CYTOGENETICS AND TAXONOMY OF THE GENUS GLOBBA L. (ZINGIBERACEAE) IN MALAYA I: TAXONOMY*

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ABSTRACT. A taxonomic review of the Malayan *Globba* based on a detailed cytological and morphological study of living and herbarium specimens results in a few amendments to Holttum's classification in 1950.) The genus in Malaya now stands at twelve species, five subspecies, eight varieties and a natural hybrid—of which two species, four subspecies, one variety and the natural hybrid are new. A key to the species of *Globba* in Malaya is presented. Descriptions are made of new taxa and those to which substantial information could be added. The distributions of the individual taxa are recorded. Interrelationships are suggested and a scheme of interspecific affinities proposed at the end of part II of this series.

MORPHOLOGY AND TAXONOMY IN MALAYAN GLOBBA

The species of *Globba* in Malaya fall into two natural groups on the basis of anther appendage number, which may be two or four. Species with four anther appendages are more clearly differentiated from one another than those with two. The median position of the appendage in *G. albiflora* serves to distinguish it from the other Malayan species in the two-appendage section.

Inflorescence characters are of greater taxonomic importance in the genus than either floral or vegetative characters.

Flower shape is relatively constant. Characters of taxonomic significance are: the length of the staminode (relative to the length of the lateral corolla lobe), the shape of the labellum, flower colour, and, in some cases, corolla tube length. Staminode length is fairly constant in each species and is an important species character. The labellum of species with four anther appendages is usually characterized by divergent basal lobes, the labellum being generally slightly longer than its breadth across the base. In contrast all except one of the species with two anther appendages have long labella with non-divergent basal lobes. The labellum spot is variable within the morphologically variable species. The staminodes are generally attached just above the base of the labellum. This varies particularly within *G. pendula*. Flower colour in species with four anther appendages is either orange, orange-red or pale yellow. *Globba cernua* ssp. *crocea* and *G. holttumii* ssp. *aurea* are two morphologically distinctive infraspecific taxa with orange flowers separable from *G. cernua* ssp. *cernua* and *G. holttumii* which have pale yellow flowers. Flower colour is more variable among species with two anther appendages. *G. albiflora* var. *aurea* is an orange flowered variety of *G. albiflora*. Ridley's *G. violacea*, *G. regalis* and *G. flavidula* are but coloured varieties of *G. leucantha*. The corolla tube length serves as a general distinction between species with four anther appendages and those with two. It is

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relatively short in the latter. The corolla tube is distinctively long in *G. variabilis* and short in *G. cernua* ssp. *porphyria*. It is, however, not a character of general taxonomic usefulness for species separation.

Leaf number varies from one to sixteen, each species having its own range of leaf number. In *G. pendula* and *G. leucantha* leafless flowering shoots occur and leaf number is particularly variable. The range of variability is much smaller in the other species. Although the ranges of variation overlap in many cases, leaf number and the position of leaves on the leafy shoot serve as useful criteria for species separation. Leaf shape is generally lanceolate to elliptic, the base cuneate decurrent and the apex usually acuminate caudate. Despite its variability in *G. pendula*, the ratio "leaf breadth/leaf length" is a generally useful discriminatory character. Pubescence is variable, the only instance where it is used as a distinguishing character is between *G. pendula*, which has stiff hairs on the main lateral veins of the upper surface, and *G. leucantha* which is hairy in the intervenous regions. Anthocyanin pigmentation is variable, particularly within *G. pendula*. Uniform purple coloration on the sheaths and the lower surface of leaves is one of the main distinguishing features that separates *G. cernua* ssp. *porphyria* from *G. cernua* ssp. *cernua*. Leaves are usually sessile or nearly so. An exception is *G. unifolia* which has distinctly petiolate leaves. Ligules are flat or bilobed, rarely trilobed. The shape varies within many species.

The *Globba* inflorescence is terminal. It consists of the peduncle which bears few to many sterile bracts and the rhachis with inflorescence branches individually subtended by primary bracts. The inflorescence branches are true cincinni, each flower being terminal and the succeeding lateral bud arising below it continuing the axis. The part of the inflorescence stalk between the flower and the succeeding floral bud is here arbitrarily referred to as the pedicel. Where the lateral bud arises immediately below the flower, the flower is considered sessile. Each flower is subtended by a bracteole.

The *Globba* inflorescence may be erect*, slightly decurved, decurved to a horizontal position or abruptly decurved to point vertically downwards. Species with two anther appendages have erect inflorescences. Inflorescence curvature is a useful criterion for species separation in the other section. The relative length of the peduncle to the inflorescence is nearly always characteristic of the species; similarly, the density of the inflorescence proper. For example, *G. patens* is characterised by a long peduncle and a short compact inflorescence proper with numerous cincinni, while *G. cernua* has a peduncle roughly equal in length to the rhachis and a rather lax inflorescence proper with relatively few cincinni. The length of the cincinni to the first flowers, the number and arrangement of the flowers and the length of the pedicels are useful taxonomic characters.

Bulbils in *Globba* are produced in the axils of sterile bracts and, in *G. pendula* and *G. leucantha* only, in the position of the last flower on each cincinnus. Bulbils are of three main types: the single-shoot bulbil, the single-shoot-with-single-tuberous-root bulbil and the multiple-shoot-with-root bulbil. The latter are produced only on cincinni and are therefore peculiar to *G. pendula* and *G. leucantha*. Sometimes, single-root-and-shoot bulbils are formed instead on the cincinni. This varies even within a population. The distinctive characteristic is therefore the position of bulbil rather than

* This includes prostrate plants with inflorescences that continue the axis of the plant.

bulbil morphology. Axillary bulbils in both these species are single shoots. The shoot-and-root bulbil occurs in some variant forms of *G. cernua*, thus consistently distinguishing these forms from others which have shoot bulbils. This form of bulbil characteristically has a conical root and a diminutive shoot in *G. marantina*, and serves to distinguish it from other Malayan species. The shoot bulbils of *G. patens*, *G. curtisii*, *G. holttumii* and *G. variabilis* consist of a few internodes without any prominent axillary buds. Those in the former two species are stout while those in the latter two slender. Bulbils in *G. albiflora* produce many axillary shoots. Environment has a considerable control over the degree of production of axillary shoots and roots (if any) in some species, such that, although the type of bulbils is generally distinctive of the species, it is not a very reliable taxonomic character.

In the following enumeration, voucher specimens are preserved in the herbarium of The University of Malaya, Kuala Lumpur (KLU), unless stated otherwise.

KEY TO THE SPECIES OF GLOBBA IN MALAYA

1a. Sterile bracts large, broad and imbricating, the lowermost bracts being c. 1·5–2·5 cm long, 2 cm wide; each subtending a bulbil with a bulbous root and an inconspicuous shoot; flowers rarely produced, rhachis and cincinni usually absent . . . . . 1. *G. marantina*

1b. Sterile bracts smaller, much narrower, not or hardly imbricating, usually less than 0·8 cm wide; axillary bulbils generally with a conspicuous shoot; flowers produced on several cincinni 2

2a. Anther with four appendages 3

2b. Anther with two appendages 16

3a. Inflorescence decurved to a horizontal position or to point vertically downwards 4

3b. Inflorescence erect or slightly curved 9

4a. Peduncle usually as long as or longer than the rhachis, inflorescence lax; leaves c. 5–9, petioles to c. 4 mm long 5

4b. Peduncle much shorter than rhachis, abruptly decurved, inflorescence more compact; leaves up to 4, petioles to 3 cm long 7

5a. Leaves narrow lanceolate, long acuminate; leaf undersurface and leaf sheaths markedly purple . . . . . 2. *G. cernua* ssp. *porphyria*

5b. Leaves rather broad elliptic, short acuminate; leaf undersurface and leaf sheaths not markedly purple; flowers pale or dull saffron yellow 6

6a. Flowers dull saffron yellow . . . . . 2. *G. cernua* ssp. *crocea*

6b. Flowers pale yellow . . . . . 2. *G. cernua* ssp. *cernua*

7a. Bracts and bracteoles orange, leaves 3–4, usually more than 3, petioles to 1·5 cm long . . . . . 4. *G. fragilis*

7b. Bracts and bracteoles green, white or rose pink; leaves 1–4, usually less than 3; petioles to 3 cm long 8

8a. Flowers on pedicel 3–4 mm long . . . . . 3. *G. unifolia* var. *unifolia*

8b. Flowers sessile or nearly so . . . . . 3. *G. unifolia* var. *sessiliflora*

9a. Flowers on cincinnus spaced c. 2–4 mm apart, inflorescence rather lax, bracts and bracteoles deflexed, glabrous and orange
5. *G. curtisii*

9b. Flowers on cincinnus crowded together near apex, inflorescence usually more compact, bracts and bracteoles erect, usually hairy, green, orange or red 10

10a. Leaves narrow lanceolate or elliptic acuminate, almost glabrous, usually more than 6 in number 11

10b. Leaves broad elliptic acuminate, usually hairy on undersurface; generally less than 6 in number 12

11a. Flower pale yellow . . . 6. *G. holttumii* ssp. *holttumii*

11b. Flower orange . . . . . 6. *G. holttumii* ssp. *aurea*

12a. Staminode c. 1½ to 3 times as long as the lateral corolla lobe; inflorescence rather lax . . . . . 7. *G.* x *intermedia*

12b. Staminode shorter or slightly longer than the lateral corolla lobe; inflorescence compact 13

13a. Flowers on pedicels 0·4–0·7 cm long, orange; sterile bracts and bracteoles grade from green to orange in colour . . . 14

13b. Flowers sessile, orange-red, sterile bracts and bracteoles grade from green to red in colour 15

14a. Leaf upper surface dark green, not ridged
8. *G. patens* var. *patens*

14b. Leaf upper surface pale green, secondary veins prominently ridged . . . . . 8. *G. patens* var. *costulata*

15a. Leaves glossy green above, almost glabrous
9. *G. variabilis* ssp. *variabilis*

15b. Leaves velvety-green above, both surfaces pubescent
9. *G. variabilis* ssp. *pusilla*

16a. Appendages median, the base occupying the whole length of each side; labellum with divergent basal lobes, slightly longer than broad across the base 17

16b. Appendages basal, the base sometimes decurrent along the side of the anther towards its apex; labellum without divergent basal lobes, usually c. 3–4 times as long as it is broad . . 18

17a. Flowers white . . . . . 10. *G. albiflora* var. *albiflora*

17b. Flowers orange . . . . . 10. *G. albiflora* var. *aurea*

18a. Leaves glabrous above or bearing stiff hairs on main lateral veins only; branches of inflorescence green with usually less than 5 crowded flowers, flowers orange, pale orange or white . 19

18b. Leaves bearing short stiff hairs or papillae in intervenous regions on the upper surface; branches of inflorescence white, bearing ultimately a succession of up to 12 well-spaced flowers 22

19a. Staminodes much longer than lateral corolla lobes; leaves glabrous above; ratio of length to width 5–6: 1. Inflorescence relatively short and rather compact . . . . 11. *G. fasciata*

19b. Staminode hardly longer than corolla lobes; leaves with stiff hairs on main lateral veins on upper surface, ratio of length to width 3–4: 1. Inflorescence long lax 20

20a. Inflorescence branches to c. 2–3 cm long to first flowers, each with up to 5 flowers spaced 3–7 mm apart
12. *G. pendula* ssp. *montana*

20b. Inflorescence branches to c. 1–1·5 cm long at first flowers, each with up to 3 flowers crowded at the apex 21

21a. Flowers orange, lip spot if present dark brown
12. *G. pendula* ssp. *pendula*

21b. Flowers pale orange or white with purple spot
12. *G. pendula* var. *elegans*

22a. Flowers more or less tinged with yellow 23

22b. Flowers mainly white or violet, not tinged with yellow . 24

23a. Flowers more or less tinged with violet, staminodes pale yellow
13. *G. leucantha* var. *bicolor*

23b. Flowers yellowish . . . 13. *G. leucantha* var. *flavidula*

24a. Flowers white with purple spot on labellum
13. *G. leucantha* var. *peninsularis*

24b. Flowers violet with white calyx . 13. *G. leucantha* var. *violacea*

1. Globba marantina L., Mantissa alt. 170 (1771); Roxb., Fl. Ind. 1: 77 (1820); Bak. in Fl. Brit. Ind. 6: 206 (1890); K. Schum., Pflanzenr. Zingib. 156 (1904); Ridl., Fl. Mal. Pen. 4: 241 (1924); Holtt. in Gard. Bull. Sing. 13: 25–26 (1950). Fig. 1D.

