

REVISIONS IN COEOLOGYNINAE (ORCHIDACEAE) II*
THE GENERA BRACISEPALUM, CHELONISTELE, ENTOMOPHOBIA,
GEESINKORCHIS AND NABALUIA

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SUMMARY

This paper embraces a taxonomic revision of the genera *Bracisepalum* (2 species), *Chelonistele* (11 species, 4 varieties), *Entomophobia* (1 species), *Geesinkorchis* (2 species) and *Nabalua* (3 species). Synonymy, descriptions, distribution, habitat notes, and colour descriptions are given; each species is illustrated by a figure. Keys are given to the species.

INTRODUCTION

Since Pfitzer's monograph of the Coelogyninae (finished by Kraenzlin) in 'Das Pflanzenreich' (1907) no attempts have been made to revise the subtribe as a whole. The classification given in his monograph, however, was criticised from several sides.

In the course of the present work done so far on Coelogyninae all species of *Pholidota* and *Chelonistele* were compared. It appeared that these two genera can be well defined if several deviating, formerly included species are moved to other genera, see below.

Bracisepalum J. J. Smith, which belongs here as well, has never been confused with these two genera. It is characterised by the saccate back of the hypochilium, its front part is about tubular but open on the upper side, the lateral sepals being connate at the very base and there saccate around the pouch of the lip.

Chelonistele Pfitzer has the lip more or less strongly sigmoid; lateral lobes either absent or developed in the front part of the hypochilium only, never continuing to its very back; keels 2, laterally slanting.

Entomophobia de Vogel is characterised by the narrow, deep lip of which the basal half is adnate to the basal half of the column, and by a transverse high callus in the lip; this combination of characters is not present in other Coelogyninae.

Geesinkorchis de Vogel has a real pollinarium with a stipes, unique in Coelogyninae as far as I know, and a raceme which produces flowers in succession; other Coelogyninae with this latter feature have entirely different flowers.

Nabalua Ames can be distinguished from both *Chelonistele* and *Pholidota* by the long and slender lateral front lobes of the hypochilium, as well as by the more or less horseshoe-shaped callus between these lobes.

Pholidota Lindley is characterised by the boat-shaped hypochilium of which the sides are erect and in front usually drawn out into lobes which continue towards the back of the lip; this genus will be treated in another paper.

* Part I in *Blumea* 28 (1983) 413–418; this treats *Bracisepalum* J. J. Smith, also included here.

Thanks are due to the directors and curators of the following herbaria for the loan of types and other material for this study, and for the hospitality during personal visits by the author (these herbaria marked *): AMES, B, BM*, BO*, BR, CAL, CGE*, E, G, K*, KLU, L*, M, NY, P, S, SAN, SING*, W.

Specimens will be cited separately in (Flora Malesiana) 'Identification Lists of Malesian Specimens'.

Living plants of *Bracisepalum densiflorum*, *B. selebicum* and *Chelonistele sulphurea* var. *sulphurea* were grown in the Leiden Botanic Garden; additional living specimens of *Geesink-orchis phaiostele*, *Chelonistele ingloria* and *C. sulphurea* var. *crassifolia* were received from the Botanic Gardens in Edinburgh and brought into flower in the Leiden Botanic Garden.

THE GENUS BRACISEPALUM

Bracisepalum and its species *B. selebicum* were in 1933 described by J.J. Smith, who had only a single collection made by Kjellberg at his disposal. It lasted 47 years before this species was rediscovered in Celebes by a Dutch-Indonesian expedition. Ample herbarium specimens were then collected, as well as living specimens of which several flowered since in the Hortus Botanicus Leiden. Based on this latter material, in 1983 a revision of the genus was given in which a second species, *B. densiflorum*, was described.

Bracisepalum is the only genus of Orchidaceae endemic to Celebes. Only two genera, both in Coelogyninae, have ever been thought endemic to Celebes. The second one, *Basigyne* J.J. Smith, was later reduced by Smith to *Dendrochilum*; the present author agrees with this opinion.

Bracisepalum has the habit of a *Dendrochilum*; in vegetative state it cannot be distinguished from this genus. The flowers, however, are definitely more like those of *Coelogyne* than of *Dendrochilum*, especially in the slender column which does not possess stelidia, the shape of the lip, and also in size and general shape. *Bracisepalum* can be distinguished from both genera by the tubular hypochilium which is open on the upper side and saccate at the back, and the lateral sepals that are connate at the very base and there connate around the pouch of the lip.

BRACISEPALUM J.J. Smith

Bracisepalum J.J. Smith, Bot. Jahrb. 65 (1933) 464; Butzin, Willdenowia 7 (1974) 246, 254; de Vogel, Blumea 28 (1983) 413, f. 1, 2. — Type species: *B. selebicum* J.J. Smith.

Epiphytes. Roots long, sometimes puberulous. Rhizome creeping, terete. *Pseudobulbs* close together, ovoid, one-foliate. Young shoots enveloped by scales which later disintegrate into loose fibres. *Leaf* petiolate. *Inflorescence* synanthous with the developed leaf, partly pendulous, wiry, with several to many, crowded to rather spaced, spirally arranged flowers. Rhachis zigzag. Sterile bracts below the flowers 1–2, appressed to the rhachis, resembling the floral bracts. *Floral bracts* persistent. *Flowers* opening rather wide or not, delicate. *Sepals* narrow, lateral ones inserted at the base of the column and on the column foot, connate at the very base, the basal portion saccate around the sac of the lip. *Petals* ± spatulate-rhomboid, oblique, about sickle-shaped, margin towards the top somewhat erose. *Lip* inserted on the tip of the column foot, more or less parallel to the column. *Hypochilium* subdivided into a saccate base of which the tip is two-saccate, and a tubular central part that is open on the upper side. *Epichilium* somewhat recurved to reflexed, cordate to shortly ovate with unequal sides, narrowed into the tubular part of the hypochilium, margin wavy, nerves much-branched. *Column* slender, straight, with a three-lobed apical hood and a distinct short foot. Anther with a short, flexible filament, inserted somewhat above the stigma, ± cordate; pollinia 4, ovate, acuminate. *Stigma* situated between the bases of the lateral lobes of the hood, cup-shaped with projecting margins, the upper margin a little more pronounced into a rostellum.

Distribution. Central Malesia: endemic in Celebes, 2 species.

Ecology. Epiphytic on trunks and branches of trees below the canopy; altitude c. 1800–2000 m.

KEY TO THE SPECIES OF BRACISEPALUM

- 1 a. Rhachis (4–)10–15 times the length of a flower. Saccate base of the lip less than a third of the length of the column 2. *B. selebicum*
- b. Rhachis less than 2 times the length of a flower. Saccate base of the lip about half as long as the column 1. *B. densiflorum*

1. *Bracisepalum densiflorum* de Vogel – Fig. 8; Plate 2c.

Bracisepalum densiflorum de Vogel, *Blumea* 28 (1983) 417. – Type: Leiden, cult. Hort. (de Vogel) 20313 (L).

Roots terete, sometimes more than 30 cm long, with erose surface. Rhizome creeping, short, terete; the portions between the pseudobulbs c. 7 mm long, conical, at the base c. 2 mm diam., below the pseudobulb c. 6 mm diam. *Pseudobulbs* to 4 by 2.2 cm. Young shoot and base of the inflorescence enveloped by 3 scales. Scales sessile, imbricate, folded into a blunt keel, resp. 5, 10 and 30 mm long. Petiole semi-orbicular in section, above channelled, in the only leaf present 20 by 1.5 mm. *Blade* obovate-lanceolate, 6 by 2.5 cm; top acuminate, margin slightly wavy; nerves 7, the midrib below prominent. *Inflorescence* synanthous with the almost entirely developed leaf, with 8 crowded, rather open flowers. Peduncle terete, 7 cm long, the basal 2 cm erect, the apical 5 cm pendulous and at the base somewhat zigzag. Sterile bracts two. Rhachis 3.2 cm long; internodes c. 5 mm long. *Floral bracts* ovate, c. 6 by 4 mm; top acute; c. 11-nerved. *Median sepal* obovate-ovate-oblong, c. 15 by 6 mm, at the base with two small auricles; top acute; 5-nerved. *Lateral sepals* recurved, oblanceolate, c. 18 by 5 mm; top acute; main nerves 4. *Petals* somewhat reflexed, more or less spatulate-rhomboid, oblique, c. 14 by 7 mm, obtuse, main nerves 3. *Lip* 11 mm long, main nerves 9. *Hypochilium* consisting of a saccate base c. 4.3 mm long, 3.3 mm wide, which is laterally on both sides somewhat inflated, and a tubular part c. 8 mm long, 4 mm wide when expanded, in front on the transition to the epichilium with four small, obtuse teeth. *Epichilium* cordate, abruptly narrowed into the tube, reflexed, c. 10 by 12 mm; top acuminate, reflexed. *Column* c. 10 mm long including the 2 mm long column foot. *Hood* convex, three-lobed, c. 3 by 5 mm, with long decurrent margins; lateral lobes apically each with 1–2 irregular teeth. Anther on a 0.2 mm long filament, c. 1 by 1 mm. *Stigma* c. 1 by 1.2 mm. Ovary and pedicel c. 8 by 0.8 mm. *Fruit* not seen.

Distribution. Celebes (Sulawesi Tengah). 1 collection: Leiden, cult. Hort. (de Vogel) 20313 (L, alc. only).

Ecology. Epiphytic on tree trunks and branches; altitude 1800–2000 m. Fl. & fr. May.

Collector's notes. The sepals and the tube of the lip are pale pink; the petals, the mid-lobe of the lip, and the column pale yellowish pink; the anther redbrown, and the pollinia brownish ochre.

2. *Bracisepalum selebicum* J.J. Smith – Fig. 9.

Bracisepalum selebicum J.J. Smith, *Bot. Jahrb.* 65 (1933) 465; de Vogel, *Blumea* 28 (1983) 415. – Type: Kjellberg 1498 (L).

