, and *Z. pseudopungens* they are more or less free. Valeton described *Z. leptostachyum* as having obscure lateral labellum lobes, the petals joined in the lower 5mm only. In *Z. longipedunculatum* and the closely related *Z. incomptum*, the petals are connate at or above the level of the more deeply cut sinuses, i.e. the lateral lobes of the labellum are clearly defined. This is also the case in *Z. purpureum, Z. zerumbet, Z. martinii, Z. puberulum* var. *borneense* and the species of the *Z. griffithii* complex. There is, therefore, a possibility that Valeton's classification based on lip-shape might be extended to incorporate the lateral petals as an ancillary character (Fig. 1). In most Bornean species the bracteoles are more or less equal to the calyx in length, only in *Z. pachysiphon, Z. leptostachyum* and *Z. sp.* aff. *puberulum* (*Gardner* 83) are they known to be much reduced.

In fairness to the field worker it should be stressed that the genus is one of the most difficult of all Zingiberaceae to collect satisfactorily; the flowers often open only one or two at a time and it is difficult to prise them from the bracts without damage—bracteoles are not infrequently left behind. Short of studying the plants over a long period (as Valeton was able to do at Bogor), whole inflorescences in alcohol provide the best solution. These must be accompanied by good notes, paying particular attention to the habit of the peduncle and the colour of the bracts at different stages of the inflorescence's life cycle.

Two new species are described below and there is no doubt that several others await description. The following key relies heavily on vegetative features, but floral characters have been used wherever possible. Although exceptions have been made, many taxa, frequently known from single, flowerless collections, have been excluded; their inclusion would render an already unsatisfactory key unworkable, and such entities are referred to under the species to which, it is felt at the present time, they may be related.

About 60 species of *Zingiber* have been described. Their distribution ranges from the southern islands of Japan to New Guinea, but is centred in Malaysia and Indonesia.

KEY TO THE SPECIES

1. Lip spotted purple and yellow 2
+ Lip plain, yellow or white 3

2. Leaves linear . . . . . 1. *Z. officinale*
+ Leaves oblong-lanceolate . . 19. *Z. odoriferum* var. *borneense*

3. Apices of bracts (and sometimes their upper margins) reflexed . 4
+ Apices of bracts flat, bracts sometimes concave 8

4. Bracts rounded at apex, strongly recurved and forming pouches; inflorescence held erect on a stout, up to 25cm peduncle 2. *Z. pachysiphon*
+ Bracts acute at apex, recurved; peduncle usually prostrate, if erect then slender and up to 15cm 5

5. Leaves lanceolate; peduncle prostrate 6
+ Leaves linear; peduncle prostrate or erect 7

6. Peduncle not exceeding 6cm; inflorescence to 3·5cm wide 4. *Z. incomptum*
+ Peduncle 15–50cm; inflorescence to 5–7cm wide 5. *Z. longipedunculatum*

7. Leaf-sheaths densely shaggy pubescent; peduncle prostrate 6. *Z.* sp. A
+ Leaf-sheaths shortly pubescent; peduncle probably erect 7. *Z.* sp. B

8. Bracts with spine-like tips and 'frilled margins' 3. *Z. pseudopungens*
+ Bracts never as above. 9

9. Leaves linear, usually at least 10 times as long as broad 11. *Z. purpureum*
+ Leaves lanceolate to elliptic, usually less than 6 times as long as broad. 10

10. Ligule to 2·5cm long, thin, entire; inflorescence short and broad (c.5 × 2·5–3·5cm); bracts with conspicuously membranous margins 12. *Z. zerumbet*
+ Ligule under 1cm long; inflorescence if less than 5cm long then under 2cm wide; margins of bracts rarely conspicuously membranous . 11

11. Leaves narrowed at the base into a (1–) 2–2.5cm 'winged' petiole; ligule to just under 1cm, rounded, entire . . . 13. *Z. martinii*
+ Leaves rounded or attenuate at the base; ligule bilobed or truncate 12

12. Leaf-sheaths conspicuously shaggy (hair often brownish) over the entire surface or more or less confined to the margins; peduncle usually prostrate 13
\+ Leaf-sheaths shortly pubescent or more or less glabrous; peduncle more or less erect. 15

13. Ligule bilobed; leaves rounded at the base and very shortly petiolate, the margins densely hairy; lateral petals connate at the level of the sinuses of the side lobes of the labellum. . 14. *Z. puberulum* var. *borneense*
\+ Ligule truncate; leaves attenuate at the base, the margins glabrous or more sparsely pubescent; lateral petals connate at well below the sinuses of the side lobes of the labellum 14

14. Bracts concave; leaf-sheaths hairy throughout; midrib brownish pubescent below. . . . . 15. *Z. acuminatum* var. *borneense*
\+ Bracts flat; leaf-sheaths hairy at margins only; midrib more or less glabrous below . . . . . 16. *Z. coloratum*

15. Inflorescence green with red margins, becoming red when flowering has ceased; lateral petals connate below the shallow sinuses of the broad labellum; flowers white . . . . . 17. *Z. albiflorum*
\+ Inflorescence red (rarely yellow) throughout its life-cycle; lateral petals connate at or above the level of the sinuses of the side lobes of the labellum (except in *Z. leptostachyum*); flowers pale yellow, rarely white . 16

16. Labellum almost entire; petals free more or less to the base; plant quite glabrous; inflorescence less than 2cm wide . 18. *Z. leptostachyum*
\+ Labellum with well-developed side lobes; plants with at least some degree of pubescence 17

17. Leaves thin, appearing 'ribbed' when dry; bracts conspicuously gland dotted in herbarium material; bracteoles absent . . 8. *Z. griffithii*
\+ Leaves thick; bracts only occasionally gland dotted; bracteoles present 18

18. Inflorescence 10–15 × 2·5–3cm; leaves brownish when dry; ligule truncate . . . . . 9. *Z.* sp. C
\+ Inflorescence 10–25 × 2cm; leaves green when dry; ligule bilobed 10. *Z.* sp. D

1. Z. officinale Rosc. in Trans. Linn. Soc. ~~Bot.~~ 8: 348 (1807).
Type: no specimen at LINN or in Herb. Cliff.
Syn.: *Amomum zingiber* L., Sp. Pl. 1: 1 (1753).