Roots tuberous. Stems to c. 50 cm tall to top of uppermost leaf-sheath, bearing c. 8–15 leaves in the upper $\frac{4}{5}$ of leafy shoot. *Leaves* to about 15 cm long and 4–5 cm wide, apex acuminate, base cuneate, lower surface minutely hairy, upper surface minutely hairy along midrib, otherwise glabrous; petiole of upper leaves usually distinct, c. 5 mm. long or longer; *ligule* hardly 2 mm long, bilobed, fringed with hairs; sheaths short-hairy to almost glabrous. *Inflorescence* hardly exserted beyond the leaf-sheaths, compact, 1–4 cm long; *peduncle* 1–3 cm long, glabrous; 8–15 imbricating sterile bracts, usually with a root-shoot bulbil in the axil of each bract. Lowermost bracts c. 1·5–2·5 cm long, c. 2 cm wide, upper gradually smaller, green, ovate, the apex very shortly pointed, edges fringed with a few hairs and surface sometimes short-hairy. *Bulbils* c. 1 cm long, each consisting of a small shoot and a swollen root, narrowly ovoid to conical, surface irregularly warty. *Rhachis* usually missing, when present glabrous, short, 0·2–1·2 cm long bearing 1–4 cincinni at 0·2–0·3 cm apart. *Cincinni* glabrous, 0·1–0·3 cm to first flowers, each cincinnus bearing up to 6 flowers at 0·1–0·3 cm apart. *Primary bracts* resemble sterile bracts. *Bracteoles* c. 0·7–1·1 cm long, ovate, apex long acuminate, edges similarly ciliated. *Flowers* almost sessile, saffron-yellow. *Calyx* with ovary to 9 mm long, glabrous; ovary minutely tuberculate; calyx lobes subequal, 2 long acute, 1 short blunt. *Corolla tube* hairy, c. 20 mm long, c. 14 mm above mouth of calyx. Corolla lobes 3, sparsely hairy, dorsal lobe hooded, c. 7 mm long, lateral lobes concave c. 5·5 mm long. *Staminodes* twice as long as lateral corolla lobes, c. 11 mm long, 4 mm wide, oblong with lobed apices. *Labellum* c. 12 mm long, 8 mm wide across the broadly divergent basal lobes; labellum spot deeper orange

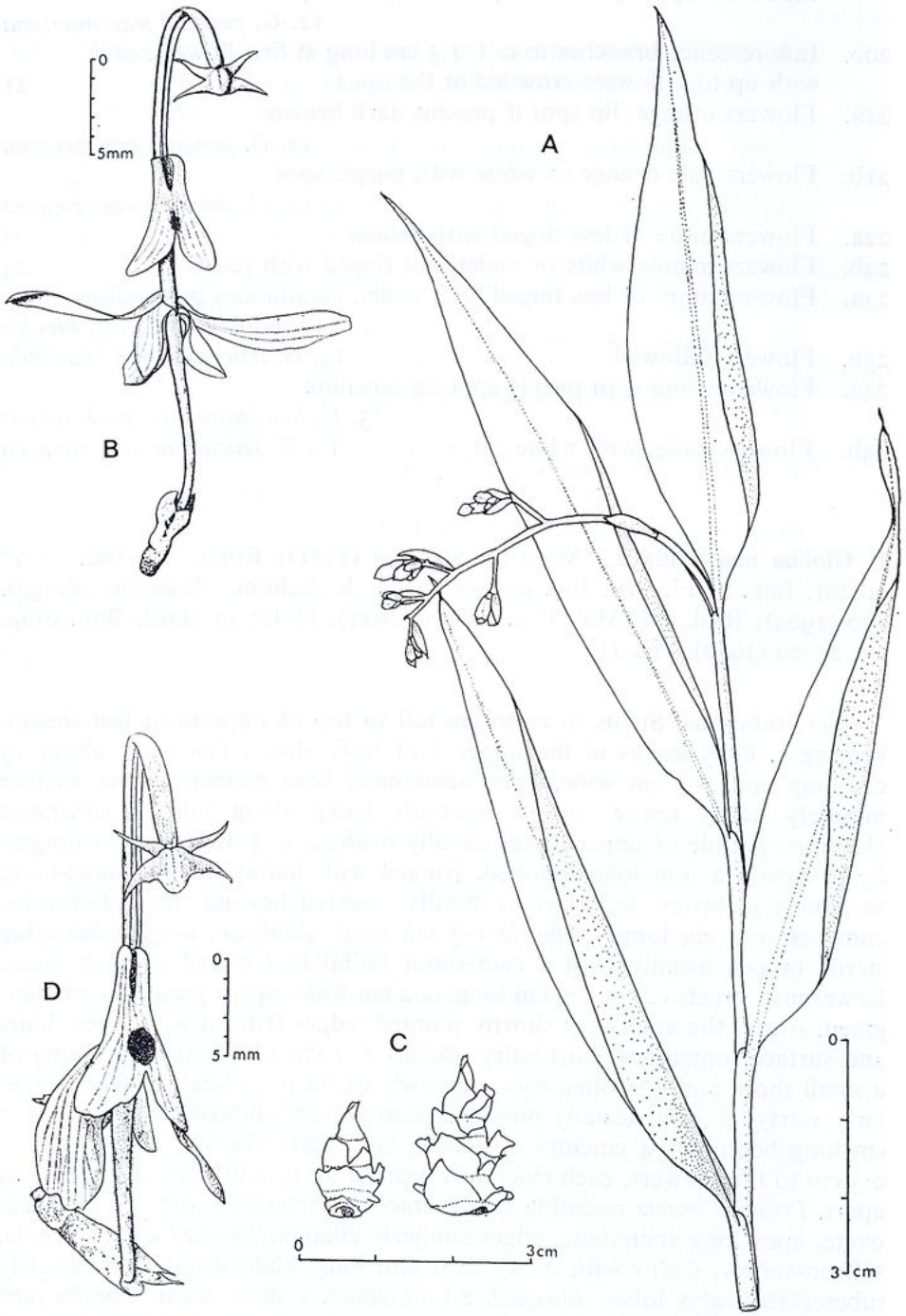

FIG. 1. A–C, *Globba cernua* ssp. *porphyria* Lim: A, inflorescence; B, flower; C, bulbils. D, *G. marantina*, flower.

in colour. *Filament* c. 20 mm long. *Anther* c. 2·5 mm long, with 4 narrow acute appendages to c. 2·5 mm long. *Fruits* not observed. 2n = 80.

Voucher specimen: Penang, Waterfall Botanic Gardens, *S. N. Lim* KLU 4831 (cultivated).

The numerous rather large, broad ovate imbricating green sterile bracts crowded on a condensed peduncle, each bract usually subtending a conical root-shoot bulbil, are characteristic of *G. marantina* and distinguish it from all other Malayan *Globba* species. The inflorescence proper is nearly always missing but, when present, bears 1–4 short cincinni on a reduced rhachis that is hardly exserted beyond the upper rim of the closely imbricating sterile bracts. The almost sessile saffron-yellow flower has a rather large conspicuous labellum with two broadly divergent basal lobes. The broad staminodes are about twice as long as the lateral corolla lobe.

G. marantina rarely flowers. The above description was made from flowering materials sent from the Waterfall Botanic Gardens, Penang, where the species was reported flowering in 1965 and 1967.

Bulbils are produced in abundance. When the plants die back seasonally, the rhizomes and bulbils undergo a dormant period of about five months from around October to March. None of the bulbils has been observed to germinate in the same season. At the end of the dormant period, the rhizomes and bulbils rapidly and almost simultaneously put out new plants; such that where there were no signs of any *Globba* plants there are now "scattered troops" (*Corner* S.F.N. 28538, Jason Bay, Johore). *G. marantina* is the only Malayan *Globba* to favour open dry habitats.

The profusion of bulbils produced each season, the ability of the bulbils to survive long, adverse conditions and their rapid establishment in suitable open habitats with relatively less competition account for its success and widespread distribution despite its being an obligate apomict. Man has probably a considerable role in its present distribution from the Philippines down Peninsular Thailand, through New Guinea (Holttum, 1950) to the Solomon Islands (Pendleton, 1949). Holttum suggests that eastern Malaysia is probably its main centre of distribution. In Malaya it occurs in Penang, down the east coast and in Singapore.

2. Globba cernua Bak. in Fl. Brit. Ind. 6: 205 (1890); Ridl. in Journ. Str. Br. R. As. Soc. 32: 99 (1891) and Fl. Mal. Pen. 4: 240 (1924); Holtt. in Gard. Bull. Sing. 13: 32 (1950).

Type: Gopeng, *King* 757 (K, SING).

Syn.: *G. trachycarpa* Bak. in Fl. Brit. Ind. 6: 205 (1890); Ridl., Fl. Mal. Pen. 4: 240 (1924). Type: Perak, Larut, *King's collector* 2415 (K, SING).

G. macranthera Ridl. in Journ. Fed. Mal. St. Mus. 4: 75 (1909) and Fl. Mal. Pen. 4: 240 (1924). Type: Pahang, Telcom Woods, *Ridley* 14003 (K, SING).

subsp. **cernua**.

Voucher specimens: Pahang, Fraser's Hill: *S. N. Lim* KLU 8205 (2n = 32); *S. N. Lim* KLU 4843(2n = 48); *M. E. D. Poore* KLU 4796 (2n = 48). Perak, Maxwell's Hill: *S. N. Lim* 4846 (2n = 32); *S. N. Lim* 4845 (2n = 48).