Roots terete, sometimes more than 30 cm long, often (partly) puberulous with root hairs. Rhizome creeping, short, terete; the portions between the pseudobulbs to c. 5 mm long. *Pseudobulbs* 1.5–4 by 0.5–2 cm. Young shoot and base of the inflorescence enveloped by (3–)5 scales. Scales sessile, the lowest 3 clasping the tubular upper two, resp. 5–10, 11–20, 16–45, 30–85, and 60–140 mm long. Petiole semi-orbicular in section, above channelled, to 5–11 cm by 1–2 mm. *Blade* (obovate-)lanceolate to linear, to 11–21 by 2.2–4 cm; top acuminate; margin entire; nerves 5, the midrib below prominent. *Inflorescence* synanthous with the almost entirely developed leaf, with (8–)23–40 rather spaced, rather closed flowers. Peduncle terete, (9–)17–33 cm long, for most of its length erect, near the top abruptly curved. Sterile bract one, below the flowers. Rhachis (6–)15–23 cm long; internodes 6–8 mm long. *Floral bracts* obovate, (5–)6–9 by 4–5 mm; top obtuse; c. 11-nerved. *Median sepal* lanceolate, (9–)12–15 by (2.5–)3–3.8 mm, sometimes at the base with 2 more or

less pronounced auricles; top acute to acuminate; 3-nerved. *Lateral sepals* somewhat tor-
dated, but not recurved, obovate-lanceolate to about linear, (11.5–)13.5–19 by (2.2–)3–
3.6 mm; top acute to acuminate; 3-nerved. *Petals* hardly recurved, more or less spatulate-
rhomboid, about sickle-shaped, (8.5–)10–12 by (3.2–)4–5 mm; top acute; main nerves 3.
Lip (11–)12.3–18.3 mm long, with 5 main nerves. *Hypochilium* consisting of a saccate base
(1–)1.5–3.7 mm long, 2–3 mm wide, laterally not inflated, and a tubular part 4.5–8 mm
long, 2–2.5 mm wide when expanded, without teeth on the transition to the epichilium.
Epichilium more or less shortly ovate with \pm unequal sides, narrowed into the tube, some-
what recurved and twisted, c. 5–7 by 6–8 mm; tip acute to acuminate, more or less recurved.
Column (7.7–)10–12 mm long, including the 1–2 mm long column foot. *Hood* convex,
three-lobed, c. (2.2–)3 by 3 mm, long decurrent along the column; the irregular lateral lobes
apically either entire or with an irregular tooth. Anther on a c. 0.1 mm long filament, c.
0.7–1 by 1 mm. *Stigma* c. 1 by 1 mm. Ovary and pedicel c. 4–7 by 0.6 mm. *Fruit* not seen.

Distribution. Celebes (Sulawesi Selatan, Sulawesi Tengah). 3 collections: Kjellberg
1498 (L), van Balgooy 3221 (L), Leiden, cult. Hort. (de Vogel) 20446 (L, alc. only).

Ecology. Epiphytic on tree trunks and branches; altitude 1800–2000 m. Fl. & fr. May.

Collector's notes. The flower colour is reddish yellow (beige), to yellow (slightly
tinged pink), to greenish cream with pink, with a yellow lip (sulphury yellow in the type),
the column white, the anther light brown, the pollinia bright ochrish yellow.

Note. J.J. Smith wrongly assumed that the inflorescence was erect; this can be under-
stood because in the type specimen only the lowest part of the raceme with five bracts is
present. As all flowers were detached, it was difficult to see that the lowest bract was sterile.

THE GENUS CHELONISTELE

The genus *Chelonanthera* was established by Blume in 1825. He distinguished three sections, which were not named but numbered. His section 1 included three species: *C. gibbosa* and *C. ventricosa* (which, by most later authors, are reckoned to belong to *Pholidota*), and *C. sulphurea*. Lindley (1833) retained this section 1 in *Chelonanthera*. Sections 2 and 3 were transferred to *Coelogyne*, with which almost all later authors agree.

Reichenbach f. (1857) made the new combination *Coelogyne sulphurea* (Blume) Rchb. f. In 1861 (in Walp., Ann. 6) he reduced *Chelonanthera* sect. 1 to section level in *Coelogyne*, making the new combinations *Coelogyne gibbosa* and *C. ventricosa*, and adding several other species which almost all later authors included in *Pholidota*. *Coelogyne sulphurea*, however, was not included at all. *Coelogyne croockewitii* (a later heterotypic synonym of *Chelonistele sulphurea*) was placed by him in *Coelogyne* sect. *Flaccidae*. As to *Chelonanthera* sect. 2 and 3 he followed Lindley in the idea that they belong in *Coelogyne*. Bentham and Hooker (Gen. Pl., 1883) and Pfitzer (in E. & P., Nat. Pfl. Fam. ed. 1, 1888) arranged Blume's sections in the same way as Reichenbach did.

O. Kuntze considered *Coelogyne* congeneric with *Pleione* D. Don, and in 1891 made a large number of new combinations under this latter genus, among which *P. croockewitii* and *P. sulphurea*. Later authors never followed him in this.

By 1907 (Pfl. R. Heft 32), Pfitzer had changed his opinion. He re-established the genus *Chelonanthera*, including only *C. gibbosa* of Blume's species, thus making this the lectotype of the genus; he added one other species, *C. clypeata*. He established a new genus *Chelonistele*, in which he made new combinations for *Chelonanthera sulphurea* (listing *Coelogyne croockewitii* as a synonym), *Panisea apiculata* and *Coelogyne tenuiflora*, *C. lurida* and *C. biflora*. *Chelonanthera ventricosa* was accommodated in *Pholidota*.

In 1894 Ridley described *Coelogyne pusilla*; in 1907 he placed this species next to *C. sulphurea*, stating in a note that they are '... almost intermediate between the genera *Coelogyne* and *Pholidota*, the lip being quite peculiar in its claw and short spreading side lobes ...'

Schlechter (Nachträge 4 to E. & P., Nat. Pfl. Fam. ed. 1, 1914) considered *Chelonistele* to be a synonym of *Coelogyne*.

Ridley changed his opinion in 1924. Both *Coelogyne pusilla* and *C. perakensis* were transferred to *Chelonistele*. *Coelogyne beyrodtiana* and *C. sulphurea* Hooker f. (non Rchb. f., he did not consider this plant conspecific with the species which Reichenbach transferred from *Chelonanthera* to *Coelogyne*) were placed in the synonymy of *Chelonistele perakensis*. The genus *Chelonanthera* was accepted by Ridley in the sense of Pfitzer.

In 1931 J.J. Smith introduced *Coelogyne* sect. *Chelonistele* without a description or any reference to *Chelonistele* Pfitzer, thus creating a nomen nudum, although it is clear that he meant the same group. Four new species and a new variety were described and a key was given to the Bornean species of this section. In a note a fifth new species, *Coelogyne breviamellata*, was compared with *Coelogyne sulphurea*, not stating, however, that it belongs to the section *Chelonistele*. In his key J.J. Smith laid much emphasis on the shape of the column and the extent to which the keels continue on the epichilium of the labellum. In the present revision this has proved to be a rather variable character within one species.

In 1935 Carr described three new species in the genus *Chelonistele*, and gave a record and colour notes on a fourth. In a second article later that year he gave a modified desc5 the genus, excluding *C. apiculata* and *C. biflora* which he considered to belong in *Panisea*. He reduced the then monotypic genus *Nabalua* to *Chelonistele*. One new species was described and six new combinations were made for species originally described in *Coelogyne*. For an additional five species records and flower colours were given.

In my experience *Chelonistele* is a good genus which can be recognised at a glance from herbarium and living material. It has a typical, more or less shallow, saccate base of the lip, which comprises either the basal part of the hypochilium only, or the entire hypochilium. Lateral lobes may or may not be present on the hypochilium. In almost all species of *Coelogyne* these lobes run from the base of the hypochilium to its front and are erect, giving the lip its typical boat-shaped appearance. In *Chelonistele*, however, the lateral lobes start beyond the saccate part of the hypochilium and they are more or less horizontally spreading; when they are absent the entire hypochilium is saccate. Two typical, entire, laterally slanting, rather high keels are present; in *C. brevilamellata* four short keels are present, which explains J.J. Smith's hesitation to place this species in *Chelonistele*. The column hood is more or less wide and thin, its margins continue as seams towards the base of the column, whereas in *Coelogyne* the hood is narrower, usually not wing-like, and if the hood is wing-like, it does not continue with wing-like seams to the base of the column.

Although *Chelonistele* is different from *Coelogyne*, it is nearer related to this genus than to all other genera of Coelogyneae.