Z. officinale is the root ginger of commerce, much cultivated throughout the tropics. It has been valued as a spice plant since ancient times and its true country of origin is unknown. Various races are grown in Malaysia and it is a common village plant. *Z. officinale* is recognized by the linear leaves and glabrous ligules; the flowers are characterized by the dull purple labellum which is spotted with yellow, but inflorescences are rarely produced.

2. Z. pachysiphon Burtt & Smith in Notes RBG Edinb. 29: 154, f.6A (1969). Fig. 1C.

Type: Sarawak, 3rd Division, Hose Mts, below Bukit Mabong, c.450–550m, on top of rock in forest, flowers cream, bracts dull light purple, 3 viii 1967, *Burtt & Martin* B4781 (holo. E).
Other material seen:
SARAWAK: 7th Division, Bukit Raya, Kapit distr., disturbed primary forest on streambed, bracts pink, flowers white, 31 iii 1969, *G. Smith* S27704 (AAU, KLU); 4th Division, Lambir National Park, leaves rather close with strong pulvinus, bracts livid red, the recurved tips white, flowers pale cream, 21 ix 1975, *Burtt* 11572 (E); 7th Division, Belaga Distr., Bukit Lobang, S of Punan Lusong, c.1600ft, plentiful in rich basalt soil of crater, livid purple bracts and cream flowers, young leaf shoots eaten, 25 viii 1978, *Burtt* 11300 (E).
SABAH: G. Lumarku, nr Sipitang, Mengalom to Milligan path, on bank by stream in tall rain forest, c.1000m, inflorescence an erect white 'torch', 23 iii 1980, *Argent & Lamb* 1542 (E).

Z. pachysiphon is characterized by the strongly recurved margins of the bracts which form almost *Curcuma*-like pouches. The colour of these bracts is variable; livid purple in the type plant, but specimens with bright red or almost white bracts have been recorded. These are probably no more than colour variants; they cannot be separated vegetatively. The lanceolate leaves are from 35–40 × 8–11cm, with sparse arachnoid hair on the lower surfaces and the prominent ligules are 1–2·5cm long, bilobed and of a thin, papery texture. The robust, cylindric inflorescence is held on a more or less erect, stout peduncle. The bracteole is considerably shorter than the calyx and the labellum shallowly 3-lobed, the lateral petals are connate well below the side lobes. The corolla tube is thickened to a marked degree.

3. Z. pseudopungens R. M. Smith **species nova** *Z. longipetiolato* Ridley pedunculo prostrato et inflorescentia lata similis, sed pedunculo breviore et apicibus bractearum pungentibus differt. Fig. 2A.

Herba 2m alta. Folia 15–20 × 2–4cm, anguste lanceolata, sessilia, glabra; ligula 1–2cm longa, membranacea, integra, glabra; vaginae leviter pubescentes. Pedunculus 5–8cm longus, fortasse subterraneus; inflorescentia ad 7 × 6cm ovata; bracteae usque ad 3·5 × 2·5cm, roseo-brunneae, apice pungentes, marginibus membranaceis crebre undulatis leviter pubescentibus; bracteolae c.2cm longae, ovatae. Flores cremei c.5·5cm longi; calyx 2·5cm, unilateraliter fissus; corollae lobi c.2·5cm; laterales ad labellum basi adnati; labellum 2·5 × 2cm, lobes lateralibus (staminodiis) 1 × 0·6cm, haud profunde incisus, lobo medio c.1·5 × 1cm, integro. Anthera sessilis, thecis c.1·8cm longis cristae longitudine aequalibus. Ovarium glabrum. Stylus in sulco per longitudinem corollae tubi percurrens; stigma ore ciliatum; glandulae epigynae lineares. Fructus ignotus.
Type: Sabah, Mt Kinabalu, Ulu Langani, Mamut rd, 3800ft, flowers pale yellow ochre, anther-crest deeper yellow, bracts edged pink, 10 viii 1961, *Chew, Corner & Stainton* 1710 (holo. K, iso. SING).
Other material seen:
SABAH: Kinabalu Park, shaded forest, 10 minutes from Poring Hot Springs on old Langanan trail, in bud, bracts pinkish brown, 19 v 1986, *Smith, Phillipps & Tan* S46/86 (E).