The morphological variation encountered in *G. cernua* accounts for the synonyms *G. trachycarpa* and *G. macranthera*. Besides the variations in leaf number (4–8), leaf shape (from lanceolate, long acuminate to elliptic, long acuminate), sterile bract number (from 3 to numerous) and inflorescence curvature (from a slight bend to the more common downward-pointing curve), chromosome races with both 2n = 32 and 2n = 48 are found. Both chromosome races have been collected from Maxwell's Hill, Perak (c. 1100 m), Cameron Highlands (c. 1400 m) and Fraser's Hill, Pahang (c. 1200 m). The chromosome races show variation ranges that overlap so that there is no easy means of morphological distinction except for differences in pollen grain size and stainability with aceto-carmine. In fact they are morphologically indistinguishable in the Maxwell's Hill population.

Characteristically, plants of *G. cernua* arise some distance from one another in loose clumps (except KLU 4796), each plant having 5 to 8 rather narrow elliptic long-acuminate leaves positioned in the upper half to four-fifths of the leafy shoot, and a broadly decurved lax inflorescence with 5 to 14 long cincinni with several to many, almost sessile, pale-yellow flowers crowded into two ranks near the apex; the staminode of the flower is typically much longer than the lateral corolla lobe.

G. cernua shows a close morphological resemblance to *G. holttumii* in floral characters but differs from it particularly in inflorescence structure (cf. fig. 3). The flowers in both species are pale yellow; the staminodes are similarly much longer than the corolla lobes. The inflorescence in *G. holttumii* is erect, shorter and more compact, with few short cincinni. The bracts are in contrast smaller and persistent. Also, the leaves of *G. holttumii* are shortly acuminate.

G. cernua occurs on the Main Range at c. 600–1500 m in cool, moist, partially shaded habitat commonly by jungle paths. The plants are usually found in abundance. Propagation is mainly by bulbils and rhizomes. Fruits are rarely observed even in the plants with 2n = 32. Specimens are often found having numerous compactly arranged bulbils with long hanging fleshy roots on the peduncle. The length of root in the bulbils depends on the humidity of the micro-environment in which it grows. Bulbils in the forms with 2n = 32 consistently do not produce tuberous roots while still attached to the parent plant. The inflorescence proper is sometimes missing.

In addition to the typical *G. cernua* subsp. *cernua* just described, two other subspecies of *G. cernua* are distinguishable.

subsp. **crocea** Lim, **ssp. nov.**

Folia plerumque 4–7, laminis ellipticis subbrevibus acuminatis, supra glabris (costa minute hirsutula excepta), subtus minute hirsutulis, vaginis pubescentibus. *Inflorescentia* late decurvata, bracteata, bracteis sterilibus (plerumque 3) pubescentibus, pedunculo hirsutulo. *Bracteolae* cioceae. *Flores* crocei, macula labelli atrobrunnea; *ovario* luteoviridi. *Bulbilli* arrhizi. 2n = 32, 48.

Type: Pahang, Jenka Forest Reserve, *M. E. D. Poore* KLU 4791 (holo. KLU; iso. K), (2n = 32).

Voucher specimen: Pahang, Jenka Forest Reserve, *I. Clear & C. C. Ho* KLU 4817 (2n = 48).

This subspecies has so far only been found growing on volcanic soil in damp deep shade in lowland Dipterocarp forests (c. 60 m alt.) in Jenka Forest Reserve, Pahang.

Two separate collections were made; one has 2n = 32 and the other 2n = 48. The former was found with pale green rugose fruits. Except for pollen size difference, the two chromosomal races are morphologically indistinguishable.

G. cernua ssp. *crocea* differs from other members of the species *G. cernua* by the fewer leaves with rather short acuminate apices and the dull saffron-yellow colour of the flowers and bracteoles. Also *G. cernua* ssp. *cernua* has a general highland distribution along part of the peninsular west coast and has not been collected from the lowlands of Pahang.

subsp. **porphyria** Lim, **ssp. nov.** Fig. 1 A–C.

Herba 7–9 foliosa, caulibus 24–45 cm altis ad vaginam folii summi, cum inflorescentia usque ad 29–52 cm altis. *Vaginae foliorum* atropurpureae, glabrae sed ciliolatae, laminis 8–11 cm longis 2–2·7 cm latis lanceolatis anguste cuneatis apice longe acuminatis supra atroviridibus glabrisque, subtus atropurpureis glabrisque, marginibus ciliolatis. *Inflorescentia* brevis, late decurvata, 4–7 cm longa, *pedunculo* 2·5–4·5 cm longo, *rachide* 1·5–2·5 cm longo, bracteis sterilibus 3. *Cincinni* rachidem 4 vel 6, ad 2–4 mm longa, 4–9 mm separati. *Staminodiis* quam corollae lobis multo longioribus, floris axin longitudinalem perpendiculariter positis; base ultra labelli staminodiorum originem 1·5 mm locato. 2n = 32.

Type: Perak, Bujang Melaka, *K. Jong* KLU 8240 (holo. KLU; iso K).

G. cernua ssp. *porphyria* comprises plants that arise quite close together but not in tight clumps, each individual plant having 7 to 9 narrow lanceolate long-acuminate leaves in the upper three-fifths of the leafy shoot, the leaf sheath and leaf under-surface being markedly dark purple. The relatively short nodding lax inflorescence bears 2 to 3 deciduous sterile bracts on the peduncle and up to 6 short cincinni on the rhachis, each cincinnus having c. 4 to 6 almost sessile pale yellow flowers crowded in 2 ranks near the apex. The staminode arises c. 1·5 mm below the base of the labellum, is characteristically longer than the corolla lobe and held perpendicular to the flower axis. Bulbils are stumpy shoots that do not develop into leafy shoots while on the parent plant.

G. cernua ssp. *porphyria* shows a general resemblance to *G. cernua* ssp. *cernua* except that its leaf sheath and leaf under-surface are markedly dark purple, its inflorescence is shorter in relation to the height of the plant (c. 0·15 cm v. the average 0·3 cm), the cincinni shorter (0·2–0·4 cm v. 0·6–1·2 cm) and fewer in number (up to 7 v. up to 14) and the labellum ends c. 1·5 mm above the attachment of the staminode, which is held perpendicular to the flower axis.

G. cernua ssp. *porphyria* has only been collected from Bujang Melaka, Perak (c. 400 m) in rather humid, partially shaded habitats on rock. It flowers all the year round in the greenhouse. Fruiting has been observed.

3. Globba unifolia Ridl. in Journ. Str. Br. R. As. Soc. 44: 193 (1905) and Fl. Mal. Pen. 4: 240 (1924); Holttum in Gard. Bull. Sing. 13: 33 (1950).
Type: Trengganu, Bundi, *Rostado* s.n. July 1902 (SING).

var. **unifolia**

This species is characterised by one to four petiolate leaves crowded at the top of the stem, and an abruptly downward decurving dense inflorescence on a peduncle bearing one or two sterile bracts and 5–15 rather long cincinni. Each cincinnus bears up to 10 rather well spaced stalked flowers with the staminode longer than the corolla lobe.

The presence of fruits on two of the eight herbarium specimens in the Singapore collection suggests that it probably has 2n = 32. Fresh specimens were not available for investigation.

var. **sessiliflora** Holtt. in Gard. Bull. Sing. 13: 34 (1950).
Type: Kemaman, Ulu Bendong, *Corner* SFN 30013 (SING).
Voucher specimen: Kelantan, Sungei Lebir, south of S. Ternya, *B. C. Stone* KLU 7367.

This variety is characterised by sessile flowers. The present collection from Kemaman has pale yellow flowers with dark brown spot. Its distribution apparently covers both Kemaman and Kelantan. It has 2n = 32.

4. Globba fragilis Lim, **sp. nov.** Fig. 2.

Herba caespitosa 3–4-foliosa, caulibus 9–12 cm altis ad vaginam folii summi, cum inflorescentia usque ad 10–15 cm altis. Laminae foliorum 3·5–6·5 cm longae 2–3·7 cm latae, ovatae, base rotundatae, apicem acuminatae caudatae, caudis 0·3–1·2 cm longis. *Inflorescentia* compacta pedunculi basi abrupte decurvata omnino puberula viridescens, *pedunculo* 0·5–1·9 cm longo, *rachide* 0·5–1·3 cm longo; bracteis sterilibus 1–2 aurantiacis puberulis persistentibus ovatis apicem versus acuminatis c. 1·5 cm longis 0·3 cm latis: rachis 4–5 cincinnos ad 3–5 mm longos 2–2·5 mm separatos puberulentes viridescentes ferens. *Bracteae primariae* (et bracteolae) aurantiacae puberulae. *Flores* aurantiaci, pedicello 0·5 mm longo; *staminodiis* quam corollae lobis multo longioribus, oblongis, apice parvilobatis, *labello* lobos binos divergentes basales gerente; appendiculis 4 binatis. 2n = 32.

Roots filamentous, fleshy, non-tuberous. *Stems* c. 9 to 12 cm to uppermost leaf sheath, with inflorescence 10 to 15 cm tall. Plants arising close together in tight clumps of 7 to 10. *Leaf* sheath purplish, ciliated along margin, otherwise glabrous; blades 3 to 4, c. 3·5 by 2 cm to 6·5 by 3·7 cm, ovate, base rounded, apex acuminate caudate with terminal cauda c. 0·3 to 1·2 cm long. Upper surface short hairy along apical third of midrib and main lateral veins, lower surface pale green and minutely pubescent. *Petiole* of uppermost leaf c. 1 cm long, lowermost leaf sessile. *Ligule* faintly bilobed, ciliated, c. 1 mm long. *Inflorescence* short, bending abruptly at base of peduncle and held horizontally, c. 1 to 3·2 cm long. *Peduncle* c. 0·5 to 1·9 cm long, usually bearing 1 to 2 orange, hairy sterile bracts. *Sterile bracts* persistent, ovate with acuminate apices, c. 1·5 by 0·3 cm, each subtending a bulbil. *Rhachis* 0·5 to 1·3 cm long, green, softly hairy, bearing 3 to 5 green,