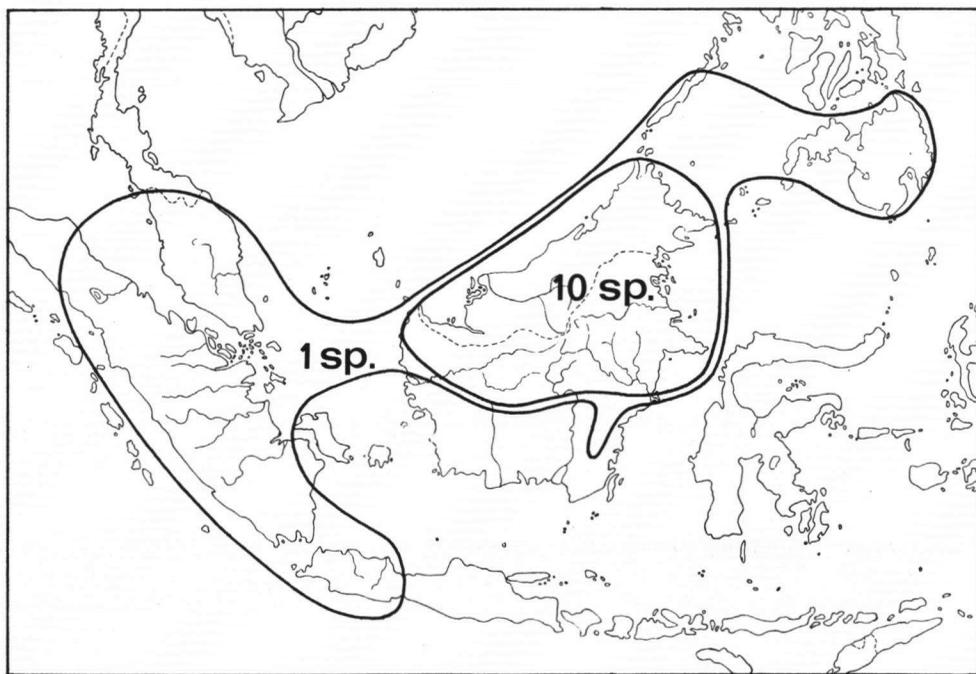
CHELONISTELE Pfitzer

Chelonistele Pfitzer in Pfitzer & Kraenzlin, Pfl. R. Heft 32 (1907) 136; Ridley, Fl. Mal. Pen. 4 (1924) 138; Carr, Gard. Bull. Str. Settl. 8 (1935) 215; Holttum, Orch. Malaya ed. 3 (1964) 236; de Vogel, Blumea 30 (1984) 203. — *Chelonanthera* sect. 1 Blume, Bijdr. (1925) 382; Lindley, Gen. & Sp. Orch. (1933) 178; Miq., Fl. Ind. Bat. 3 (1859) 673; all p.p. — *Coelogyne* Rchb. f., Bonplandia 5 (1857) 43; Hooker f., Fl. Brit. India 5 (1890) 833; J.J. Smith, Orch. Java (1905) 146; Schltr. in E. & P., Nat. Pfl. Fam. 1, Nachtr. 4 (1914) 52; Ames, Orch. 6 (1920) 43; Backer & Bakh. f., Fl. Java 3 (1968) 279; all p.p. — *Coelogyne* sect. *Chelonistele* J.J. Smith, Bull. Jard. Bot. Btzg III, 11 (1931) 97, nom. nud.; in Fedde, Rep. 32 (1933) 169, nom. nud. — *Coelogyne* subg. *Chelonistele* (Pfitzer) Butzin, Willdenowia 7 (1974) 246, 254. — Type species: *C. sulphurea* (Blume) Pfitzer (lecto, here chosen). *Sigmatochilus* Rolfe in Gibbs, J. Linn. Soc. (Bot.) 42 (1914) 155. — Type species: *S. kinabaluensis* Rolfe.

Epiphytes or lithophytes. Roots long, sparsely branched to multibranching, some parts villous with root hairs. Rhizome creeping, rather short, sometimes branched; pseudobulbs close together, sometimes rather spaced. Scales of the young shoot imbricate, distichous, the upper ones usually tubular; top acute; membranous to herbaceous; after anthesis usually disintegrating soon into shorter or longer persistent fibres, sometimes drying out and long persistent; nerves many, fine, all \pm equal. *Pseudobulbs* all turned to one side of the rhizome, short and swollen to very slender, \pm terete to somewhat flattened. *Leaves*: one or two per pseudobulb, petiolate. Petiole semi-orbicular in section, deeply channelled. Blade elliptic to linear, widest below to above the middle; herbaceous to thick-coriaceous; midrib below prominent, other nerves distinct to indistinguishable. *Raceme* erect to patent, proteranthous to synanthous with the just emerging to almost entirely developed young leaf or leaves, few- to many-flowered. Scape consisting of one internode, elongating after anthesis. Rhachis zigzag or not, curved or straight; internodes rather long. Sterile bract(s) rarely present at the base of the raceme. *Floral bracts* in most species caducous before or during anthesis, loosely imbricate, distichous, folded along the midrib; papyraceous to membranous; nerves fine, rather many, all \pm equal; glabrous or with scattered, minute hairs. *Flowers* distichous, in some species secund, several or all open at the same time, rather closed to widely open; lip directed downwards; tender to rather fleshy. Pedicel \pm terete to more or less angular, more or less curved. *Median sepal* rather shallowly (to deeply) concave, ovate to ovate-oblong; top obtuse to acuminate; midrib prominent or bearing a rounded to thin and wing-like low keel. *Lateral sepals* somewhat asymmetric, rather shallowly (to deeply) concave, ovate to ovate-lanceolate; top acute to acuminate or apiculate; midrib bearing a rather prominent, rounded

to wing-like low keel. *Petals* rolled backwards or not, linear to (ob)ovate-lanceolate; top truncate to acute. *Lip* rather straight to strongly sigmoid. *Hypochilium* either with a short and shallow saccate back part and in front convex and there on either side terminated with a lateral lobe, or entirely saccate or boat-shaped and then in front with or without lateral lobes; keels 2 (in *C. brevilamellata* 4, in *C. dentifera* sometimes the central nerve swollen into a ridge or an additional lateral short keel developed on the epichilium), long or short, starting on the convex part of the hypochilium or on the front part of the sac in case of an entirely saccate hypochilium, in one case running through almost the entire sac, continuing more or less far onto the epichilium, low and wing-like, laterally slanting. *Epichilium* lingulate to broadly spatulate or almost orbicular; basal part narrowed or not; top acute to deeply retuse; front lobes absent or present and then broadly rounded to rather rectangular with rounded corners, their margins irregular to entire, undulating or more or less flat. *Column* without column foot, more or less spatulate, \pm wedge-shaped or \pm inverted hastate in outline when flattened; top broadly rounded to retuse, its margin entire to more or less deeply serrate, with or without lateral lobes, shallowly to rather deeply concave. Anther \pm reniform to long-cordate. *Pollinia* 4, each attached to a small caudicle which is usually disintegrated when dried, \pm orbicular to pear-shaped in outline, flattened, with a shallow depression in one side. *Stigma* shallowly cup-shaped, transversely elliptic to narrowly longitudinally elliptic; rostellum a narrow or broad rim to narrowly triangular or lingulate, its top entire to two-lobed. Ovary (rather) slender, more or less clearly angular in section due to the ribs; ribs 3 or 6, in the first case formed by the jugae which may or may not be overlain by the margins of the valvae, in the second case by the jugae and a median longitudinal keel on the valvae. *Fruit* ellipsoid, rather large, the lignified column (possibly in some species also the perianth) persistent; jugae flat, band-like; valvae smooth, in the middle with a longitudinal keel.

Distribution. West Malesia: Malay Peninsula, Sumatra, Java, Borneo, S. Philippines. One species present in the entire area, the other 10 restricted to Borneo.



Distribution map of the species of *Chelonistele*.

Ecology. Epiphytes, sometimes recorded on bases of tree trunks or on tree roots, or on branches of shrubs, sometimes in moss cushions, less frequently terrestrial, on rocks and boulders; in heath forest, (lower) montane and elfin forest, recorded from rather exposed to rather shaded places; altitude 550–3500 m.

KEY TO THE SPECIES OF CHELONISTELE

- 1 a. Pseudobulbs 2-foliolate 2
- b. Pseudobulbs 1-foliolate 4
- 2 a. Flowers outside with scattered minute hairs. Lip \pm halfway without triangular lateral lobes 8. *C. ramentacea*
- b. Flowers glabrous. Lip \pm halfway with distinct, \pm triangular lateral lobes 3
- 3 a. Keels on the lip at the back extended into a short, rounded lobe which projects over the hypochilium sac. Leaves elliptic or oblong, less than $3\frac{1}{2}$ times as long as wide 9. *C. richardsii*
- b. Keels on the lip at the back rather abruptly lowering in height, not extended into a lobe. Leaves (oblong to) lanceolate to linear-lanceolate, (3.5–)5–8.5 times as long as wide 10b. *C. sulphurea* var. *crassifolia*
- 4 a. Hypochilium in front without lateral lobes 5. *C. kinabaluensis*
- b. Hypochilium in front with distinct lateral lobes 5
- 5 a. Keels on the lip less than $\frac{1}{4}$ of the length of the lip 6
- b. Keels on the lip usually half the length of the lip or (much) longer, rarely somewhat shorter 7
- 6 a. Epichilium strongly reflexed. Petals linear, much narrower than the sepals 6. *C. lamellulifera*
- b. Epichilium at most somewhat recurved. Petals obovate-lanceolate, about as wide as the sepals 2. *C. brevilamellata*
- 7 a. Keels on the hypochilium low, on the epichilium 3–4 times as high as on the hypochilium, wing-like, with rounded to acute front margin 11. *C. unguiculata*
- b. Keels on the lip more or less equally high over the entire length or somewhat higher on the hypochilium, rarely slightly higher on the epichilium 8
- 8 a. Leaves 3–8 mm wide. Sepals less than 8 mm long 4. *C. ingloria*
- b. Leaves wider than 15 mm, usually much wider. Sepals more than 10 mm long 9
- 9 a. Column when flattened in outline inverted hastate, its lateral lobes below the top large, triangular in outline, turned to the front 3. *C. dentifera*
- b. Column never with large triangular lateral lobes below the top 10
- 10 a. Column when flattened widest well below the middle 7. *C. lurida*
- b. Column when flattened widest at or above the middle 11
- 11 a. Petiole of at least the longest leaves 4–10 times the length of the pseudobulb (but see note 2 under this species). Median sepal 17–23 mm long 1. *C. amplissima*
- b. Petiole $\frac{1}{2}$ –3 times the length of the pseudobulb. Median sepal 10–15.5(–18) mm long 10a. *C. sulphurea* var. *sulphurea*

1. *Chelonistele amplissima* (Ames & Schweinfurth) Carr – Fig. 10; Plate 2d.

Chelonistele amplissima (Ames & Schweinfurth) Carr, Gard. Bull. Str. Settl. 8 (1935) 218. – *Coelogyne amplissima* Ames & Schweinfurth in Ames, Orch. 6 (1920) 21. – Type: Clemens 80 (holo AMES, n.v.; L).

Coelogyne amplissima Ames & Schweinfurth var. *schweinfurthiana* J.J. Smith, Bull. Jard. Bot. Btzg III, 11 (1931) 101. – Syn t y p e s : Endert 4252 (lecto L, here chosen), Endert 3970 (L).