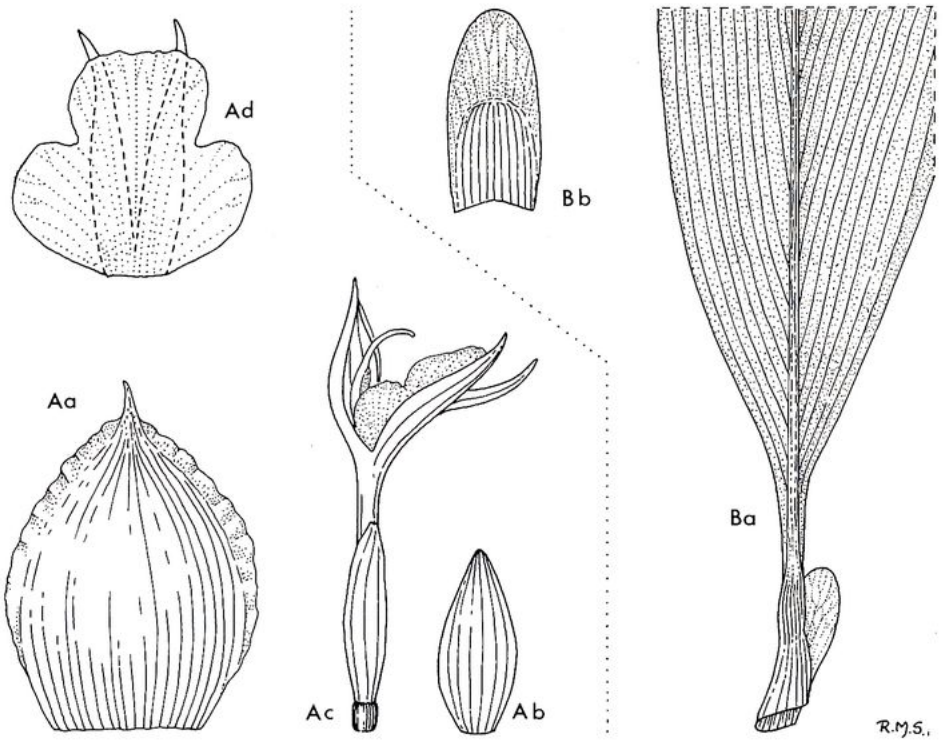

FIG. 2. A, *Z. pseudopungens*: Aa, bract × 1; Ab, bracteole × 1; Ac, flower × 1; Ad, labellum & lateral petals × 2 (from spirit & dried material of *Chew, Corner & Stainton* 1710). B, *Z. martinii*: Ba, part of leaf showing winged petiole & ligule × $\frac{2}{3}$; Bb, ligule × 1 (from *Burtt & Martin* B5302).

The almost spine-like tips, which are not recurved, and the frilled margins of the bracts of *Z. pseudopungens* are most distinctive. The short peduncle is probably always subterranean. The side lobes of the labellum are not deeply cut and the lateral petals more or less free to the base. The narrowly lanceolate leaves and membranous ligules are glabrous, the leaf sheaths lightly pubescent.

A further collection from Sabah (Ranau distr. nr Kampong Pinawanti, *Shea & Aban* SAN76770, K) differs in the very much longer peduncle (to 45cm) and red, rather than brownish pink, bracts which have less markedly pungent tips. Vegetatively it is identical to *Z. pseudopungens*.

4. Z. incomptum Burtt & Smith in Notes RBG Edinb. 29: 152, f. 6b (1969). Fig. 1D.
Type: Cult. RBG Edinb., ix 1964, C4328; originally collected from Sarawak, 1st Division, Poi Range, G. Berumpet, c.1066m, 13 viii 1962, *Burtt & Woods* B2831 (holo. E).

Z. incomptum is known from the type collection only. The inflorescence is borne on a short, decumbent peduncle, the green, red tinged, bracts are acuminate and shortly recurved at the tips. The leaves are more or less glabrous, measuring up to 23 × 6cm, with caudate acuminate apices, and there is a shallowly bilobed membranous ligule.

5. Z. longipedunculatum Ridley in J. Str. Br. Roy. Asiat. Soc. 50:149 (1908). Fig. 3.
Type: Sarawak, without precise locality, 1907, *Hewitt* s.n. (K).
Other material seen:
SARAWAK: 1st Division, Bau distr., B. Jebong, by streams on limestone-influenced soil, 100ft, in open secondary forest, flowering shoot with deep red bracts running along ground c.12 inches from leafy shoot, deep red bracts turning back to show yellow underside, young flowers pale yellow, open flowers white, 12 vii 1970, *Lehmann* S29413 (E); nr Bau, 18 ix 1978, *Bogner* 1434 (K); 5th Division, Long Ugong, Bakelalan to Murud, bright red bracts and peduncle, pale creamy flowers, forest margin by stream, 17 x 1967, *Burtt & Martin* B5558 (E); 7th Division, S Hose mts, W of B. Sanpandai, camp iv, c.4000ft, on top of large rock on forest slope, inflorescence red, upturned at end of long prostrate peduncle, flowers cream, 1 iv 1980, *Burtt* 12766 (E); Kapit distr., S Melinau, Rumah Ungka, c.200ft, inflorescence on long prostrate peduncle, bracts red, 19 iii 1980, *Burtt* 12650 (E); B. Sanpandai, Melinau, mossy forest, i iv 1980, *Manis & Salang* S41155 (K).

The inflorescence of *Z. longipedunculatum* with its recurved bracts is similar to that of *Z. incomptum*, but is wider (to 7cm) and much more robust. It is further distinguished by the very much longer peduncle, which is always prostrate, more thickened corolla tube, and larger leaves. The bilobed ligule is variably pubescent. Calyx and bracteole are almost equal in length, the lateral lobes of the labellum well-defined and, as in *Z. incomptum*, the lateral petals are connate at their level.

A collection from the Hose Mts in the 7th Division of Sarawak (*Burtt & Martin* B4803, E) deviates in the long (up to 2.5cm), membranous ligules which are similar to those of *Z. pachysiphon*. Dissection of an unopened bud shows the labellum shape to be as in *Z. longipedunculatum*.