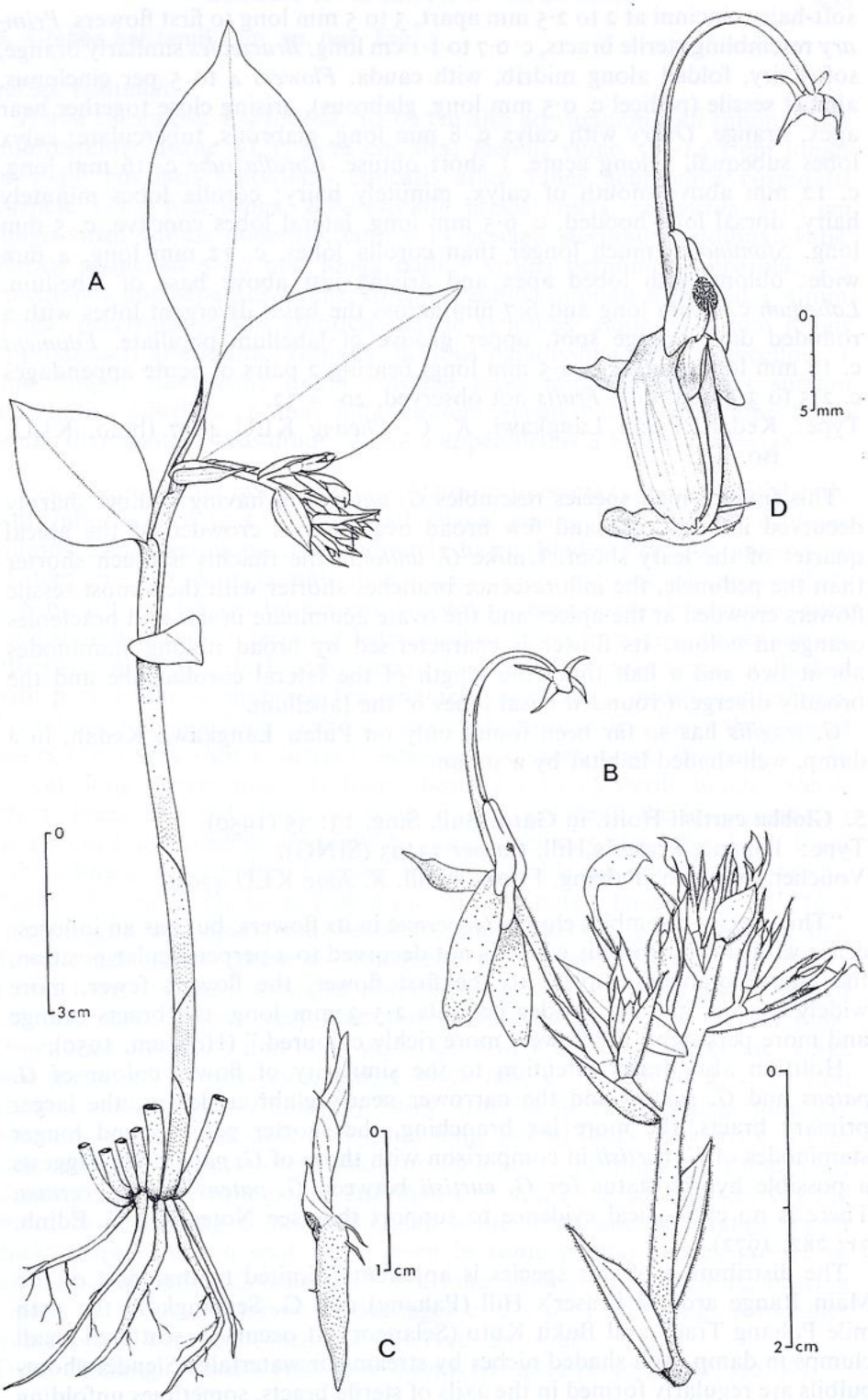

FIG. 2 *Globba fragilis* Lim: A, plant; B, inflorescence; C, bulbil; D, flower.

soft-hairy cincinni at 2 to 2·5 mm apart, 3 to 5 mm long to first flowers. *Primary* resembling sterile bracts, c· 0·7 to 1·1 cm long. *Bracteoles* similarly orange, soft-hairy, folded along midrib, with cauda. *Flowers* 4 to 5 per cincinnus, almost sessile (pedicel c. 0·5 mm long, glabrous), arising close together near apex, orange. *Ovary* with calyx c. 8 mm long, glabrous, tuberculate; calyx lobes subequal, 2 long acute, 1 short obtuse. *Corolla tube* c. 16 mm long, c. 12 mm above mouth of calyx, minutely hairy; corolla lobes minutely hairy, dorsal lobe hooded, c. 6·5 mm long, lateral lobes concave, c. 5 mm long. *Staminodes* much longer than corolla lobes, c. 12 mm long, 4 mm wide; oblong with lobed apex and arising just above base of labellum. *Labellum* c. 7 mm long and 6·7 mm across the basal divergent lobes with a rounded dark orange spot, upper groove of labellum papillate. *Filament* c. 17 mm long; *anther* c. 2·5 mm long, bearing 2 pairs of acute appendages c. 2·5 to 3·5 mm long. *Fruits* not observed. 2n = 32.

Type: Kedah, Pulau Langkawi, *K. C. Cheang* KLU 4847 (holo. KLU; iso. K).

This fragile small species resembles *G. unifolia* in having a short sharply decurved inflorescence and few broad ovate leaves crowded at the apical quarter of the leafy shoot. Unlike *G. unifolia*, the rhachis is much shorter than the peduncle, the inflorescence branches shorter with the almost sessile flowers crowded at the apices and the ovate acuminate bracts and bracteoles orange in colour. Its flower is characterised by broad oblong staminodes about two and a half times the length of the lateral corolla lobe and the broadly divergent rounded basal lobes of the labellum.

G. fragilis has so far been found only on Pulau Langkawi, Kedah, in a damp, well-shaded habitat by a stream.

5. Globba curtisii Holtt. in Gard. Bull. Sing. 13: 35 (1950).
Type: Pahang, Fraser's Hill, *Corner* 33193 (SING).
Voucher specimen: Pahang, Fraser's Hill, *K. Jong* KLU 4793.

"This species resembles closely *G. cernua* in its flowers, but has an inflorescence with shorter rhachis which is not decurved to a perpendicular position, the lateral branches shorter to the first flower, the flowers fewer, more widely spaced, and on slender pedicels 2·5–3 mm long, the bracts orange and more persistent, the flowers more richly coloured." (Holttum, 1950).

Holttum also draws attention to the similarity of flower colour of *G. patens* and *G. curtisii* and the narrower nearly glabrous leaves, the larger primary bracts, the more lax branching, the shorter pedicels and longer staminodes of *G. curtisii* in comparison with those of *G. patens*. He suggests a possible hybrid status for *G. curtisii* between *G. patens* and *G. cernua*. There is no cytological evidence to support this (see Notes R.B.G. Edinb. 31: 282, 1972).

The distribution of this species is apparently limited to that part of the Main Range around Fraser's Hill (Pahang) and G. Semangkok, the 15th mile Pahang Track and Bukit Kutu (Selangor). It occurs in scattered small clumps in damp, well shaded niches by streams or waterfalls. Slender shoot-bulbils are regularly formed in the axils of sterile bracts, sometimes unfolding their leaves while still attached to the parent plant. Fruits have not been observed. The morphological constancy of this species is marked.

6. Globba holttumii Lim, **sp. nov.** Fig. 3.

subsp. **holttumii**

Herba caespitosa 7–9-foliosa, 30–60 cm alta ad vaginam folii summi, cum inflorescentia usque ad 37·5–72 cm alta; *laminis* vulgo 5·5–14·3 cm longis et 2–4·8 cm latis lanceolatis cuneatis apice longe acuminatis cuspidatis cuspide 1–1·5 mm longa. *Inflorescentia* brevis erecta, *pedunculo* 7–10 cm longo viridi minute puberulo, cum 7–13 bracteis sterilibus viridibus ovatis. *Rachis* usque ad 5–20 mm longa pallide viridis perminute puberula, 4–5 cincinnis 2 mm separatis ferens, cincinni rachilla omnino glabra ad 4–5 mm longa; *bracteolis* glabris ellipticis pallide viridibus usque ad 4 mm longis approximatis alternatim ordinatis; floribus pallidissime flavis, pedicello c. 1 mm longo; *staminodiis* quam corollae lobis multo longioribus sursum attenuatis; *labello* c. 6 mm longo basem versus 7 mm lato, lobis binis acutis divergentibus basalibus. *Anthera* appendiculis 4 binatis. 2n = 48.

Roots filamentous, none tuberous. *Stems* 30 to 60 cm to highest leaf sheath, with inflorescence 37·5 to 72 cm tall. Plants arising close together in dense clumps. *Leaf* sheaths purplish, minutely hairy. Blades 7 to 9 at upper 7/10 of stem, in some plants commonly c. 5·5 by 2 cm to 14·3 by 4·8 cm, in others c. 8 by 1·7 to 11·8 cm by 3·3 cm, lanceolate, base narrowly cuneate, apex long acuminate with a terminal hairy cauda 1 to 1·5 mm long; upper surface otherwise glabrous, dark shiny green; lower surface pale green or flushed with purple, almost glabrous but minutely hairy along midrib and margin. *Ligule* c. 2 to 3 mm long, narrow, truncated, more or less hairy throughout (hairs often very short), ciliated. *Inflorescence* short, erect. *Peduncle* c. 7 to 10 cm. long, green, minutely hairy, bearing 7 to 13 sterile bracts. *Sterile* bracts green, minutely hairy on back, ovate, persistent, the lowermost c. 3 to 4·5 cm long, grading gradually to upper ones c. 5 mm long. Each bract subtending a shoot-bulbil. *Primary bracts* resemble the upper sterile bracts. *Rhachis* 0·5 to 20 cm long, pale green, very minutely hairy, bearing 4 to 5 cincinni c. 2 mm apart; individual cincinnus stalks c. 4 to 5 mm to first flowers, pale green, glabrous. *Bracteoles* pale green, glabrous, elliptic, to 4 mm long, typically arranged alternately in 2 ranks (seen clearly in old inflorescence). *Flowers* very pale yellow. *Pedicels* slender, c. 1 mm long. *Ovary with calyx* c. 7 mm long, glabrous. *Ovary* whitish, tuberculate; calyx pale green, calyx lobes subequal. *Corolla tube* c. 18 mm long, c. 13 mm above mouth of calyx, minutely hairy. Corolla lobes spreading, minutely hairy; dorsal lobe hooded, c. 6·5 mm long, lateral lobes concave, c. 5 mm long. *Staminodes* much longer than corolla lobes, c. 11 mm long, 2 mm wide, tapering gradually to a point. *Labellum* c. 6 mm long, c. 7 mm across the broad base, bearing 2 basal divergent acute lobes and an orange-brown shield-shaped median spot (spot green in some plants); upper groove of labellum papillate. *Filament* c. 20 mm long; *anther* c. 2 mm long, bearing 2 pairs of broad or narrow appendages c. 2·5 to 3 mm long; sometimes with tooth in between. *Fruits* not observed. 2n = 48.
Type: Pahang, Fraser's Hill, *S. N. Lim* KLU 4822 (holo. KLU; iso. K).

G. holttumii closely resembles *G. cernua* ssp. *porphyria* vegetatively but the leaf sheaths and the leaf undersurface are not uniformly dark purple. Its flowers closely resemble those of *G. cernua* ssp. *cernua* and *G. cernua* ssp.