Plant 30–62 cm high. Roots 1–2.5 mm diam. Scales of the young shoot 7–8; smallest one 10–13 mm long, longest one 8–13(–20) cm long; nerves 45–65; sometimes with scattered minute hairs outside. *Pseudobulbs* swollen, 1.8–4(–5) cm long; when dried smooth with coarse longitudinal folds. *Leaves*: one per pseudobulb. Petiole 4–10 times the length of the pseudobulb, rarely some of the shorter leaves less than 4 times this length (see note 2), (4–)12–25(–36) cm by 2.5–5 mm. *Blade* (oblong to) lanceolate to linear-lanceolate, usually widest above the middle, (14–)16–33 by 3–6.3(–8.5) cm; top acute with acuminate tip, rarely ± truncate with minute apiculate tip; subcoriaceous to coriaceous, rather stiff; midrib above prominent, below much more so, other main nerves hardly prominent, small nerves usually (rather) inconspicuous. *Raceme* proteranthous, rarely synanthous with the just emerging very young leaf, (4–)8–11-flowered. Scape 0.5–3.5(–7.5) cm beyond the scales, 1–3 mm diam., after anthesis increasing to 23–26 cm in length. Rhachis curved or straight, somewhat zigzag or not, 6.5–12 cm long; internode length 9–15(–20) mm. *Floral bracts* (twice observed) ovate, 18–27 by 9–14 mm; nerves 19–27; in- and outside with scattered, minute hairs. *Flowers* opening wide to very wide, tender to rather fleshy. Pedicel more or less angular at the ribs, 5–11 by 0.8–1.7 mm. *Median sepal* ovate-oblong, 17–23 by 5.7–10 mm; top acute; margin and top recurved or straight; nerves 5–9, the midrib prominent; usually with scattered minute hairs in- and outside, especially at the base. *Lateral sepals* ovate-oblong, 18–23 by (5–)6–9(–10) mm; top acute; margins and top recurved or straight; nerves 5–9, midrib bearing a more or less thin wing-like keel; hairy like the median sepal. *Petals* rolled backwards, linear, 18–23.2 by 1.2–2.2 mm; top acute to obtuse; 1–3-nerved; slightly hairy like the median sepal. *Lip* (16–)18–24 mm long. *Hypochilium* at the base somewhat concave, in front somewhat convex, 6–10 mm long, back part 3–6(–7) mm wide; margin near the base on either side with or without a short, erect, lateral lobe; front lobes curved to the front, erect, falcate, (1–)2–4(–5) by (0.5–)1–3 mm, with acute (rarely rounded) top; width over the spread lobes (6–)7–14 mm; keels beginning 3–4.5 mm from the base, highest in the back and there 1.3–1.7 mm high, continuing to the junction of hypochilium and epichilium to up to halfway the epichilium; nerves 7–9, sometimes two of these at the very back swollen into ridges. *Epichilium* when flattened abruptly widening from a rather wide base into a ± rectangular endlobe with rounded corners, (9–)10–14.5 by (8–)10–16 mm; top truncate, ± straight to slightly and broadly exsculptate, sometimes the tip small triangular; margins not undulating; basal narrow part 3–6(–7) mm wide; lateral lobes more or less turned downwards, rather rectangular in outline with somewhat rounded corners, (3.5–)4–5(–6) by (4–)6–10(–11) mm. *Column* more or less gradually widening towards the top, when flattened varying from almost wedge-shaped in outline to almost spatulate with ± parallel margins in the upper part, 12–14 by 7–12 mm; top truncate, coarsely irregularly serrate, sometimes somewhat retuse, sometimes at the lateral top margins with a small lobe; front and back more or less densely covered with minute hairs, rarely ± glabrous. Anther in outline (broadly) cordate, 2.3–3.3 by 2–3.3 mm; top more or less acute, tip sometimes truncate or obtuse. *Pollinia* more or less obliquely obovate in outline, 1–1.8 by 0.8–1.2 mm. *Stigma* ± elliptic, 2–3 by 2–2.3(–3) mm; rostellum inflexed, triangular, 1.5–2.3 by 2–2.3(–3) mm, its tip acute to truncate. Ovary distinctly angular at the ribs, 10–16 by 0.7–2.2 mm; ribs 3, distinct, formed by the margins of the valves which (partly) overtop the jugae; more or less densely hairy with minute hairs. *Fruit* not seen.

Distribution. Borneo: Sarawak (3rd & 4th Division). Sabah (West Coast Residency). Kalimantan (Kalimantan Timur). 25 collections (AMES, BM, E, K, L, SING).

Ecology. Epiphytes in heath and elfin forest; altitude 800–2300 m. Fl. probably all the year round.

Collector's notes. Sepals cream-coloured, sometimes tinged green or pink, greenish, pinkish or pale orange-brown, or lemon yellow. Petals similarly coloured or paler. Lip white,

pinkish, salmon, pinkish orange, to ?rust-brown, with a yellowish, orange, purple or brown spot. Column pink, greenish, salmon or ?rust-brown.

Notes. 1. A variety *schweinfurthiana* was described by J. J. Smith, based on specimens which differ from the type collection in the somewhat larger flowers and in the top of the leaf, which is shortly acuminate and acute instead of almost truncate with apiculate tip. These plants fit entirely within the variation of *C. amplissima*.

2. Kostermans 13061 consists of plants which are smaller in all respects: height of the plant 16 cm, leaf blade 8.5 cm long, lateral sepals 16 mm long, lip 14 mm long, column 8 mm long. The pseudobulbs are relatively much longer than in other plants of *C. amplissima*; they are 1.3 times the length of the petiole. These plants grew in heath forest at 800 m altitude. S 21150 (Asah ak Unyoug) from the same vegetation type and altitude, has similarly small flowers; the petiole, however, has the usual length, and is almost 7 times the length of the pseudobulb. In flower details these plants match *C. amplissima* well and in spite of the above mentioned differences they are probably conspecific. The measurements are, however, not inserted in the above description. More and better material is needed to ascertain whether these plants represent a small-flowered variety. In SF 6865 (Moulton) the petiole of one leaf is 2 times the length of the pseudobulb, in another leaf it is almost 7.5 times the length of that organ.

2. *Chelonistele breviamellata* (J. J. Smith) Carr — Fig. 11.

Chelonistele breviamellata (J. J. Smith) Carr, Gard. Bull. Str. Settl. 8 (1935) 216, 217. — *Coelogyne* (sect. ?) *breviamellata* J. J. Smith, Bull. Jard. Bot. Btzg III, 9 (1931) 102. — *Syntypes*: Endert 4427 (lecto L, here chosen), Endert 4281 (L).

Plant 43–55 cm high. Roots 0.5–1.5 mm diam., the tips distinctly swollen into ovoid bodies. Scales of the young shoot 7; shortest one c. 1 cm long, longest one c. 12 cm long; nerves c. 45. *Pseudobulbs* very slender, \pm terete, 11–15 cm long, when dried rather finely longitudinally wrinkled. *Leaves*: one per pseudobulb. Petiole 10.5–12.5 cm by 1.5–2 mm. *Blade* obovate-lanceolate, 20–26 by 3.5–4.8 cm; top acuminate; thin coriaceous, stiff when dry; main nerves 7–9, above and below somewhat prominent, the midrib below much so, small nerves 62–64, hardly prominent. *Raceme* synanthous with the just emerging to \pm half-way developed young leaf, 9–10-flowered. Scape 5–10 cm beyond the scales, 2 mm diam., after anthesis increasing to 17.5 cm in length. Rhachis curved or straight, very slightly zigzag, 8–9.5 cm long; internodes 10–14 mm long. *Floral bracts* not seen. *Flowers* probably all turned to one side, probably not widely opening, tender. Pedicel \pm terete to somewhat angular by the ribs, c. 12 by 1 mm. *Median sepal* oblong, 22–29 by c. 10 mm; top obtuse, its tip either obtuse or retuse; main nerves 7, midrib bearing a thin, wing-like keel. *Lateral sepals* ovate-oblong, 22–29 by 7.5–10 mm; top acute; nerves 7, midrib bearing a thin wing-like keel. *Petals* obovate-lanceolate, slightly asymmetric, 22–29 by 7.5–9 mm; top acute to rounded; nerves 5. *Lip* c. 30 mm long. *Hypochilium* slender, at the back shallowly concave, in front probably rather flat, when flattened \pm broadly spatulate, 24–25 by 10.5–15 mm; in front two-lobed, lobes broadly rounded, \pm folded, with irregular margins; in the back with a swollen, grooved, conical body with a rounded top; main nerves 3, of which the lateral ones bear \pm halfway an oblique, broadly triangular, c. 3 mm long thin keel; towards the end of the hypochilium a branch of each lateral main nerve bears a broadly triangular, 2 mm long thin keel, connected with the lower placed keels by a low ridge; additional nerves 6, variously branched. *Epichilium* when flattened \pm semi-orbicular in outline, c. 7 by 7 mm; top retuse; margin irregularly serrate and folded, lateral nerves much branched. *Column* spatulate when flattened, margins curved to the front, 18–20 by 9–12 mm; wing thin, the top curved

backwards, broadly rounded, retuse, laterally on each side with a broadly rounded lobe. Anther in outline \pm cordate, c. 2 by 1.2 mm; top acuminate. *Pollinia* not seen. *Stigma* narrowly elliptic in outline, c. 4 mm long including the narrowly triangular, acuminate, c. 2 mm long rostellum. Ovary slender, 7–8 by 1.4–2 mm, more or less angular by the rounded to wing-like ribs. *Fruit* not seen.

Distribution. Borneo: Kalimantan (Kalimantan Timur). 2 collections: Endert 4427, 4281 (L).

Ecology. Epiphytes in dense elfin forest, with abundance of lianas, rattans, moss and orchids; altitude c. 1800 m. Fl. Oct. (2 records).

Collector's notes. Flowers pure white, lower half of lip pinkish, upper half with a large yellow stain, column with beautiful longitudinal dark brown marks.

Notes. 1. Although no holotype was designated by J.J. Smith when he described this species, he indicated Endert 4427 as such on the label. This specimen has been chosen here as the lectotype.

2. The notes on ecology are copied from Endert's account of his trip in: 'Midden-Oost Borneo Expeditie 1925' (1927) 270–274. The details on flower colours were not present on the collection labels; they were copied from notes accompanying the original description by J.J. Smith.

3. *Chelonistele dentifera* de Vogel – Fig. 12.

Chelonistele dentifera de Vogel, Blumea 30 (1984) 203, pl. 3a–d. – Type: S 21954 (Sibat ak Luang) (holo L; K, SAR n.v., SING).