6. Zingiber sp. **A**
SARAWAK: 4th Division, B. Nauong (Kana) Ulu Anap, c.900m, yellow sandy soils, Biban sandstone formation, upper limits of mixed dipterocarp forest, rich crimson bracts, aromatic leaves as well as roots, 11 × 1963, *Banying ak Nyudong* S19424 (K, AAU).

This collection is very distinctive vegetatively and is probably specifically distinct, but no flowers are available. It is characterized by linear (to 1·5cm wide), glabrous leaves, and densely shaggy pubescent ligules and leaf-sheaths. This hair is of the type in *Z. puberulum* var. *borneense* (no. 14 below), but the broad inflorescence and slightly recurved bract tips suggest a relationship with *Z. longipedunculatum*.

7. Zingiber sp **B**
SARAWAK: 1st Division, Kuching, viii 1905, *Hewitt* s.n. (K).

This taxon has the habit of *Z. officinale*, with which it agrees in the linear leaves and small, 4–6 × 2·5–3·5cm inflorescence which is held on a (probably) erect c.14cm peduncle. It differs in having pubescent leaf-sheaths and ligules, and recurved bract tips, and is perhaps closest to *Z. incomptum*.

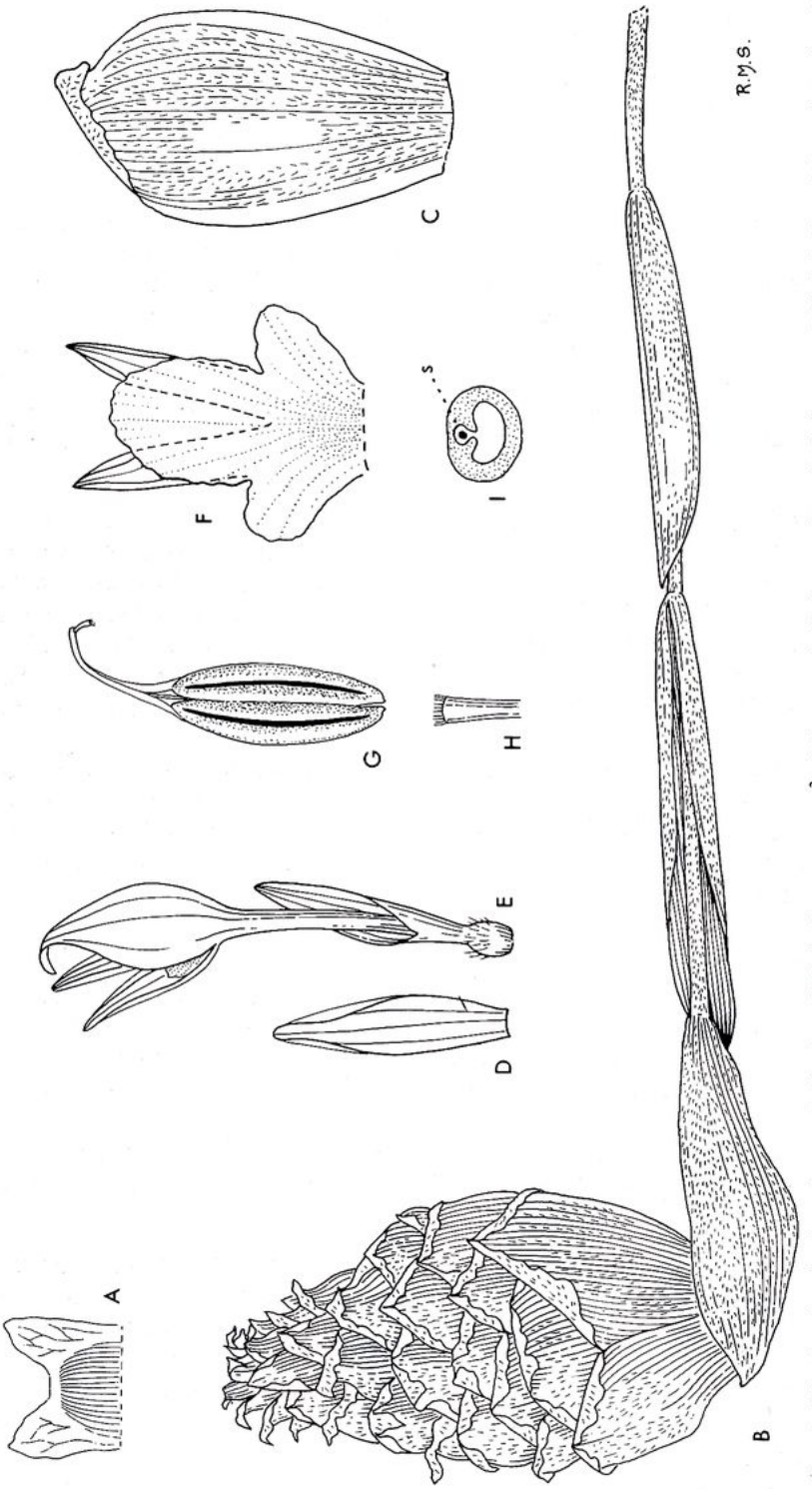

FIG. 3. *Zingiber longipedunculatum*. A, ligule × 1; B, inflorescence × $\frac{2}{3}$; C, bract × 1; D, bracteole × 1; E, flower × 1; F, labellum & lateral petals × 1; G, anther × 2; H, stigma, much enlarged; I, corolla-tube in T.S., s = style × 4 (from spirit material of *Lehmann* S29413).