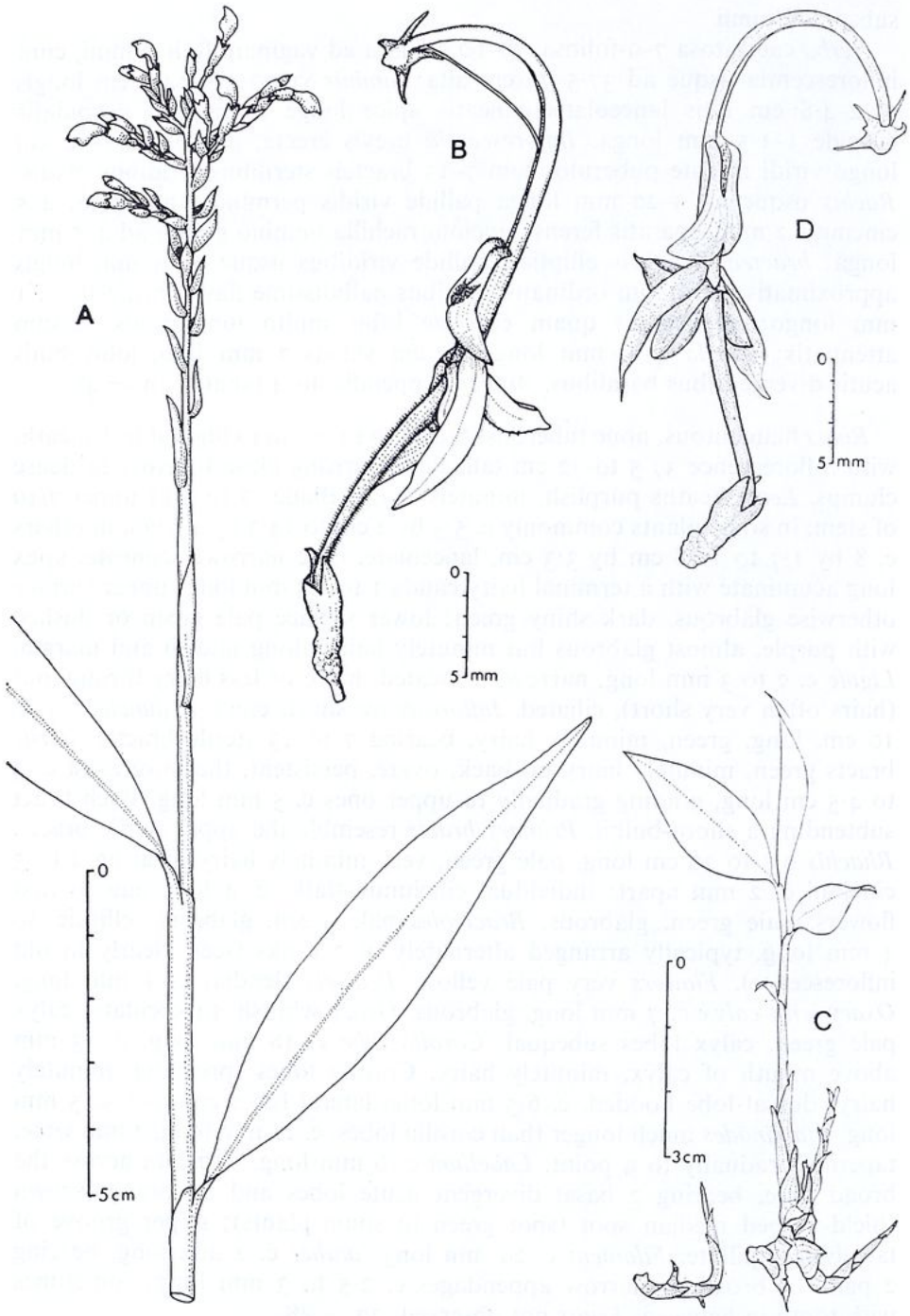

FIG. 3. *Globba holttumii* Lim: A, inflorescence; B, flower; C, bulbils. D, ssp. *aurea*, flower.

crocea, but the inflorescence is not decurved. The smaller number of cincinni are crowded on to the markedly shorter rhachis and the more numerous flowers show a characteristic alternate arrangement into two close ranks, while the few flowers of *G. cernua* are crowded near the tip of the cincinnus. Bracts are persistent while those of *G. cernua* are deciduous.

G. holttumii has 2n = 48 and flowers all the year round. It occurs abundantly in dense clumps by streamsides or waterfalls in rather damp and partially shaded habitats, usually on sloping ground. The localities collected from so far are Fraser's Hill, Pahang (c. 1200 m), Genting Simpah (c. 600 m) and Genting Highlands (c. 1200 m), Selangor.

subsp. **aurea** Lim, **ssp. nov.** Fig. 3D.

Folia 11 × 3 cm ad 15 × 4 cm. *Cincinni* 6–16. *Flores* (et bracteolae) aurantiaci, pedicello 2–3 mm longo, labello c. 6 mm longo basem versus 4 mm lato. 2n = 48.

Type: Johore, Lenggo Forest Reserve, Mersing, *P. C. Lee* KLU 8206 (holo. KLU; iso. K).

The lemon-orange colour of flowers and bracteoles (sometimes including the apical half of rhachis, the cincinnus stalks and the primary bracts), the longer labellum, the relatively well stalked flowers (pedicel length being c. 2 to 3 mm instead of the almost 1 mm of *G. holttumii*), and the larger number of cincinni (6–16 v. 4–5) are characteristics that distinguish this subspecies from *G. holttumii* ssp. *holttumii*.

The rather dense inflorescence with many cincinni and the lemon-orange colour of flowers and bracteoles are rather like those of *G. patens* Miq. They differ, however, in vegetative and floral structure.

G. holttumii ssp. *aurea* has so far been collected from rather dry, partially shaded habitats in lowland *Dryobalanops* forests in Lenggor Forest Reserve, Mersing, Johore (c. 100 m) and from Genting Highlands, Selangor (c. 600 m). It grows on slopes as part of the forest ground flora, and in Genting Highlands, alongside *G. holttumii* and *G. patens*. Flowering occurs more or less throughout the year. Propagation is mainly by rhizomatous growths, bulbils being infrequently produced. The two collections are morphologically constant.

7. Globba x intermedia Lim, **hybr. nov.**

Plantae hybridae (*G. patens* Miq. x *G. cernua* Bak.), *G. patentem* simulantes sed foliis angustioribus, inflorescentiis laxioribus, cincinnis longioribus; floribus aurantiacis valde pedicellatis. 2n = 48.

Roots filamentous, none tuberous. *Stems* c. 20 to 70 cm to the highest leaf sheath, c. 30 to 96 cm tall with inflorescence. Plants arising in tight clumps. *Basal leaf sheaths* purplish, usually glabrous but with long hairs at the margins; leafy sheaths almost always short dense hairy. *Blades* 4 to 5, sometimes 6 to 7, crowded generally at the apical third to one-half of the leafy shoot; generally elliptic, noticeably asymmetric; commonly c. 10 by 3·5 cm to 18 by 6·5 cm, sometimes narrower measuring c. 12 by 3·5 cm to 24·5 by 6·5 cm; base cuneate, apex very shortly acuminate, caudate. *Upper surface* dark green, glabrous except short hairy along midrib and

apex; lower surface pale green, sometimes gently flushed with purple, pubescent. *Petiole* c. 1 to 2 mm long, the uppermost sometimes up to 7 mm long. *Ligule* c. 2 to 3 mm long, bilobed or truncated, hairy with ciliated margin. *Inflorescence* bent at base of peduncle and held at c. 45° to the axis of the plant. *Peduncle* c. 11 to 26 cm above uppermost leaf; *rhachis* commonly c. 2 to 3·5 cm long (measuring less than one-fifth length of inflorescence), sometimes up to 6 cm long (measuring to one-third of inflorescence); both pubescent, dark green, sometimes purplish; peduncle bearing 2 to 18 (commonly 7 to 9) green hairy persistent sterile bracts, the lower two ensheathing, oblong, sometimes with terminal cauda, c. 1·5 to 2 cm long, grading into smaller membranous bracts of c. 0·6 cm long just below rhachis; each sterile bract subtends an axillary shoot-bulbil. *Inflorescence* compact, rhachis bearing c. 5 to 14 cincinni at c. 3 to 7 mm apart. *Primary bracts* green sometimes tinged with orange, hairy, persistent. *Bracteoles* orange, minutely hairy. *Cincinni* orange-green, minutely hairy, c. 1 to 5 mm to first flower, sometimes up to 9 mm long; each bearing a succession of up to 6 stalked flowers in two close ranks. *Flower* uniformly orange with brown heart-shaped labellum spot and yellow ovary. *Pedicel* c. 2 mm long. *Ovary* minutely tuberculate; calyx lobes 3, subequal; ovary with calyx c. 7 mm long. *Corolla tubes* minutely hairy, c. 14 mm long, c. 10 mm above mouth of calyx. *Corolla lobes* sparsely hairy, dorsal lobe hooded, c. 6·5 mm long, laterals concave, c. 5 mm long. *Staminodes* conspicuously longer than corolla lobes, c. 7·5 to 15 mm long. *Labellum* c. 8 to 9 mm long, c. 6 mm broad at base, with two divergent basal lobes, upper groove of labellum papillate. *Filament* c. 18 to 21 mm long. *Anther* c. 2 mm long, bearing 2 pairs of divergent appendages; appendages with broad base, acute apices. *Fruits* not observed.

Type: Pahang, Cameron Highlands, Gunong Jasar, *S. N. Lim* KLU 4848 (holo. KLU; iso. K).

Voucher specimens: Pahang, Cameron Highlands: Gunong Jasar, *S. N. Lim* KLU 4942; Parit Fall, *S. N. Lim* KLU 4840; Robinson Fall, *S. N. Lim* KLU 4841.

Globba x *intermedia* is a natural hybrid of *G. patens* and *G. cernua*. It consists of a number of nothomorphs that show variations in the number of leaves (4–7), the ratio of leaf breadth to leaf length (0·26–0·37), the position of leaves on the leafy shoot (0·21–0·59), the shape of ligules (bilobed or truncated), the number of sterile bracts (2–18, commonly 7–9), the relative length of rhachis to the whole inflorescence (0·13–0·26) and the relative length of the staminode to the lateral corolla lobe (1·4–2·3).

Except for the more narrow leaves, the less compact inflorescence, the longer cincinni, and the floral structure, *G.* x *intermedia* shows a strong resemblance to *G. patens*. The resemblance lies particularly in the way the plants arise in rather tight clumps, the leaf shape, texture and their position on the leafy shoot (the latter does not always hold true), the general pattern of hairiness, the inflorescence curvature, the arrangement of flowers on each cincinnus, the flower colour and bulbil morphology. The resemblance to *G. cernua*, the other putative parent, is not as obvious. The occurrence of more than 5 leaves (6–7), the smaller number of cincinni and the long staminode are characters inherited from *G. cernua*. Characteristics intermediate between *G. patens* and *G. cernua* are particularly the relative leaf

breadth to length (0·26–0·37, the broader ones being intermediate between 0·1–0·3 of *G. cernua* to 0·36–0·55 of *G. patens*), the distance apart of the cincinni (0·3–0·7 cm instead of 0·1–0·2 cm of *G. patens* and 0·9–1·2 cm of *G. cernua*), and the length of the cincinni to the first flowers (the lowermost cincinni being 0·3–0·5 cm as compared with 0·1–0·2 cm of *G. patens* and 0·9–1·2 cm of *G. cernua*).