Plant 32–52 cm high. Roots 1–1.5 mm diam. Scales of the young shoot 6–8; smallest one 5–8 mm long, longest one 6–8 cm long; nerves 35–60. *Pseudobulbs* rather to very slender, (4.5–)6–10.5 cm long; when dried rather finely longitudinally wrinkled. *Leaves*: one per pseudobulb. Petiole (2–)5–10 cm by 1.5–2 mm. *Blade* (obovate-)lanceolate to linear, 14–31 by 2.5–9 cm; top acuminate; herbaceous; main nerves 5–7, usually all about equally prominent below, above slightly so, small nerves 50–60, above and below slightly prominent. *Raceme* synanthous with the just emerging young leaves, 6–9-flowered, \pm curved. Scape flexuous, beyond the scales 1.5–6 cm, c. 1 mm diam., after anthesis increasing to c. 13 cm in length. Rhachis curved, slightly to distinctly zigzag, 6.5–10 cm long; internode length 7–18(–21) mm. Sterile bract once observed, leaf-like, larger than the floral bracts. *Floral bracts* ovate-oblong, c. 19 by 7 mm when flattened; nerves 16–21; in- and outside with few scattered, minute hairs. *Flowers* opening rather wide, tender. Pedicel more or less angular by 3 ribs, 5–11 by 0.3–0.8 mm. *Median sepal* ovate-oblong, 11.5–14 by 4–6 mm; top obtuse to acute; nerves 5–7, midrib bearing a rather prominent rounded to wing-like keel. *Lateral sepals* ovate-oblong, 10.5–14 by 3.5–5.5 mm; top acute, slightly acuminate; margin more or less curved backwards; nerves 5–7, midrib bearing a rather prominent rounded to wing-like keel. *Petals* linear, rolled backwards, 11–14 by 1–1.5 mm; top obtuse (to acute); nerves 1(–2). *Lip* 11–16 mm long. *Hypochilium* at the base shallowly concave, slightly convex to the front, 6.5–9 mm long; back part 2.5–5 mm wide; in front on either side with a broad, \pm rhomboid lateral lobe 2.5–4.7 by 3–4.5 mm with more or less rounded top, width over the spread lobes 8–14 mm; keels highest in the back, starting 2–4 mm from the base, sometimes the central nerve swollen into a rounded ridge; rarely with minute hairs on keels and hypochilium in the part between the lateral lobes. *Epichilium* broadly spatulate, 4.5–9 by 5–9 mm; top slightly to deeply retuse; basal part 3–5 mm wide; lateral lobes semi-elliptic, broadly rounded, 2–4 by 3–6.5(–8) mm, margin undulate, irregular or entire, sometimes the central nerve swollen into a third, low keel or with an additional lateral small

keel developed. *Column* below the top on either side drawn out into a triangular lobe which is turned to the front, inverted hastate, 9.5–10 mm long, when flattened 4.3–8 mm wide over the lobes; top margin more or less recurved, irregular to serrate. Anther more or less clasped by the top part of the hood, in outline \pm cordate, 1.5–2.3 by 1.5–2.3 mm; top (broadly) triangular to retuse. *Pollinia* pear-shaped to orbicular in outline, 0.5–1 by 0.4–0.7 mm. *Stigma* \pm elliptic in outline, 1.5–3 by 1.5–2 mm; rostellum triangular, 1–1.5 by 1.5–2 mm. Ovary angular by the 3 ribs, 3–7 by 1–1.5 mm. *Fruit* not seen.

Distribution. Borneo: Sarawak (3rd & 4th Division). 6 collections (E, K, L, SING).

Ecology. Epiphytes, sometimes low growing, in mixed Dipterocarp forest or lower montane forest; altitude 550–1100 m. Fl. Aug., Sept. (2 records), Oct.

Collector's notes. Flowers white or cream-coloured to pale green with a rich yellow or brown and yellow mark in the middle or near the tip of the lip.

Vernacular names. Bunga bakong (Kayan lang.), bunga melakian (Iban lang.).

4. *Chelonistele ingloria* (J.J. Smith) Carr – Fig. 13; Plate 3a.

Chelonistele ingloria (J.J. Smith) Carr, Gard. Bull. Str. Settl. 8 (1935) 216, 217. – *Coelogyne* (sect. *Chelonistele*) *ingloria* J.J. Smith, Bull. Jard. Bot. Btzg III, 11 (1931) 95. – *Type*: Ender 3972 (L).

Plant 10.5–20 cm high. Roots 0.5–1 mm diam. Scales of the young shoot 5–7; shortest one 3–5 mm long, longest one 1.7–3.5 cm long; nerves 23–27, in fresh state hardly visible. *Pseudobulbs* rather to very slender, 1.5–3.5 cm long, when dried rather coarsely longitudinally wrinkled. *Leaves*: one per pseudobulb. Petiole 1–3 cm by 0.5–1.5 mm. *Blade* (ovate-lanceolate to) linear-lanceolate, (4–)7–9.5(–13) cm by 3–8 mm; top acute; coriaceous, in fresh state thick and fleshy; main nerves 3, small nerves c. 15, only visible in the young leaf, midrib below somewhat prominent. *Raceme* synanthous with the somewhat to almost half-way developed young leaf, 3–6(–8)-flowered. Scape wiry, erect, beyond the scales 0.5–2(–4.5) cm, after anthesis increasing to 7–8 cm in length. Rhachis more or less curved, very slightly zigzag, 1.3–3(–4) cm long; internodes (4–)6–10 mm long. *Floral bracts* once observed, ovate, c. 11 by 5.5 mm when flattened; nerves c. 17; in- and outside with scattered minute hairs. *Flowers* opening rather wide, tender. Pedicel more or less angular by the ribs, 6–8 by 0.3–0.7 mm. *Median sepal* ovate-oblong, 6–7 by 2–3.5 mm; top obtuse to acute; margins either or not recurved; nerves 3–5, midrib bearing a rather prominent rounded keel; sometimes outside with few scattered minute hairs. *Lateral sepals* ovate-oblong, when flattened 6.5–8 by 2–3.5 mm; top acute, its tip acuminate; margins either or not recurved; nerves 3–5, midrib bearing a rather prominent thin to rounded keel; sometimes hairy like the median sepal. *Petals* curved to rolled backwards, linear, 6.5–7.5 by 0.3–0.5 mm; top obtuse; nerves 1. *Lip* 6.5–8.5 mm long. *Hypochilium* rather slender, at the base shallowly concave, in front \pm convex, 2.2–4 mm long; in front laterally on each side with an obliquely triangular lobe 0.7–2 by 0.7–2 mm with acute or rounded tip, width over the spread lobes 2.5–7 mm; laterally on each side with a longitudinal, laterally slanting, somewhat swollen, in fresh state rather inconspicuous 0.4–0.5 mm high keel that is highest at the back, which begins c. 1 mm from the back of the lip and continues till about the base of the lateral lobes of the epichilium; main nerves 3–5. *Epichilium* more or less recurved, about spatulate in outline, in front two-lobed, 3.7–4.5 by 3–5 mm; top rather deeply retuse, tip usually acute; lateral lobes broadly rounded, semi-elliptic in outline, 1.7–2 by 2–3.5 mm; basal narrowed portion 1.2–3.3 mm wide. *Column* more or less obovate to spatulate, 4–5.5 by 3–4 mm; top obtuse to truncate, either or not laterally notched, either or not denticulate or with small lobes; wing wide, thin, laterally curved above to the front, widest above or below the centre. Anther more or less (broadly) cordate in outline, 0.7–1 by c. 1 mm; top broadly

triangular, either or not somewhat recurved. *Pollinia* \pm pear-shaped in outline, 0.4–0.5 by 0.3–0.4 mm. *Stigma* more or less irregularly transversely elliptic in outline, 0.5–1 by 0.7–1.3 mm; rostellum rather broadly triangular, 0.5–1.3 by 0.7–1.3 mm. Ovary more or less triangular in section, 2–4 by 0.5–1.5 mm; ribs either or not prominent. *Fruit* not seen.

Distribution. Borneo: Sarawak (5th Division). Sabah (? prov.). Kalimantan (Kalimantan Timur). 7 collections (E, K, L, SING).

Ecology. Epiphytes, once recorded on a narrow, forested ridge; altitude 1300–1500 m. Fl. Oct. (2 records), Nov. (2 records).

Collector's notes. Sepals and petals pale greenish cream to light salmon-coloured, deep translucent yellow or yellowish brown, lip white to cream-coloured with an orange golden to yellow-brown transverse honey-mark between the tips of the keels. Not fragrant (once recorded).

5. *Chelonistele kinabaluensis* (Rolfe) de Vogel – Fig. 14.

Chelonistele kinabaluensis (Rolfe) de Vogel, Blumea 30 (1984) 203. – *Sigmatocilus kinabaluensis* Rolfe in Gibbs, J. Linn. Soc. (Bot.) 42 (1914) 155, 39, pl. 3; Ames & Schweinf., Orch. 6 (1920) 43; Carr, Gard. Bull. Str. Settl. 8 (1935) 220. – *Pholidota sigmatocilus* (Rolfe) J. J. Smith, Blumea 5 (1943) 299. – Type: Gibbs 4260 (BM).

Plant (7.5–)11–20 cm high, the inflorescence usually somewhat overtopping the leaves. Roots 0.7–1.5 mm diam. Scales of the young shoot 5–7; smallest one 0.5–1.1 cm long, longest one 3–7 cm long; nerves 25–45. *Pseudobulbs* close together, rather slender but sometimes rather swollen, 1.7–3 cm long, when dried rather finely wrinkled. *Leaves*: one per pseudobulb. Petiole 1–3.5(–8.5) cm by 1–2 mm. *Blade* (ovate-)lanceolate to linear, 4.5–8(–10) by 0.9–2.2(–2.6) cm; probably thick fleshy, when dried thick coriaceous, more or less finely wrinkled; nerves indistinguishable. *Raceme* synanthous with the more than halfway emerged young leaf, 5–9-flowered. Scape straight, stiff, in section \pm elliptic, beyond the scales 3–6.5 cm, after anthesis increasing to 11 cm in length. Rhachis \pm straight, erect, (1.5–)2–5.5 cm long; internodes (4–)5–10 mm long. *Floral bracts* often still present when the flowers are open, ovate, 10–15 by 6–8 mm; nerves 11–15; sometimes inside at the base with few scattered minute hairs. *Flowers* all turned to one side, rather closed, glabrous, lip turned downwards. Pedicel angular, twisted, 6–9 by 0.4–0.7 mm. *Median sepal* deeply concave with more or less depressed sides, \pm ovate to ovate-oblong, 8–13(–14) by 4.5–6 mm; top obtuse to acute; nerves 5(–7), midrib prominent or bearing a rounded keel. *Lateral sepals* ovate-oblong, 9.5–13(–14) by 4–6.3(–7) mm; top acute to acuminate; nerves 5, midrib bearing a low rounded keel. *Petals* ligulate, somewhat asymmetric, 8–11(–13) by 1.7–3(–4) mm; top obtuse to acute; nerves 3(–5). *Lip* strongly sigmoid, the tip extending from between the lateral sepals. *Hypochilium* boat-shaped, laterally sometimes somewhat compressed, 3.5–4.5 (–5) mm long, 0.8–2.5 mm wide, 1.5–2.2 mm high, without lateral lobes; nerves 5–7; keels 2, on the junction of epichilium and hypochilium, low, clasped by the margins of the hood, wing-like, 1.3–2 mm long. *Epichilium* lingulate when flattened, often near the base somewhat narrowed, more or less curved, 5–6(–7) by 2–3(–4) mm; top acute to obtuse, sometimes somewhat swollen, in the top portion the margins more or less folded upwards; 5–7-nerved. *Column* widest at the top when flattened, 3.5–5(–6) mm long; hood relatively large, its top in outline more or less truncate to retuse, its central portion with a more or less irregular to rather distinctly 3-lobed margin, more or less clearly separated from the lateral lobes; lateral lobes more or less distinct, top \pm rounded, their margins turned to the front, clasping the keels on the lip, leaving a rather narrow opening to the anther and the stigma. Anther almost entirely hidden behind the rostellum