8. Z. griffithii Bak., in Hook. f., Fl. Brit. Ind. 6: 246 (1892).
Syntypes: Malacca; *Griffith*, Kew distribution no. 5731 (K); bracts of a beautiful rose colour, 1867–68, *Maingay* 3168, Kew distribution no. 1564 (K).
The following probably belong here:
SARAWAK: 1st Division, Lundu distr., Mt Gading, c.2000ft, red bracts, flowers white, 18 vii 1963, *Chew Wee Lek* 583 (K); Kuching, swampy ground, flowers [bracts] red, 5 viii 1913, *Native collector* 35 (E).

Z. griffithii is reported to be fairly common in W Malaysia. In the dried state the upper surface of the elliptic leaves has a 'ribbed' appearance and the rather thin bracts are densely gland dotted. Neither of the above collections have flowers, but Holttum (*Gard. Bull. Sing.* 13:60, 1950) records that they are white or cream, the lateral petals connate to half way up the distinctly 3-lobed labellum. He could find no bracteoles on his material, and none can be observed on the Bornean plant from Mt Gading which bears some floral remnants. The colour of the bracts is usually red but yellow inflorescences may occur.

The following recent collections from Sabah approach *Z. griffithii* closely: Sandakan distr., Tawai plateau, Karamuak R, 100ft, on edge of primary rain forest, 6–12 ix 1977, *Gardner* 71 (E); Labuk rd, near stream, flowers [bracts ?] yellow, 15 vi 1977, *Talip & Ejan* SAN87050 (K); mile 30, Ulu Dusan, 12 viii 1977, *Lantoh* SAN87844 (K); Teluped, Hap Seng loging centre, 24 vi 1976, *Leopold & Taha* SAN83579 (K); Lamag distr., beside river draining south from G. Lotung, 1400ft, inflorescences red, flowers white, 22 v 1976, *Cockburn* SAN83355 (K).

The 'ribbed' appearance of the leaves is evident on all these collections and the character of the petals and labellum lobes (taken from *Gardner* 71, which has flowered in cultivation at Edinburgh) matches *Z. griffithii* well. However, no conspicuous glands can be seen on the bracts and the bracteoles are well-formed and more or less equal to the calyx in length.

9. Zingiber sp. **C**
SARAWAK: 5th Division, Bakelalan to Murud, slope below camp 1, S Komap, bright red bracts, pale yellow flowers, 16 x 1967, *Burtt & Martin* B5537 (E).
SABAH: Kinabalu Park, old Langanan trail, Poring Hot Springs, in deep litter, inflorescence (immature) red, 19 vi 1986, *Smith, Phillipps & Tan* S43/86 (E).
KALIMANTAN: Between Long Bawan and Panado, 1000m, evergreen forest along stream, on sandstone, scape and bracts red, perianth and labellum white, 17 vii 1981, *Geesink* 9086 (L, E).

In the herbarium, these collections are distinguished by the brownish green appearance of the lanceolate elliptic, thick-textured leaves. The ligules are truncate and densely pubescent. A single (imperfect) flower has been examined, from *Geesink* 9086; the lateral petals and labellum are probably as in *Z. griffithii*. Some inflorescences are sparsely gland-dotted.

10. Zingiber sp. **D**
SABAH: Beluran distr., S. Makopako, Bongya F.R., 15 vii 1975, *Kodoh & Aban* SAN81945 (K); Elopura Forest distr., mile 9, B. Garam, old Jap. trace,

damp places in dipterocarp forest, 50ft, flower white, bracts red, 1 vii 1949, *Keith* A2634 (K); Sandakan distr., Sepilok F.R., dark red at back of leaf, 26 v 1982, *Gambating* SAN90413 (K); Bettotan, peduncle red, inflorescence yellow, 23 vii 1927, *Boden Kloss* 18749 (K, SING).

In the distinctly caudate acuminate leaf tips, narrow (to 19 × 2·5cm) inflorescence and glabrous habit, these collections are superficially closest to *Z. leptostachyum*. They differ, however, in the rather thick, lanceolate leaves which are rounded at the base in all but *Boden Kloss* 18749, long bracteole and distinctly 3-lobed labellum. Sp. D and the preceding species are probably most closely related to *Z. griffithii*.

11. Z. purpureum Rosc. in Trans. Linn. Soc. 8: 348 (1807).
Type: Cult. Liverpool Bot. Gdn, no specimen extant.
Syn.: *Z. cassumunar* Roxb. in Asiat. Res. 11:347, t.5 (1810).
Type: probably the drawing, Icones Roxburghianae 501 (K).
The following may belong here:
SARAWAK: 3rd Division, Rejang. rec'd 22 vii 1911, *Barlett* s.n. (K).
SABAH: G. Moewara Tagal, 27 vi 1912, *Amdjah* 137 (K).

Z. purpureum is native to India and is a well-known medicinal plant widely planted throughout Malaysia. The above collections, with their narrow leaves and acute-tipped, pubescent bracts may belong to this species. Whether they were growing near native settlements is unrecorded.

12. Z. zerumbet (L.) Smith in Exotic. Bot. 2: 105, f.112 (1806). Fig. 1F.
Type: no specimen at LINN or in Herb. Cliff.
Syn.: *Amomum zerumbet* L., Sp. Pl. 1:1 (1753).
Bornean material seen:
SARAWAK: 7th Division, S Melinau, Rumah Ungkah, pale yellow flowers, 23 vii 1967, *Burtt & Martin* B5137 (E).
KALIMANTAN: Bangarmassing, flowers light yellow or nearly white, bracts green, red in fruit, common, 1857–8, *Motley* 27 (K).