G. x *intermedia* consists of F_1 hybrids and probably those progeny of subsequent successive back-crosses of F_1 to *G. cernua* that resemble F_1. The other progeny of these subsequent backcrosses to *G. cernua* (the introgressants of *G. patens* into *G. cernua*) are arbitrarily classified with *G. cernua* because they show a smooth integration morphologically into the species.

G. x *intermedia* has so far been collected from the Parit Falls (1400 m), Robinson Falls (1300 m) and Gunong Jasar (1400–1500 m), Cameron Highlands, Pahang. One other herbarium specimen is from Bukit Tangga (400 m), Negri Sembilan. It probably has a wider occurence along the Main Range. Plants have so far been found in relatively damp and rather well shaded habitats by streams, waterfalls and alongside jungle paths.

8. Globba patens Miq., Fl. Ind. Bat. Suppl. 613 (1860).

Type: Sumatra, Labu Alung, (*T*) *H.B.* 2038 (U)

Syn.: *G. aurantiaca* auct.; K. Schum., Pflanzenr., Zingib. 46: 151 (1904); Ridl., Fl. Mal. Pen. 4: 239 (1924); Holtt. in Gard. Bull. Sing. 13: 36 (1950), non Miquel.

Voucher specimens: Selangor, Gombak road 22 mile, *S. N. Lim* KLU 8211 (2n = 32); Pahang, Fraser's Hill, *A. R. G. Lethbridge* KLU 8232 (2n = 48).

var. **patens**

After examining the type specimens of *G. aurantiaca* Miq. and *G. patens* Miq., both collected from Sumatra, Holttum concluded that the type specimen of *G. aurantiaca* was quite different from the Malayan plants to which he had applied the name. These plants are actually *G. patens* Miq. "Though Miquel's type of this species (in Utrecht Herbarium) lacks fully developed flowers, all other characters match so closely the Peninsular species described by Holttum that their identity can hardly be doubted" (Holttum, June 1967, personal communication). The true *G. aurantiaca* has yet to be found in Malaya.

G. patens var. *patens* is easily distinguished from other Malayan *Globba* species by the 3 to 6 broad, elliptic leaves with abruptly acuminate apices crowded usually above the apical third of the leafy shoot, the almost erect compact inflorescence with numerous very short cincinni crowded on a relatively short rhachis, the small and persistent bracts and bracteoles and the orange-stalked flower with the staminodes as long as or shorter than the lateral corolla lobes.

Holttum (1950) suggests a close relationship between *G. patens* and *G. variabilis* on the basis of their close morphological resemblance. The distinct differences lie in the long pedicels and shorter labellum of *G. patens* flowers and the colour of primary bracts, bracteoles and flowers, those in *G. patens* being orange and those in *G. variabilis* salmon-pink. The plants of *G. patens* are usually more hairy, the leaves broader and fewer in number,

the sterile bracts more narrow and the inflorescence proper with many more cincinni. The morphological affinity between *G. patens* and *G. variabilis* is apparent.

G. patens is of common occurrence in lowland and montane forests (to 1200 m) on the west coast of Malaya from Penang to Malacca, and has been collected a few times from Johore.

The commonest form of *G. patens* var. *patens* is nearest morphologically to Miquel's type specimen of *G. patens* originally described from Sumatra. The leaf upper surface is commonly glabrous except for the midrib, margin and apex. The leaf number is usually c. 3 to 4 but some plants have 5 to 7 leaves. The nearly glabrous seven-leaved form described by Holttum from Ulu Kahang (*Holttum* SFN 10927) is probably a variant form. The degree of hairiness varies, but most plants are long-hairy. The sterile bracts vary from 4 to 9 but commonly number 7 to 9. The staminode is usually as long as or shorter than the lateral corolla lobe. This group of *G. patens* is of common occurrence in the ground flora of lowland rain forests, and has been found occasionally on higher grounds (e.g. Genting Highlands, 800 m). It flowers more or less throughout the year and has been frequently observed with fruits. Its somatic chromosome number is 32.

The chromosome race with $2n = 48$ shows a very close morphological resemblance to that with $2n = 32$. The morphological differences lie in the thicker stem, inflorescence stalk and leaves, the larger number of leaves (5–7 instead of the usual 3–4), the broader primary bracts, the shorter rhachis with a smaller number of cincinni, the deeper orange colour of flowers, the longer labellum and the staminode being always longer (c. $1\frac{1}{2}$ times) than the lateral corolla lobe.

var. **costulata** Lim, **var. nov.**

Folia valde venoso-costulata (in venis secundariis tertiariisque), supra dense hirsutula pilis intercostalibus basaliter crasso-papilliformibus.
Type: Pahang, Fraser's Hill, *A. R. Lethbridge* KLU 8209 (holo. KLU).

The prominently ridged leaves with hairy upper surface distinguish this variety from *G. patens* var *patens*. Leaves are generally paler green and the inflorescence is more compact than *G. patens* var. *patens*.

This variety has been collected from damp, well shaded habitats by streams or waterfall in Fraser's Hill and Cameron Highlands, Pahang (altitude 1200 m) and at the edge of a swamp in Sungei Lallang Forest Reserve, Semenyih, Selangor (c. 200 m). It apparently resembles the form described by Holttum, collected from Bukit Kutu (Selangor) and Bukit Tangga (Negri Sembilan). Its somatic chromosome number is 32 and it has been observed to bear fruits.

9. Globba variabilis Ridl. in Trans. Linn. Soc. 3: 378 (1893), Journ. Str. Br. R. As. Soc. 32: 98 (1899) and Fl. Mal. Pen. 4: 239 (1924); Holtt. in Gard. Bull. Sing. 13: 37 (1950).
Type: Pahang, Tahan River, *Ridley* 2405 (K).

Syn.: *G. malaccensis* Ridl. in Journ. Str. Br. R. As. Soc. 32: 93 (1899) and Fl. Mal. Pen. 4: 237 (1924). Type: to be selected (SING).
G. perakensis Ridl. in Journ. Str. Br. R. As. Soc. 32: 98 (1899) and Fl. Mal. Pen. 4: 239 (1924). Type: Perak, Ipoh, *Curtis* 3142 (SING–n.v.).

ssp. **variabilis**
Voucher specimen: Selangor, Gombak Forest Reserve, *S. N. Lim* KLU 8208.

G. variabilis ssp. *variabilis* is characterised by 3 to 6 elliptic shortly acuminate almost glabrous leaves crowded at the upper half of the leafy stem, an erect compact inflorescence with orange to red cincinnus stalks, primary bracts, bracteoles and flowers and the staminode of the distinctly sessile flowers about the same length as the lateral corolla lobe.

G. variabilis is nearly allied to *G. patens* but for the broader and more conspicuous sterile bracts, primary bracts and bracteoles (the latter two being orange-red), the smaller number of cincinni, the sessile flowers and the longer labellum.

G. variabilis grows in moist, rather deep shade commonly by streams or waterfalls. It "occurs in lowland forest and at moderate elevations, most commonly in Pahang and Johore, and on the western side as far north as Perak, but not to Penang." (Holttum, 1950, p. 38). A few collections have been recorded from Kelantan and a recent collection from Bukit Timah Forest Reserve, Singapore. The species has a widespread distribution; but, where found, appears to have a restricted occurrence along streams or by waterfalls.

Fresh specimens collected from Genting Simpah, Gombak 12th and 16th Mile, Sungei Laland Forest Reserve (Selangor), Fraser's Hill (Pahang) and Bukit Timah Forest Reserve (Singapore) show $2n = 48$ and high percentages of pollen failure. Many of the herbarium specimens in the Singapore Botanic Gardens collection from Pahang, Johore and Perak are fruit-bearing. These resemble the live plants investigated, but could be plants with $2n = 32$ as these are more fertile.

Slender shoot-bulbils are frequently produced by *G. variabilis*. Flowering occurs nearly the whole year round.

ssp. **pusilla** Lim, **ssp. nov.** Fig. 4.

Herba florifera bulbiligeraque caespitosa 4–5-foliosa; caulis ad vaginam folii summi 8–10 cm longus cum inflorescentia usque ad 20–30 cm longus. *Laminae* foliorum 7–11 cm longae et 2·5–3·5 cm latae (raro ad 11 × 3·5 cm) ovatae vel ellipticae, base obtusae vel rotundatae basem versus in pseudopetiolis 2–3 cm longis abrupte attenuatae, asymmetricae, apicem versus brevi-acuminatae caudatae, supra atrovirides puberulae (apicem marginemque versus pubescentia densiore) infra pallide virides puberulae (ad costam et marginem versus). *Inflorescentia* compacta 10–15 cm longa rachide vix 2 cm longa, omnino puberula violaceae, pedunculo 3–4 bracteis sterilibus ferenti; bracteis binis infimis vaginantibus brevicaudatis 2–3 cm longis. *Bracteae primariae* ellipticae vel ovatae persistenter puberulae, violaceae c. 8 mm longae et 5 mm latae. *Cincinni* rachillae parce puberulae floribus vulgo 4–6 sessilibus approximatis ferentes parte basali 5 mm longa, *bracteolis* ad

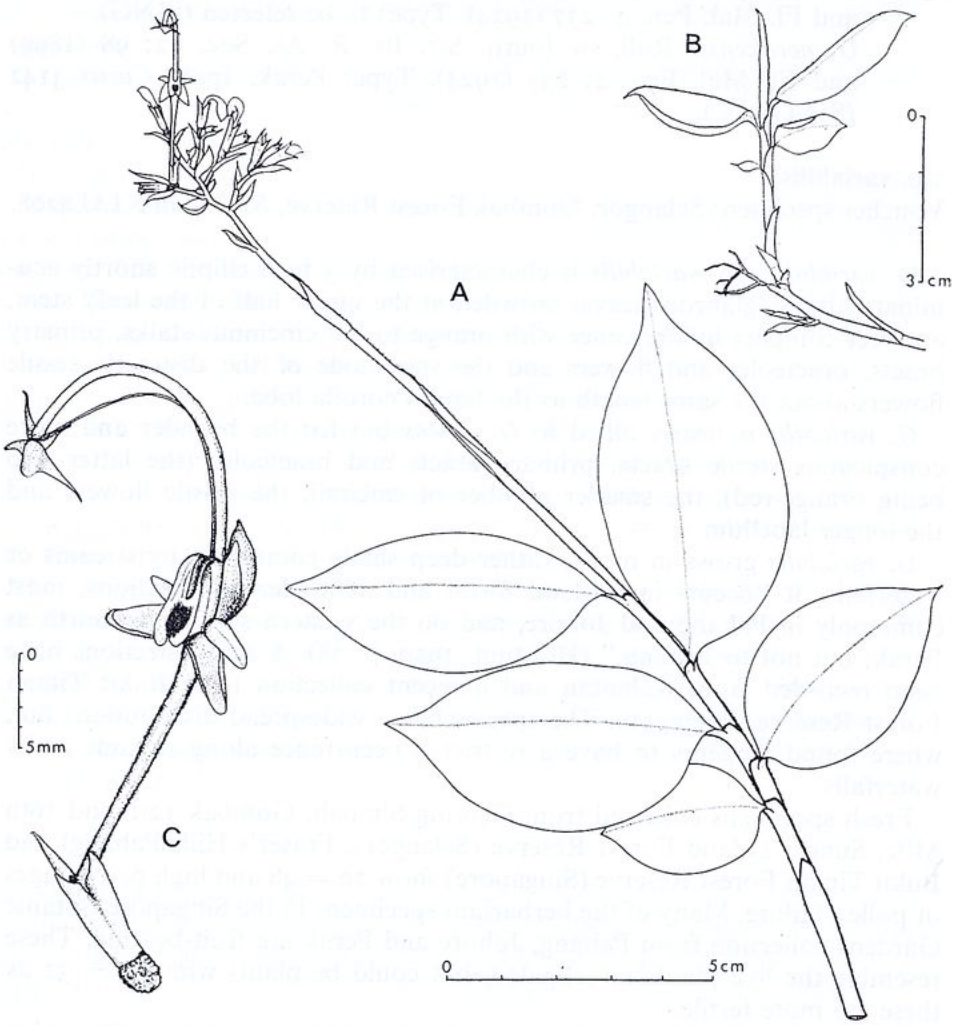

FIG. 4. *Globba variabilis* ssp. *pusilla* Lim: A, plant; B, bulbil; C, flower.