and enclosed by the hood, in outline irregularly cordate, 1–1.3 by 0.8–1.3 mm; top acute to obtuse to distinctly retuse. *Pollinia* ± elliptic in outline, 0.35–5 by 0.2–0.3 mm. *Stigma* ± orbicular in outline, c. 1.5 by 1.5 mm including the rostellum; rostellum shallowly two-lobed, lobes small, curved, ± triangular, clasping the caudiculae of the pollinia. Ovary rather slender, angular by the ribs, 4–7 by 0.8–1.5 mm; ribs more or less thin and wing-like. *Mature fruits* not seen; young fruits with persistent perianth, jugae enlarged to 1.5 mm high wing-like keels, valvae in the centre with an distinct low keel.

Distribution. Borneo: Sabah (West Coast Residency). 10 collections (AMES, B, BM, BO, E, G, K, L, NY, S).

Ecology. Epiphytic on branches of shrubs in thick moss cushions, or terrestrial (both once recorded); altitude 2000–3500 m. Fl. Jan., Feb., June, July (2 records), Aug. (2 records), Nov. (2 records), Dec. (2 records).

Collector's notes. Flowers white to cream-coloured. A green throat twice recorded, once in combination with a dark spot in its centre.

6. *Chelonistele lamellulifera* Carr — Fig. 15.

Chelonistele lamellulifera Carr, Gard. Bull. Str. Settl. 8 (1935) 78. — *Coelogyne lamellulifera* (Carr) Masamune, Enum. Phan. Born. (1942) 142. — Type: Synges S. 531 (K).

Plant 26–48 cm high. Roots 1.5–3 mm diam. Scales of the young shoot 7–8, somewhat inflated; smallest one 0.7–1.3 cm long, longest one 6–9 cm long; nerves 26–70. *Pseudobulbs* 1.5–2 cm apart, very slender to rather swollen, ± terete, 5–8 cm long, when dried rather finely longitudinally wrinkled. *Leaves*: one per pseudobulb. Petiole 4.5–13 cm by 2–4(–8) mm. *Blade* obovate-lanceolate to linear-lanceolate, usually the largest width above the centre, (16–)19–28(–35) by 2.3–5(–8.5) cm; top acute to acuminate; stiff herbaceous to subcoriaceous; main nerves 5–7(–9), slightly prominent above, more so below, especially the midrib, small nerves 28–64(–70), more or less conspicuous. *Raceme* synanthous with the just emerging to somewhat developed young leaf, 7–11-flowered. Scape erect, 0–2.5(–7.5) cm extending from the scales. Rhachis curved or straight, somewhat zigzag, 5–10 cm long; internodes 6–10 mm long. *Floral bracts* caducous at anthesis, ovate, to 24–26 by 10–14 mm; nerves 21–25. *Flowers* opening wide, fleshy or not. Pedicel angular by the ribs, (2.5–)4–9 by 0.4–0.8 mm. *Median sepal* ovate to ovate-oblong, 9.5–12 by 4–6 mm; top ± obtuse to acuminate; margins rolled backwards; nerves 5, midrib bearing a rounded to more or less wing-like keel. *Lateral sepals* ovate to ovate-oblong, 10–12.5 by 4–6.5 mm; top acute; margins rolled backwards; nerves 5, midrib bearing a low wing-like keel. *Petals* linear, curved or rolled backwards, 11–13 by 1.2–1.8 mm; top rounded to truncate; nerves 1–3, the midrib prominent. *Lip* 10–15.5 mm long when flattened. *Hypochilium* entirely saccate, 3–8 mm long, 3–6 mm wide, 2–3 mm high in the basal part; in front laterally on each side with a triangular to ± rectangular, more or less curved, 2.5–4.7 by 2–4.5 mm big erect lobe with rounded top and more or less irregular margin; on the junction with the epichilium between the lateral lobes with two widely separated, more or less high, more or less fleshy, laterally slanting short keels 2–2.7 mm long, 0.5–1 mm high (in one flower of the type specimen each keel is subdivided into two shorter keels); back of the hypochilium either or not with two short, swollen ridges. *Epichilium* strongly reflexed to recurved, (broadly) spatulate to almost rectangular when spread, 6–8 by 3.5–8 mm; top broadly rounded to retuse; lateral lobes if present broadly rounded, 1.5–2.5 by 2–5.5 mm; central portion sometimes rather fleshy. *Column* more or less broadly spatulate in outline when flattened, 4.2–8.3 by 3.5–6 mm; wing wide with the lateral margins turned to the front; top margin more or less truncate, irregularly erose to serrate, sometimes recurved, laterally on either

side with a more or less distinct, \pm triangular lobe. Anther in outline more or less cordate, 1–2 by 1.2–2 mm; top recurved, retuse to broadly truncate. *Pollinia* \pm elliptic to pear-shaped in outline, 0.7–1.2 by 0.5–0.7 mm. *Stigma* \pm elliptic to obovate in outline, 1.8–3 by 1.5–2.5 mm; rostellum broadly triangular to rounded, tip sometimes retuse. Ovary \pm triangular in section, 4–6 by 1–1.7 mm; ribs distinct. *Fruit* not seen.

Distribution. Borneo: Sarawak (3rd, 4th & 5th Division). 7 collections (E, K, L, NY, SING).

Ecology. Epiphyte in elfin forest (twice recorded); altitude 900–2300 m. Fl. Aug., Sept., Oct., Nov. (4 records).

Collector's notes. Sepals and petals pale green, light buff or brownish green. Lip similarly coloured to pinkish with an orange-brown to orange honey mark, lateral lobes brown (once recorded). Column pinkish, greenish or buff, either or not with brown markings or brown tip (each once recorded). Slight sweet scent (once recorded).

7. *Chelonistele lurida* (L. Linden & Cogn.) Pfitzer

For literature, see under the varieties.

Plant 16–35(–50) cm high. Roots 1–2.5 mm diam. Scales of the young shoot 6–9; smallest one c. 5 mm long, longest one 6.5–13(–15) mm long; nerves 25–60(–70). *Pseudobulbs* rather swollen to slender, 2.5–11 cm long; when dried rather coarsely longitudinally wrinkled. *Leaves*: one per pseudobulb. Petiole 3.5–9(–14) by (1–)2–3 mm. *Blade* (ovate-oblong to) ovate-lanceolate, (7–)12–18(–27) by (1.4–)2.5–4.5 cm; top acuminate; very stiff coriaceous, when fresh probably thick and fleshy, rarely herbaceous; midrib above more or less sunken, below conspicuous, other main nerves and small nerves almost always inconspicuous. *Raceme* (proteranthous to) synanthous with the just emerging to halfway emerged young leaf (4–)6–12-flowered. Scape beyond the scales (0–)5–9 cm, 1.5–3 mm diam., after anthesis increasing to 13 cm in length. Rhachis almost straight to curved, very slightly zigzag, (5.5–)9–14 cm long; internode length 10–17(–20) mm. *Floral bracts* ovate to ovate-oblong, c. 21.5 by 11 mm; glabrous or in- and outside with scattered minute hairs. *Flowers* opening rather wide, fleshy to rather tender. Pedicel more or less angular by the ribs, (7–)10–20 by 0.7–1 mm; glabrous, sometimes with scattered minute hairs. *Median sepal* ovate to ovate-oblong, 13–21 by 5–8 mm; top (obtuse to) acute; nerves 5–7, midrib bearing a rounded keel; glabrous, sometimes in- and outside with scattered minute hairs. *Lateral sepals* ovate-oblong to ovate-lanceolate, 14–23.5 by (4.2–)5–6.5(–8) mm; top acute; margins either or not recurved; nerves 5–7, midrib bearing a low thin keel; glabrous or with hairs as on the median sepal. *Petals* rolled backwards, ovate-lanceolate to linear-lanceolate, 13–21 by 2–3(–6) mm; top rounded to truncate; near the base sometimes with recurved auricles; nerves 3; glabrous, or inside at the base or sometimes all over with minute, simple hairs. *Lip* 12–21 mm long. *Hypochilium* at the base somewhat concave, in front somewhat convex, (4–)6.5–15 mm long, back part 2.5–5 mm wide; in front laterally on each side with a more or less obliquely triangular or obliquely spatulate to sometimes linear lateral lobe 2.2–6 by 1–4 mm with a triangular to more or less rounded top and entire to serrate front margin; width over the spread lobes 6.5–14 mm; keels beginning (3–)4–10 mm from the back, 1–1.5 mm high; nerves 7–11, two of which may or may not be swollen in the back into distinct ridges; sometimes on the junction of hypochilium and column base on either side with two swollen subulate cusps or warts which may be unequal in height. *Epichilium* gradually or abruptly widening to the top, more or less clearly spatulate, 6.5–8(–10) by 6–8(–11) mm; top truncate or broadly rounded, sometimes retuse, sometimes apiculate; margins in front undulating, lateral margins serrate or

entire; basal narrowed portion 2.2–5.5 mm wide. *Column* over more than half its length very wide, abruptly narrowing to the base, (7–)11–17.5 by 4.5–9 mm; hood widest below the centre of the column; top more or less irregularly serrate; margins turned to the front. Anther in outline (long) cordate, 2–2.5 by 1–2 mm; top acute. *Pollinia* ± obliquely pear-shaped in outline, 0.7–1.3 by 0.5–0.9 mm. *Stigma* (3–)4–4.5 by 1.5–2 mm including the triangular, (1.5–)2–3 by 1.5–2 mm big, acute to obtuse, inflexed rostellum. Ovary more or less angular by the ribs, 6–10 by (1–)1.5–2 mm; ribs 3, formed by the overlapping of each juga by the margins of the adjoining valvae. *Fruit body* 3.3 by 1.5 cm; valvae probably smooth, in the centre with a distinct longitudinal keel, the margins near the jugae recurved or swollen.