Z. zerumbet was described from Sri Lanka and is much cultivated for its medicinal properties throughout SE Asia. It may be recognized by the up to 2·5cm long, papery ligules, short, broadly cylindric inflorescence, and the prominently membranous-margined bracts.

13. Z. martinii R. M. Smith **species nova** *Z. leptostachyo* Valeton ob plantam glabram et inflorescentiam anguste fusiformem similis, sed petiolis brevibus decurrentibus, ligula prominente integra, labello distincte trilobo differt. Fig. 2B.

Statura ignota. Folia 28–35 × 6–9cm, lanceolata, acuminata, basi in petiolum alatum (1–)2–2·5cm longum angustata, glabra; ligula 1cm longa, integra; vaginae glabrae. Pedunculus 18–20cm longus, fortasse erectus; inflorescentia 11–15 × 2–3cm, fusiformis, glabra; bracteae usque ad 4 × 2cm, apice rotundatae et plerumque mucrone parva instructa, marginibus membranaceis, virides vel roseae; bracteolae c.2cm longae, anguste lanceolatae. Flores cremei; calyx 3cm longus unilateraliter fissus; corolla c.6cm longa; lobi 2·5cm, anguste lanceolati, laterales ad labellum

ad medium (i.e. ad sinus loborum labelli lateralium) adnati; labellum 3·3 × 2·3cm, lobis lateralibus (staminodiis) 1·2 × 0.8cm, rotundatis, lobo medio oblongo integro. Anthera subsessilis, thecis 1·5cm longis, cristae longitudine aequalibus. Ovarium ad apicem pubescens; stylus in sulco per longitudinem corollae tubi percurrens; stigma ore ciliatum; glandulae epigynae lineares. Fructus ignotus.
Type: Sarawak, 4/5th Division boundary, Bakelalan to Mt Murud, stream below camp 3, pale pink bracts, pale cream flowers, 29 ix 1967, *Burtt & Martin* B5302 (holo. E).
Other material seen:
SARAWAK: 1st Division, Kuching, spike green, flowers yellow, 1 i 1915, *Ridley* s.n. (K); 5th Division, Bakelalan to Long Ugong, slender green bracted spikes and pale yellow flowers, wet forest soil, 18 × 1967, *Burtt & Martin* B5563 (E).

Z. martinii is a more or less glabrous plant with narrowly fusiform inflorescences which are held erect on peduncles of up to 18cm. The leaves are broadly lanceolate to elliptic, acuminate at the apex, the bases narrowed into a 1–2cm 'winged' petiole; the prominent ligule is rounded and entire. *Z. acuminatum* Val., a Javan native, has similar leaf bases but differs from *Z. martinii* in several important respects. Ridley determined his collection from Kuching as *Z. leptostachyum* and recorded the labellum as 'entire'; it is not possible to verify this from the preserved flower remains. Vegetatively and in inflorescence shape, Ridley's plant is identical with the holotype of *Z. martinii*.

A collection (*Lehmann* 388, E) from B. Jebong in the 1st Division of Sarawak, which is in immature fruit, lacks such markedly winged petioles.

14. Z. puberulum Ridley var. **borneense** R. M. Smith **var. nov.** a varietate typica ligula biloba et bracteis acutis vivide rubris differt.
Type: Cult. RBG Edinb., x 1965, C8005, originally collected from Sarawak, 7th Division, Hose mts, 23 viii 1967, *Burtt & Martin* B5127 (holo. E).
Other material seen:
SARAWAK: 7th Division, Hose mts, gorge of Ulu Melinau, on base of rotting tree, 16 viii 1967, *Burtt & Martin* B4936 (E).

Z. puberulum was described from W Malaysia and is distinguished by the dense yellow-browm indumentum of the leaf-sheaths and ligule. The inflorescence is fusiform, tapering gradually towards the apex, and the side lobes of the labellum are well defined. The Bornean variety differs in the distinctly bilobed ligule, the presence of a very short petiole (2–3mm), and acute, rather than rounded, bracts that are bright red as they emerge from the ground; in the species the bracts are pink at flowering. An illustration, made from the type plant of *Z. puberulum* var. *borneense* may be found in *Notes RBG Edinb.* 31:181, f. 1 (1972)—sub *Z. coloratum*.

A collection from Tiang Bekap, Padawan distr., in the 1st Division of Sarawak (on limestone, *Lee* S40029) has a similar indumentum but differs in the more robust inflorescence which is held erect on a stout peduncle of almost 50cm.

Tentatively placed here is *Gardner* 83 (Fig. 1E) which has flowered at Edinburgh from material collected in the Sandakan district of Sabah. In the

densely pubescent leaf margins, the shape of the inflorescence and in the character of the lip and lateral petals it agrees with *Z. puberulum*, but differs in having elliptic rather than lanceolate leaves and less pubescent leaf-sheaths.