6 mm longis violaceis duplicatis persistentibus; *labello* pallide aurantiaco c. 6 mm longo lobis binis angustis brevibus rotundatis non-divergentibus. *Fructus* valde rugulosi. 2n = 32.
Type: Johore, Gunong Panti, *W. L. Chew* KLU 8246 (holo KLU; iso. K). Voucher specimens: Johore, Gunong Panti, *Kuswata* 422 (Univ. Sing.); Sungei Sedili, Sungei Kayu, *Kiah* 32013.

This subspecies shows a general resemblance to *G. variabilis* ssp. *variabilis* in inflorescence structure and floral morphology. The inflorescence in both is compact; the rachis, inflorescence branches, primary and secondary bracts reddish; the flowers sessile and the staminodes shorter than the corolla lobes. *G. variabilis* ssp. *pusilla*, is, however, distinctly smaller (8–10 cm v. 30–45 cm to highest leaf sheaths); its leaves are broader with shorter cauda (3 by 2·5 cm to 7 by 3·5 cm, largest 11 by 3·5 cm v. 10 by 3 cm to 24 by 8·5

cm), the upper surface dark velvety green: the peduncle and sterile bracts are markedly purplish red; the number of sterile bracts smaller (3–4 v. 7–11) and the labellum much shorter (c. 6 mm v. 9 mm long) with non-divergent rounded lobes. Its somatic chromosome number is 32 while that of *G. variabilis s.s.* is 48.

This subspecies has been collected only from Johore and seems to show a more restricted distribution than *G. variabilis* s.s. which occurs in Pahang, Johore and on the western side of Malaya as far north as Perak.

10. Globba albiflora Ridl. in Journ. Str. Br. R. As. Soc. 32: 96 (1899) and Fl. Mal. Pen. 4: 237 (1924); Holtt. in Gard. Bull. Sing. 13: 31 (1950).
Type: Penang, *Curtis* 2851 (K, SING).

var. **albiflora**
Voucher specimen: Penang, Penang Hill, *S. N. Lim*, KLU 8221.

This species is characterised by 10 to 16 narrow, acuminate caudate, almost glabrous leaves positioned in the upper four-fifths of the leafy shoot, a lax inflorescence on a condensed peduncle with numerous rather long cincinni each bearing several well spaced flowers, the long acute hairy staminode and the short anther with broad lateral spurs.

The typical form is found on Penang Hill (450 m) growing in a moist, cool, partially shaded habitat on boulders by a small waterfall. Its occurrence seems localised and it is morphologically rather constant.

G. albiflora var. *albiflora* seasonally undergoes a dormancy period of three to five months in Penang as well as in Kuala Lumpur (in cultivation) during the earlier part of the year. Fruits are frequently produced, and plants are propagated vegetatively as well as by seeds. The somatic chromosome number is 32.

var. **aurea** Holtt. in Gard. Bull. Sing. 13: 32 (1950).
Type: Kelantan, Gua Lambok, Sungei Betis, *Henderson* S.F.N. 29715 (SING–n.v.)

This orange flowered variety of *G. albiflora* has been collected only from Gua Lambok in Kelantan. I have not been able to collect specimens of this variety. A chromosome count of 32 was reported by Mahanty (1965).

11. G. fasciata Ridl. in Journ. Str. Br. R. As. Soc. 57: 101 (1910) & Fl. Mal. Pen. 4: 136 (1924).
Type: Pahang, Temengoh, *Ridley* 14415 (SING).

This species is very near *G. pendula*. It "differs from typical *G. pendula* in its narrower leaves, shorter denser inflorescence, long staminodes and perhaps in the spurs of the anther having a broader base" (Holttum 1950).

This species has not been re-collected.

12. Globba pendula Roxb. in Asiat. Res. 11: 359 (1810); Bak. in Fl. Brit. Ind. 6: 205 (1890); Ridl. in Journ. Str. Br. R. As. Soc. 32: 92 (1899) and Fl. Mal. Pen. 4: 236 (1924); Holtt. in Gard. Bull. Sing. 13: 29 (1950).
Type: Coloured drawing (K).
Syn.: *G. wallichii* Bak. in Fl. Brit. Ind. 6: 205 (1890); Ridl. in Journ. Str. Br. R. As. Soc. 32: 89 (1899) and Fl. Mal. Pen. 4: 235 (1924). Type: Penang, Herb. Wallich.
G. uliginosa Miq., Fl. Ind. Bat. Suppl. 613 (1860); Bak. in Fl. Brit. Ind. 6: 203 (1890); Ridl. in Journ. Str. Br. R. As. Soc. 32: 90 (1899) and Fl. Mal. Pen. 4: 235 (1924). Type: Sumatra, Amann, Bankga (U 044077).
(?) *G. aphylla* Miq., Fl. Ind. Bat. Suppl. 614 (1860). Type: Sumatra, Lubu Alung (U 122298).
G. panicoides Miq., Fl. Ind. Bat. Suppl. 614 (1860); Ridl. in Journ. Str. Br. R. As. Soc. 32: 91 (1899) and Fl. Mal. Pen. 4: 235 (1924). Type: Sumatra, Lubu Sampit, Balangkian, (T) H.B. 2039 (U).
(?) *G. kingii* Bak. in Fl. Brit. Ind. 6: 204 (1890). Type: Singapore, *King* 715 (CAL, n.v.).
G. valida Ridl. in Journ. Fed. Mal. Str. Mus. 4: 76 (1904) and in Fl. Mal. Pen. 4: 236 (1924). Type: Pahang, Telom, *Ridley* 13907 (K).

subsp. **pendula**

G. pendula is the commonest *Globba* in Malaya and has a distribution that covers the whole country from the lowlands to as high as 1200 m. The plants usually occur in abundance where they are found, on stream banks, under forest canopies, among grasses in relatively exposed areas or in the deep damp shade of primary forests. The known distribution includes Sumatra, Borneo, and Banca (Ridley, 1924).

G. pendula is a highly variable species. It is generally characterised by rather narrow elliptic leaves with acuminate-caudate apices and stiff curved hairs on the main lateral veins of the upper surface. The inflorescence consists of a much reduced peduncle and a very long rhachis with numerous well spaced rather long cincinni each bearing up to three flowers crowded near the apex. Flowers are orange with an upward-pointing dorsal corolla lobe. Along the west coast, particularly in Negri Sembilan and Malacca, a very small-leaved form KLU 4788) seems common. These plants grow in relatively exposed areas on well drained soil. They have been cultivated alongside the larger forms, and the difference in size proved constant. These plants vary as to whether or not a longitudinal pale median band is present on the leaves. In Genting Simpah, Selangor, a rather constant form occurs marked by dark green leaves with white median bands (KLU 8213). Cincinnus length is variable even among plants of the same vicinity but it is generally short. Holttum (1950) records a form found in Pahang "with rather numerous flowers (up to 8) on each branch of the inflorescence, otherwise like *G. pendula*". Corolla lobe attachment is not always at the same level. This varies from well below the labellum base (c. 1·5 mm in KLU 8213) just above it (e.g. KLU 4788). The dark brown labellum spot varies in size and intensity of colour; sometimes it is absent.

Two large forms have been found on stream banks on Fraser's Hill, Pahang (KLU 8203), that have $2n = 48$. These seem to intergrade into the

complex variation patterns shown by *G. pendula* as a whole. Other than pollen size difference, it is difficult to distinguish these forms from those with 2n = 32 by morphological means.

Fruits are rather commonly produced in almost all the plants with 2n = 32. They have not been observed on the plants with 2n = 48. Bulbils may be formed in abundance. Shoot-bulbils are produced in the axils of the sterile bracts, while multiple shoot-root bulbils are formed in place of the possible fourth flowers on cincinni. The latter are frequently produced on lower inflorescence branches even while the upper ones are bearing flowers. Old inflorescences usually have one such bulbil on each branch.

G. pendula is closely allied to *G. leucantha*. The features that separate them are the larger leaves of *G. leucantha* with short stiff hairs all over the upper surface between the veins (the generally narrower leaves of *G. pendula* have curved hairs only on the main lateral veins) and the shorter more compact inflorescence of *G. leucantha* with longer cincinni that are distally white and shiny. The cincinni of *G. pendula* usually bear up to three flowers crowded near the apices, the more numerous flowers of *G. leucantha* are better spaced. Also, the dorsal corolla lobe of *G. pendula* is in an erect position while that of *G. leucantha* is spreading.