Distribution. Borneo: Sarawak, Sabah, Kalimantan.

Ecology. See under the varieties. Altitude 800–3000 m.

KEY TO THE VARIETIES OF CHELONISTELE LURIDA

- 1 a. Median sepal 13–18 mm long. Lip 12–17 mm long, hypochilium (4–)6.5–9.5 mm long a. var. *lurida*
- b. Median sepal c. 21 mm long. Lip 21–22.5 mm long, hypochilium 14–15 mm long b. var. *grandiflora*

a. var. *lurida* – Fig. 16 a–i; Plate 3b.

Chelonistele lurida (L. Linden & Cogn.) Pfitzer, Pfl. R. Heft 32 (1907) 138; Carr, Gard. Bull. Str. Sett. 8 (1935) 217. – *Coelogyne lurida* L. Linden & Cogn., Lindenia 11 (1895) 32; *ibid.* 12 (1896) 33, t. 532; Constantin, Atl. Coul. Orch. Cult. (1915) pl. 24, f. 34. – Type: Cult. Jard. Bot. Bruxelles s.n., Herb. Cogniaux (BR).

Coelogyne sarawakensis Schltr., Notizbl. Berl.-Dahl. 8 (1921) 15. – Type: Beccari 3963 (n.v., a drawing of the type by Carr present in K).

Median sepal ovate (to ovate-oblong), 13–18 by (4.5–7–8.5 mm. Lateral sepals ovate-oblong (to ovate-lanceolate), 14–15(–20) by 5–6.3(–7) mm. Petals lanceolate, 14(–18) by 2–3.5 mm. Lip 12–17 mm long. Hypochilium (4–)6.5–9.5 mm long, keels starting 3–6 mm from the base.

Distribution. Borneo: Sabah (West Coast Residency, Interior Residency). Kalimantan (Kalimantan Tengah, Kalimantan Timur). 12 collections (BM, BR, K, L).

Ecology. Elfin forest, sometimes in secondary forest, on trunks and moss-covered roots; altitude 800–3000 m. Fl. Jan., Feb., June, July, Sept., Oct., Dec.; fr. June.

Collector's notes. Sepals and petals greenish brown, pale ochre, greenish cream, pale yellow sometimes suffused pale brown in the lower half, petals sometimes white tipped, or mauve. Lip white, yellow, salmon or pale green, with brown to yellow and brown patches, sometimes yellow with an orange-red or brown margin on the base of the epichilium and the margins of the lateral lobes; epichilium white or with white tip. Column deep ochre to whitish with yellow-green stalk and hood, speckled brown. Not scented (once recorded).

b. var. *grandiflora* de Vogel – Fig. 16 j, k; Plate 3c.

Chelonistele lurida (L. Linden & Cogn.) Pfitzer var. *grandiflora* de Vogel, Blumea 30 (1984) 205, pl. 3e, f. – Type: G.P. Lewis 336 (K).

Median sepal ovate-oblong, c. 21 by 7.8–8 mm. Lateral sepals ovate-lanceolate, 22–23.5 by 4.2–8 mm. Petals lanceolate to linear, 20–21 by 3.8–6 mm. Lip 21–22.5 mm long. Hypochilium 14–15 mm long, keels starting 9–10 mm from the base of the lip.

Distribution. Borneo: Sarawak (4th Division). 3 collections: Burt & Woods B. 2169 (E), Jermy 13225 (K), Lewis 336 (K).

Ecology. Montane and elfin forest, epiphytic on trunks and main branches, in moss, rather exposed; altitude 1500–2000 m. Fl. June, Oct. (2 records).

Collector's notes. Sepals and petals white, sometimes tinged pink. Lip with a yellow patch on the base of the epichilium and a faint yellow or pale brown spot on each lateral lobe. Column with two faint yellow streaks on the back.

8. *Chelonistele ramentacea* J.J. Wood – Fig. 17.

Chelonistele ramentacea J.J. Wood, Kew Bull. 39 (1983) 80, f. 6. – Type: Burt & Woods B. 2192 (E).

Plant c. 27 cm high. Roots to 2.5 mm diam. Scales of the young shoot 8; smallest one c. 5 mm long, longest one c. 7 cm long; nerves c. 54; bases of the fibres long persistent. *Pseudobulbs* rather swollen at the base, c. 2 cm long; when dried rather coarsely longitudinally wrinkled. *Leaves*: two per pseudobulb. Petiole 8–10 cm by c. 2 mm. *Blade* obovate-oblong to obovate-lanceolate, 9–15 by 2.8–3.5 cm; top somewhat acuminate; stiff herbaceous; main nerves 3–5, midrib prominent below, other main nerves much less so, small nerves c. 45, rather inconspicuous. *Raceme* synanthous with the just emerging very young leaves, 12-flowered. Scape more or less flexuous, beyond the scales c. 7.5 cm, c. 2 mm diam. Rhachis probably pendulous, not zigzag, c. 14.5 cm long; internode length 9–15 mm. *Floral bracts* not seen. *Flower* probably rather closed, somewhat fleshy. Pedicel somewhat angular by the ribs, c. 5 by 0.7 mm. *Median sepal* ovate-oblong, deeply concave, c. 10.5 by 5 mm; top acuminate; sides laterally somewhat depressed; nerves 5, midrib prominent; outside rather sparsely covered with small, one-celled, dark hairs. *Lateral sepals* ovate-oblong, deeply concave, c. 10.5 by 5 mm; top slightly acuminate; nerves 5, midrib bearing a low, rounded keel; with hairs as on the median sepal. *Petals* ovate-lanceolate, c. 10.5 by 3.5 mm; top abruptly broadly acute; nerves 5, the two lateral ones short; outside with few scattered hairs, inside some hairs at the base. *Lip* c. 13 mm long. *Hypochilium* in the back concave, continuing with a narrow depression in the centre towards the front, laterally of this depression from the back of the keels towards the front of the hypochilium convex, c. 5 mm long, 5.5 mm wide; lateral margins not drawn out into lobes, in front rounded; keels starting c. 1 mm from the base, c. 0.7 mm high, continuing to slightly beyond the narrowed portion of the epichilium. *Epichilium* broadly spatulate in outline, c. 8 by 9 mm; top deeply retuse, tip minute, triangular; basal part c. 2.8 mm wide; lateral lobes semi-elliptic, c. 3.7 by 7 mm; somewhat fleshy. *Column* broadly spatulate in outline, c. 7 by 4.5 mm; hood rather abruptly widening, with serrate top margin; at the back with few scattered hairs. Anther in outline transversely elliptic with an abruptly acuminate top and an acuminate fleshy stalk, c. 1.5 by 1.7 mm. *Pollinia* ± pear-shaped in outline. *Stigma* transversely elliptic in outline, c. 1 by 1.8 mm; rostellum a narrow rim with an acuminate top, its tip truncate. Ovary angular by the 6 ribs, c. 6 by 1.8 mm. *Fruit* not seen.

Distribution. Borneo: Sarawak (4th Division). 1 collection: Burt & Woods B. 2192 (E).

Ecology. No details recorded; altitude c. 1330 m. Fl. June.

Collector's notes. Sepals and petals green. Lip white, with 2 brown ridges, in front of these with a yellow patch, brown marks at the base of the lobes. Hood of the column purple.

9. *Chelonistele richardsii* Carr – Fig. 18.

Chelonistele richardsii Carr, Gard. Bull. Str. Settl. 8 (1935) 79. – *Coelogyne richardsii* (Carr) Masamune, Enum. Phan. Born. (1942) 144. – Type: Richards S. 59 (K).

Plant c. 8 cm high. Roots c. 1.5 mm diam. Scales of the young shoot 7; smallest one 5 mm long, longest one 5 cm long; nerves c. 40; herbaceous, rather soon dry but long persistent, then papyraceous. *Pseudobulbs* ascending, somewhat swollen, somewhat flattened, c. 2 cm long; when dried with few irregular coarse ribs. *Leaves*: two per pseudobulb. Petiole 1–1.8 cm by c. 2 mm. *Blade* elliptic to oblong, 3.5–4.2 by c. 1.3 cm; top acute; margin finely crenulate; stiff coriaceous, when fresh probably thick fleshy; midrib above sunken, below rather prominent, other nerves not visible. *Raceme* synanthous with the just emerging very young leaves, more than 7-flowered. Scape beyond the scales c. 2.5 cm, c. 1.5 mm diam. Rhachis curved, not zigzag, more than 6.5 cm long; internode length 8–15 mm. *Floral bracts* not seen. *Flower* probably rather closed, tender. Pedicel somewhat angular, c. 6 by 0.5 mm. *Median sepal* ovate-oblong, c. 8 by 3.5 mm; top acute, its tip \pm obtuse; nerves 5, midrib somewhat prominent. *Lateral sepals* ovate-oblong, c. 8 by 3.5 mm; top acute; nerves 5, midrib bearing a low rounded keel. *Petals* linear-lanceolate, rolled backwards, c. 8 by 1.2 mm; top obtuse; nerves 3. *Lip* c. 11.5 mm long. *Hypochilium* in the back concave, in front somewhat convex, c. 4 mm long; in front on either side with an obliquely triangular lobe 0.8 by 1 mm with acute top, width over the spread lobes c. 4 mm; keels highest in the back, starting c. 2 mm from the base of the lip, at the back extended in a short rounded lobe which projects over the hypochilium sac. *Epichilium* spatulate when flattened, c. 7.5 by 8 mm; top deeply retuse, its tip acute; basal part c. 2 mm wide; lateral lobes recurved, broadly rounded, 3.5 by 4 mm. *Column* broadly spatulate in outline when flattened, c. 4.5 by 4.5 mm; top margin rather coarsely dentate, lateral top margins entire, reflexed; in front at the base with a swollen tubercle. Anther and pollinia not seen. *Stigma* elliptic, 2 by 0.8 mm including the ligulate, 1 by 0.5 mm big rostellum. Ovary angular by the 6 ribs, c. 2 by 0.7 mm. *Fruit* not seen.