15. Z. acuminatum Val. var. **borneense** Val. in Bull. Bot. Buitenz. sér. 3, 23:141 (1918). Fig. 4.
Type: Kalimantan, *Nieuwenhuis* s.n., cult. Bogor (L).
Other material seen:
SARAWAK: 1st Division, Bau distr., B. Jebong, on alluvial soil below limestone hill, 100ft, pink bracts, flowers white, 12 vii 1970, *Lehmann* S29414 (E); Mt Matang, pale cream flowers, dull pink bracts, 7 x 1967, *Burtt*

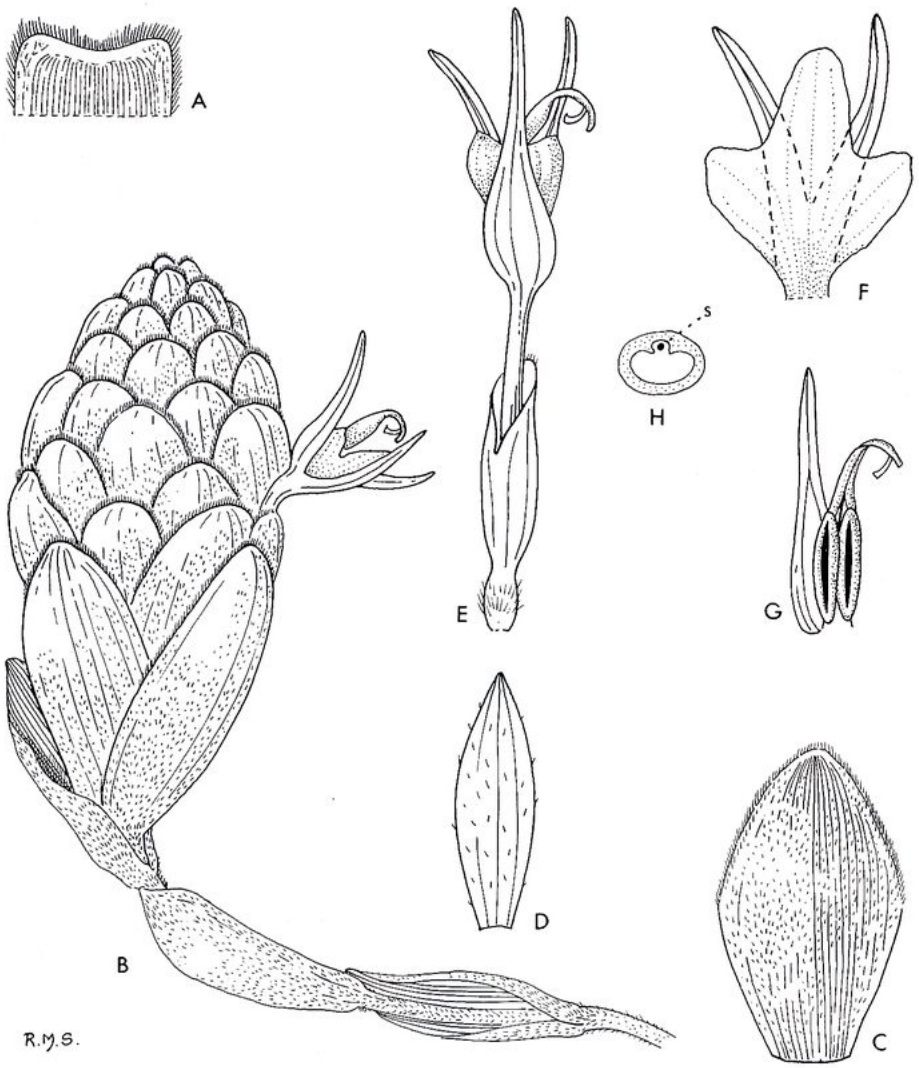

FIG. 4. *Zingiber acuminatum* var. *borneense*. A, ligule ×2; B, inflorescence ×⅔; C, bract ×1; D, bracteole ×1; E, flower ×1; F, labellum & lateral staminodes ×1; G, anther & dorsal petal ×1; H, corolla-tube in T.S., s = style ×4 (from spirit material of *Lehmann* S29414).

& Martin B5153 (E); B. Manok, Padawan rd, Kuching, limestone, inflorescence orange, corolla white, tinged creamy yellow at tip, 2 ix 1979, *Mamit* S41078 (K); *ibidem*, bright red bracts in fruit, 13 v 1975, *Burtt* 8135 (E); Klingklan range, Sabal F.R., 74th mile, Kuching/Simanggang rd, 1950ft, bracts bright red, flowers light yellow, 10 x 1979, *Yu Puan Ching* S40791 (K).

Until more is understood of *Zingiber* in Borneo, it is not proposed to accord specific rank to this variety; but the differences from the species, which was described from Java, are significant. *Z. acuminatum* var. *borneense* is distinguished from var. *acuminatum* by its shorter, elliptic inflorescence, densely brownish pubescence of the leaf-sheaths (described as 'sooty' by Valeton), shorter ligule and by the narrowed, rather than shortly 'winged' leaf bases. The leaves are narrowly to broadly elliptic, often reaching 30cm in length. The bracts of *Z. acuminatum* var. *borneense* are incurved at the more or less rounded tips, this distinctive feature being retained in the dried material.

Valeton recorded pale yellow concolorous flowers. The Leiden syntype has two labels; the second (unnumbered) bears the note '*flos pallide flavidus labio atropurpureo maculato*'. Valeton attributed this character to *Z. odoriferum* var. *borneense* (no. 19 below) and it is reasonable to suppose that an error was made when the material was processed.

16. Z. coloratum N.E.Br. in Gard. Chron. ser. 2, 12:167 (1879). Fig. 1A.
Type: N.W. Borneo, without precise locality, *Burbidge* s.n. (K).
The following material probably belongs here:
SABAH: Mt Kinabalu. Ulu Liwagu and Ulu Mesilau, 3800ft, flowers pale yellow, bracts rose red, 28 viii 1961, *Chew, Corner & Stainton* 2519 (K); Ranau distr., B. Kipungit, above Poring Hot Springs, bracts red, 9 xii 1983, *Beaman et al.* 7838 (E).