An examination of almost all the type specimens was conducted with the aim of reviewing the taxonomic status of the many synonyms that Holttum considered conspecific with *G. pendula* in 1950. Most of the types are poor specimens. The type of *G. oligantha* Miq. bears young inflorescences, and that of *G. aphylla* Miq. is a young leafless flowering shoot. Such leafless flowering stems occur in *G. leucantha* and have been observed in *G. pendula* ssp. *montana*. Holttum (1967, personal communication) observed that "the almost glabrous sheaths of the base of the specimen agrees with those of *G. pendula* rather than with *G. leucantha*". This character rules out the possibility of its being a leafless flowering shoot of *G. pendula* ssp. *montana* which has a pubescent basal sheath. *G. wallichii* Bak. and *G. uliginosa* Miq. were described as spurless but the Singapore sheets show otherwise. *G. uliginosa* is probably the small form of *G. pendula* common on the peninsular west coast. The type bears fruits. These and *G. panicoides* are undoubtedly *G. pendula*. The type of *G. kingii* Bak. is not available for examination. King informed Ridley that it was similar to *G. panicoides*; also, Baker's description agrees with that of *G. pendula*. Until more field studies are made, I do not feel justified in making intraspecific distinction. An exception stands out against the rest. The specimens from Penang Hill, Ayer Itam Dam and the Waterfall Gardens, Penang appear distinctive enough to be separated as an infraspecific taxon. These resemble the type of *G. montana* Ridl. in having long cincinni, and have been classified as *G. pendula* ssp. *montana*. The others are considered conspecific with *G. pendula* Roxb.

subsp. **pendula** var. **elegans** (Ridl.) Holtt. in Gard. Bull. Sing. 13: 31 (1950).
Type: Perak, Bruas Woods, *Ridley* 8392. (holo. K)
Syn.: *G. elegans* Ridl. in Journ. Str. Br. R. As. Soc. 32: 96 (1899) and Fl. Mal. Pen. 4: 237 (1924). Type as above.
Voucher specimen: Pahang, Fraser's Hill, *A. R. G. Lethbridge* KLU 4830 (KLU, K).

The specimen KLU 4830 shows a close morphological resemblance to the type specimens of *G. pendula* var. *elegans* except for flower colour which is recorded as "white with a violet spot on lip". The rhachis and cincinnus stalks grade from pale green to waxy-white towards the apex of the inflorescence, the calyx is waxy-white and the flower pale translucent orange, the colour being more intense at the basal part of the lip and at the anther. The faint lip spot is dark-purple and the basal lobes are slightly bilobed as is recorded by Holttum.

Plants of *G. pendula* var. *elegans* grow in dense clumps in damp, cool, partially shaded habitats by streams on Fraser's Hill. Multiple-shoot bulbils are formed in place of possible fourth flowers on cincinni. These bulbils are often observed on the lower cincinni while the upper branches are still bearing flowers.

This variety has $2n = 32$.

subsp. **montana** (Ridl.) Lim, **comb. et stat. nov.**

Type: Kedah, Kedah Peak, *Ridley* s.n. (SING).

Syn.: *G. montana* Ridl. in Journ. Str. Br. R. As. Soc. 32: 42 (1899) and Fl. Mal. Pen. 4: 236 (1924). Type as above.

Plants c. 45–95 cm to highest leaf-sheath, with inflorescence c. 75 to 140 cm tall. *Leaf blades* usually c. 9–13, sometimes c. 2–4 or absent altogether. *Basal sheaths* mottled with purple, pubescent. *Bladed sheaths* hairy or almost glabrous. *Leaf blade* elliptic, base broadly cuneate, apex acuminate caudate; c. 17 by 4·8 cm to 22 by 5 cm, upper surface with stiff curved hairs on main lateral veins, lower surface purplish, covered with soft adpressed hairs. *Petiole* absent. *Ligule* gently bilobed, hairy with ciliated margin, c. 2 to 3 mm long. *Peduncle* c. 3 to 5·5 cm long; *rhachis* much longer c. 27 to 40 cm long, both short-hairy, sometimes strongly mottled with purple. Peduncle bearing 2 to 3 rather long ovate minutely hairy deciduous sterile bracts. *Inflorescence* lax, rhachis bearing numerous cincinni at c. 1·3 to 3 cm apart. Lowermost cincinni c. 2 to 3 cm to the first flowers, grading upwards to 0. Each cincinnus bearing up to 5 flowers arranged c. 3–7 mm apart; the whole mature cincinnus may measure up to 5 cm long. *Primary bracts* resembling sterile bracts. *Bracteoles* small, glabrous, orange, deciduous. *Bulbils* with bulbous roots, varying from single root-shoot system to multiple root-shoot system within the population. *Flowers* orange with shiny pale green ovary. *Ovary* with calyx c. 6 mm long, calyx lobes subequal. *Corolla tube* short, minutely hairy, c. 5 mm above mouth of calyx; corolla lobes glabrous; dorsal lobe hooded, erect, c. 5·5 mm long; lateral lobes concave, spreading, c. 4·5 mm long. *Staminodes* oblong, blunt, longer than lateral corolla lobe, c. 8 mm long. *Labellum* c. 10 mm long, 3 mm across the bilobed base; lip spot usually rounded dark brown, sometimes absent; upper groove of labellum papillate. The distance between the base of the labellum and the staminode attachment varies. *Filament* c. 15 mm long; *anther* c. 2·5 mm long bearing 2 basal acute appendages. *Fruits* faintly trilobed, shiny green, often mottled with purple.

Voucher specimen: Penang, Penang Hill, *S. N. Lim* KLU 8219.

This subspecies has been found occurring in abundance by jungle paths in relatively cool and partially open habitats on well drained soil on Penang

Hill (c. 450 m) and near the Ayer Itam Dam (c. 150 m), Penang. It is cultivated in the Penang Botanic Gardens.

G. pendula ssp. *montana* differs from *G. pendula* ssp. *pendula* in having rather long cincinni each bearing up to 5 well-spaced flowers and pubescent basal sheaths. These features strongly resemble those of *G. leucantha* but the pattern of hairiness of the upper leaf surface, the long lax inflorescence and the orange flowers with erect dorsal corolla lobe, indicate affinity with *G. pendula*.

The live plants from Penang Hill and Ayer Itam Dam closely resemble the type specimen of *G. montana*. Both are large plants with hairy basal sheaths and long well-spaced cincinni. In the type of *G. montana* the staminodes are missing and Ridley (1924) records an unusually broad base for the anther-appendages which are, however, distinctly basal. The labellum is reported as small, entire and free above the corolla. This is a variable feature in the subspecies. The plants are so generally alike that they are here placed within the same taxon without hesitation.

G. pendula ssp. *montana* has $2n = 32$. Fruits are frequently formed and plants have been successfully raised from seeds.

This subspecies is morphologically variable. The number of leaves is usually 9 to 13, but sometimes plants are found with even 2 leaves. Leafless flowering shoots are not uncommon, and are reminiscent of the type of *G. aphylla* which is a young leafless flowering shoot. The degree of anthocyanin pigmentation varies and lip spot may or may not be present The length of staminode varies, but is always longer than the lateral corolla lobe. The attachment of the lateral corolla lobes also varies. Bulbil-morphology varies from a single root-shoot system to a multiple root-shoot system even within the same population.

Unlike *G. pendula* ssp. *pendula*, this subspecies becomes dormant from about October through the early part of the following year, completely disappearing from where they used to occur in abundance. Young plants are produced in profuse numbers by rhizomatous growth and from bulbils from the last season around March or April at the beginning of the wet season. Flowering begins about two months later. Observations showed that a dry spell in January and February followed immediately by heavy rainfall induces flowering two months later around May and June.

13. G. leucantha Miq., Fl. Ind. Bat. Suppl. 612 (1860).

This species commonly grows as part of forest ground flora in rather open habitat on well drained soil. Its distribution covers the southern half of Malaya to Perak and Trengganu. It is recorded as "common in forests in the southern part of Malaya" and "abundant on Bukit Timah" (Holttum 1950), but only a few collections were made in Gunong Panti, Johore, and in Bukit Timah Forest Reserve, Singapore. It appears to be of more limited occurrence in Singapore now.

G. leucantha closely resembles *G. pendula*. Generally differences lie in the larger leaves of *G. leucantha*, which are usually hairy between the veins on the upper surface, and the shorter more compact inflorescence with longer cincinni each with up to 8 well-spaced flowers.

The species is morphologically variable. Baker described two new species,

G. pallidiflora and *G. floribunda* based on Malayan specimens. These were identified by Ridley as *G. leucantha*, originally described from Sumatra. A re-examination of the type of *G. leucantha* showed that it lacked the intervenous short hairs which appear in most Malayan specimens, and led Holttum (1967, personal communication) to propose that the species be regarded as one with many varieties. Unfortunately, Baker's types are not available for a re-investigation. The representation of the species on the Malay Peninsula is composed of varieties, as listed below.

var. **peninsularis** Holttum **var. nov.** a typo pilis brevibus erectis numerosis in folii pagina superiore inter venas distincta.
Type: Johore, Gunong Panti, *J. Sinclair* KLU 8200.
Syn.: *G. floribunda* Bak. in Fl. Brit. Ind. 6: 203 (1890). Type: Johore, *King* 714 (CAL, n.v.).
G. pallidiflora Bak. in Fl. Brit. Ind. 6: 204 (1890). Type: Johore, *King* 716 (CAL, n.v.).
G. leucantha auctt.; Holttum in Gard. Bull. Sing. 13: 26, f. 1 (1950)—non Miq.
"Differs from the typical form of the species in presence of numerous short erect hairs on upper surface of leaf-blades between the veins" (Holttum 1967, personal communication). This variety has 2n = 32.

var. **flavidula** (Ridl.) Holtt. in Gard. Bull. Sing. 13: 28 (1950).
Type: Pahang, Ulu Sungei Merapoh, *Foxworthy & Nur* 11940 (K, SING).
Syn.: *G. flavidula* Ridl., Fl. Mal. Pen. 5: 338 (1925). Type as above.
"Flowers yellowish" (Ridley 1925). Chromosome number unknown.

var. **violacea** (Ridl.) Holtt. in Gard. Bull. Sing. 13: 27 (1950).
Type: Johore, Gunong Pulai, *Ridley* s.n.
Syn.: *G. violacea* Ridl. in Journ. Str. Br. R. As. Soc. 32: 97 (1899) and Fl. Mal. Pen. 4: 239 (1924). Type as above.
"Calyx white; corolla and staminodes violet; lip violet with a darker spot towards the yellowish apex; anther violet." (Holttum, 1950).

This variety has been collected from lowland and mid-mountain forests from Pahang, Kelantan and Trengganu. Fruits are present on most of the herbarium specimens in the Singapore collection. Chromosome number unknown.

var. **bicolor** Holtt. in Gard. Bull. Sing. 13: 27 (1950).
Type: Kelantan, Kuala Lebir, *Gimlette* s.n. 1905.
Syn.: *G. regalis* Ridl., Journ. Fed. Mal. St. Mus. 4: 75 (1909) and Fl. Mal. Pen. 4: 237 (1924). Type: Pahang, Telom, *Ridley* 13905 (K).
"Leaves minutely scabrous on the upper surface (hardly hairy); calyx and corolla-lobes more or less flushed with violet, staminodes and apical lobes of lip pale yellow, base of lip white or flushed with lilac, stamen yellow, spurs sometimes tinged with violet." (Holttum, 1950).

The peduncle in the type collection is 20 cm long and bears numerous bulbils. Holttum (1967, personal communication) observes a similar condition in a Kew specimen collected by Kloss at Ulu Langat, Selangor (February 1912). This differs from other varieties of *G. leucantha*. The presence or absence of a long peduncle bearing bulbils may be due to environmental differences but needs experimental verification.

This variety has been collected from lowland and mid-mountain forests from Pahang, Kelantan and Trengganu.

Fruits are present on almost all the herbarium sheets in the Singapore collection. The chromosome number is unknown.

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