Z. coloratum is characterized by the lanceolate acuminate leaves which are narrowed at the base and arachnoid hairy below. The ligule is truncate/retuse and the leaf-sheaths densely pubescent at the margins only. The red bracted inflorescence is fusiform and acute at the apex. Flowers of *Chew et al.* 2519 were preserved in alcohol; they show the mid-lobe of the labellum to be more or less rectangular, the side lobes are rounded and not deeply cut and the lateral petals are connate at the base only.

17. Z. albiflorum R. M. Smith in Bot. J. Linn. Soc. 85:41, f. 9 (1980). Fig. 1B.
Type: Sarawak, 4th Division, G. Mulu NP, G. Mulu, 1400m, 1977, *Kerby* 191 (living material only), cult. RBG Edinb., bracts green, red-edged, flowers white, thecae brown at edges, v 1980, C13880 (holo. E).
Other material seen;
SARAWAK: 4th Division, G. Mulu, 4000ft, nr camp in moss forest, flowers white, anthers with brown margin, 17 v 1962. *Burtt & Woods* B2127 (E); *ibidem*, submontane forest, 1300m, common ground herb, flowers already fallen, remnant bracts scarlet, *Martin* S38847 (AAU).

Z. albiflorum remains known from the type locality only; it is recognized by the green, red-edged bracts which turn pure red only when flowering has ceased. In this respect *Z. albiflorum* resembles *Z. zerumbet*, but differs in the colour of the flowers, much shorter, bilobed ligule, and in the lateral petals which are connate for only a few millimetres at the base of the labellum. In cultivation *Z. albiflorum* produced a short, entirely subterranean peduncle, but in the wild collection the peduncle is up to 12cm long. The lanceolate-elliptic leaves are sparsely pubescent below.

A single collection from the Tambunan rd in Sabah (*Beaman* 7101, E) deviates in having an entire ligule and cream bracts.

Two collections from the 1st Division of Sarawak (Bau distr., G. Doya, *Burtt* 8189, E; Bidi, *Hewitt* s.n., K) may be related. Only a single (damaged) flower has been seen (on *Burtt* 8189) and the character of the lip and lateral staminodes is probably as in *Z. albiflorum*; the ligule is similarly bilobed. However, these collections are yellow-flowered and the bracts, which have conspicuously membranous margins are probably red throughout their life-cycle. The erect peduncle is up to 20cm long.

18. Z. leptostachyum Val., Ic. Bog. 3: t. 275 (1908) & in Bull. Jard. Bot. Buitenz, sér. 3, 25:140 (1918).
Type: Kalimantan, without precise locality, *Nieuwenhuis*, cult. Bogor (L).
Syn.: ?*Z. stenostachys* K. Schum., Pflanzenr. Zing., 175 (1904). Type: Kalimantan; G. Balacan & G. Sakumbang, *Korthals* s.n. (K).
?*Z. flavidus* Ridley in J. Str. Br. Roy. Asiat. Soc. 53:58 (1909). Type: Sarawak; 1st Division, Quop, *Hewitt* s.n. (K).

Z. leptostachyum is described as an entirely glabrous plant with, in the living state, short bright green leaves 'rather more reminiscent of a *Globba* than a *Zingiber*'. Valeton further defined the species by the bracteoles which are much shorter than the calyx, and by the almost entire, broadly ovate labellum in which the side lobes are short and rounded. The inflorescence is slender (under 2cm wide and up to 15cm long), the bracts described as red and white. No recently collected material can be assigned here.

Valeton considered *Z. leptostachyum* to be very close to, or even conspecific with, *Z. stenostachym* which Schumann described from flowerless material. Comparison of both holotypes suggests that the latter is no more than a depauperate form of *Z. leptostachyum* and it is, therefore, placed in the above synonomy tentatively. Should good material of Schumann's species be collected from the type locality and the character of the bracteole and labellum found to be as in Valeton's excellent figure of *Z. leptostachyum*, Schumann's epithet would, of course, take precedence.

Superficially, *Z. flavidus* is identical to *Z. stenostachys* and Ridley described the labellum as entire. Not surprisingly, there are no flowers on the Kew type. Neither is it possible to examine the bracteole which Ridley states (presumably in error) to be $1\frac{1}{2}$ inches long, i.e. longer than the bract.

19. Z. odoriferum Bl. var. **borneense** Val. in Bull. Jard. Bot. Buitenz, sér 2, 27:144 (1918).
Type: Borneo, locality unknown, *Teuscher* s.n., cult. Bogor n.v.

No material of this variety has been seen. It is a large leaved plant (leaves up to 40 × 9cm), with a fusiform inflorescence held on an erect 40–100cm peduncle. *Z. odoriferum* was described from Java, and Valeton records that the Bornean plant differs in the narrower, acute inflorescences, and ovate central and acute lateral labellum lobes. The flowers are pale yellow with a purple spotted labellum. The species is figured in *Icones Bogoriensis* t. 175 (1905) where the distribution is given as Java and Sumatra. Later (1918) Valeton amended this to Java and Borneo—Teuscher did not collect in Sumatra—and accorded varietal rank to the Bornean plant.

Incompletely known species:
Z. porphyrosphaerum K. Schum, Pflanzenr. Zing. 175 (1904).
Type: Sarawak; 2nd Division, Rejang R, Sibu, recd 1891, *Haviland* (K).

Schumann saw no flowers of *Z. porphyrosphaerum*. The inflorescence of the type specimen is rather flat-topped, borne on a (probably) prostrate peduncle. The leaves are linear-lanceolate, more or less glabrous and with a small truncate ligule. The species is probably correctly placed in *Zingiber*, but it is not possible to verify this.

Excluded species:
Z. borneense K. Schum. = **Amomum borneense** (K. Schum) R. M. Smith.

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