Distribution. Borneo: Sarawak (4th Division). 1 collection: Richards S. 59 (K).

Ecology. Elfin forest; altitude not known. Fl. July, Aug.

Collector's notes. Sepals and petals greenish yellow, lip with a brown fringe, yellow lines on the stigma (? column). Not scented.

10. *Chelonistele sulphurea* (Blume) Pfitzer

For literature, see under the varieties.

Plant (15–)20–55 cm high. Roots 1–2 mm diam. Scales of the young shoot 6–9; shortest one 3–10 mm long, longest one (3–)5–10(–15) cm long; nerves 25–45(–60). *Pseudobulbs* rather swollen to very slender, (1.5–)3–8(–15) cm long, when dried irregularly wrinkled. *Leaves*: one or two per pseudobulb. Petiole 0.3–3 times the length of the pseudobulb, (1.5–)2.5–9(–15) cm by 1.5–3 mm. *Blade* (oblong to) lanceolate or obovate-lanceolate to linear-lanceolate, (4–)6–25(–35) by 0.8–3.5(–6.5) cm; top obtuse to acuminate; herbaceous to stiff coriaceous, when fresh either or not fleshy; main nerves (1–)5–7(–9), all more or less prominent, especially below, midrib more distinctly so, small nerves 20–40(–70), inconspicuous to slightly prominent. *Raceme* proteranthous to synanthous with the just emerging to somewhat developed young leaf, exceptionally the young leaf almost entirely developed, 4–10(–18)-flowered. Scape wiry, erect, beyond the scales (0.7–)1.5–3.5(–9) cm, after anthesis increasing to 6–17 cm in length. Rhachis more or less straight to curved, either or not slightly zigzag, 3.5–12(–15) cm long; internodes (4–)7–14 mm long. *Floral bracts* ovate-oblong to ovate-lanceolate, (13–)17–25 by 5–10 mm; nerves 15–35. *Flowers* more or less turned to one side, tender. Pedicel more or less angular by 3 ribs, (4–)6–9(–16) by 0.3–0.5(–0.7) mm. *Median sepal* ovate-oblong, 10–15.5(–18) by 4–5.5(–6.3) mm; top \pm acute; margins either or not somewhat recurved; nerves 5(–7), midrib bearing a low,

rounded, or thin, wing-like keel; glabrous or in- and outside slightly hairy. *Lateral sepals* ovate-oblong to ovate-lanceolate, 10–16(–19) by 3.5–6 mm; top acute, more or less clearly apiculate; margins either or not recurved; nerves 5, midrib bearing a low, rounded or thin, wing-like keel; glabrous or in- and outside slightly hairy. *Petals* curved to rolled backwards, linear, 10–16(–18.5) by 0.7–1.7 mm; top truncate to sometimes acute; nerves 1–3; glabrous or in- and outside slightly hairy, especially at the base. *Lip* 11–17 mm long. *Hypochilium* at the base shallowly concave, in front somewhat convex, 5.5–9(–10) mm long; back part (2–)3–4.5 mm wide; in front laterally on each side with an obliquely triangular to narrowly triangular (to ± linear), rarely broadly rounded, more or less erect lobe 1.5–3(–4) by 1–2.5(–4) mm, width over the spread lobes 5–11 mm; laterally on each side with a longitudinal, laterally slanting, thin, 0.5–1(–1.5) mm high keel which may be somewhat higher in the back, rarely so in front, which begins 1.8–3(–4) mm from the back of the lip and continues till on the narrow base of the epichilium to up to halfway the widened epichilium blade; main nerves 5–7. *Epichilium* more or less recurved, more or less broadly spatulate in outline, in front either or not deeply 2-lobed, 4–8(–12) by 4.5–8(–10) mm; top truncate to deeply retuse, the tip sometimes more or less triangular; lateral lobes semi-orbicular to semi-elliptic in outline when flattened, often somewhat angular, 1.7–3(–3.8) by (2–)3–5(–9) mm, margin wavy; basal narrowed portion (2–)2.5–4(–4.7) mm wide. *Column* more or less broadly spatulate in outline, (5.5–)7–12(–13) mm long; top more or less distinctly truncate to broadly rounded, either or not laterally notched, top margin either or not recurved, entire to irregularly dentate to serrate, transition to the lateral margins either gradually rounded to angular; wing more or less wide, laterally curved to the front, towards the base gradually to abruptly narrowing. Anther in outline more or less reniform to cordate, 1.2–2.2 by 1–2.1 mm; top broadly rounded to acute, tip acute to truncate, sometimes more or less recurved. *Pollinia* ± pear-shaped to obliquely obovate in outline, 0.6–1(–1.2) by 0.4–0.7(–1) mm. *Stigma* (transversely elliptic to) elliptic, 1–4 by 1–2 mm; rostellum narrowly to broadly triangular, sometimes ligulate, 1–2 by 1–2 mm; top acute to obtuse. Ovary more or less triangular in section, 4–7(–9) by (0.5–)1–1.7 mm; ribs 3 or 6, in the first case sometimes the lateral margins of the valvae extending over the base of the jugae. *Fruit body* 2–3.5 by 1–1.4 cm.

Distribution. Sumatra, Malay Peninsula, Java, Borneo, S. Philippines.

Ecology. See under the varieties. Altitude 600–2700 m.

KEY TO THE VARIETIES OF CHELONISTELE SULPHUREA

- 1a. Leaf one per pseudobulb, herbaceous to rather coriaceous a. var. *sulphurea*
 b. Leaves two per pseudobulb, stiff coriaceous, fleshy when fresh b. var. *crassifolia*

a. var. *sulphurea* – Fig. 19a–d, 20a–d, f, g; Plate 3d

Chelonistele sulphurea (Blume) Pfitzer, Pfl. R. Heft 32 (1907) 137; Carr, Gard. Bull. Str. Settl. 8 (1935) 217; Lamb, Nat. Malaysiana 4, 1 (1979) 26, fig. – *Chelonanthera sulphurea* Blume, Bijdr. (1825) 383; Lindley, Gen. & Sp. Orch. (1833) 178; Miq., Fl. Ind. Bat. 3 (1859) 673. – *Coelogyne sulphurea* (Blume) Rchb. f., Bonplandia 5 (1857) 43; Gard. Chron. (1871) 970; Hooker f., Fl. Brit. India 5 (1890) 833; J.J. Smith, Orch. Java (1905) 146; Ridley, Mat. Fl. Mal. Pen. 1 (1907) 132; J.J. Smith, Orch. Java, Fig. Atl. Heft 2 (1909) f. CVIII; Ames, Orch. 6 (1920) 43; Backer & Bakh. f., Fl. Java 3 (1968) 279; H. Teuscher, Amer. Orch. Soc. Bull. 40 (1971) 412, phot. – *Pleione sulphurea* O. Kuntze, Rev. Gen. Pl. 2 (1891) 680. – Type: Blume s.n., H.L.B. 902, 322-1084.

Chelonistele pusilla (Ridley) Ridley, Fl. Mal. Pen. 4 (1924) 138; Stapf in Curtis, Bot. Mag. 150 (1924) t. 9046; Holttum, Orch. Malaya ed. 3 (1964) 237. – *Coelogyne pusilla* Ridley, J. Linn. Soc. Bot. 32

- (1896) 327; Mat. Fl. Mal. Pen. 1 (1907) 133. — *Pholidota pusilla* (Ridley) Kraenzlin, Pfl. R. Heft 32 (1907) 158. — Type: Ridley s.n., Malay Peninsula, Perak, Larut Hills 4000' (n.v.).
- Chelonistele perakensis* (Rolfe) Ridley, Fl. Mal. Pen. 4 (1924) 138; Holttum, Orch. Malaya ed. 3 (1964) 237; Vaughan, Nat. Malaysiana 8 (1983) 5, phot. — *Coelogyne perakensis* Rolfe in Curtis, Bot. Mag. 134 (1908) t. 8203. — Syn types: Wray 1538 (lecto K, here chosen; CAL, E), 673 (K), 1498 (K); Scortechini 573b (K), 1312 (CAL, K); Cult. Hort. Kew s.n., 31-3-1903 (K); Cult. Roy. Bot. Gard. Glasnevin (Moore) s.n., 12-5-1880 (K), idem, Feb. 1901 (K).
- Chelonistele cuneata* (J. J. Smith) Carr, Gard. Bull. Str. Settl. 8 (1935) 217. — *Coelogyne* (sect. *Chelonistele*) *cuneata* J. J. Smith, Bull. Jard. Bot. Btzg III, 11 (1931) 97. — Type: Ender 3879 (L).
- Chelonistele pinniloba* (J. J. Smith) Carr, Gard. Bull. Str. Settl. 8 (1935) 218. — *Coelogyne* (sect. *Chelonistele*) *pinniloba* J. J. Smith, Bull. Jard. Bot. Btzg III, 11 (1931) 98. — Type: Ender 4524 (L).
- Chelonistele kutaiensis* (J. J. Smith) Carr, Gard. Bull. Str. Settl. 8 (1935) 77, 216. — *Coelogyne* (sect. *Chelonistele*) *kutaiensis* J. J. Smith, Bull. Jard. Bot. Btzg III, 11 (1931) 99. — Syn types: Ender 4429 (lecto L, here chosen), 4380 (L).
- Coelogyne croockewitii* Teysm. & Binnend., Nat. Tijd. Ned. Ind. 5 (1853) 488; Rchb. f. in Walp., Ann. 6 (1861) 225. — *Pleione croockewitii* O. Kuntze, Rev. Gen. Pl. 2 (1891) 680. — Type: Binnendijk s.n. (L, sheet nr. 902, 322-1008).
- Coelogyne decipiens* Sander, Orch. Guide 31 (1901) 30. — Type: not indicated (placed in the synonymy of *Chelonistele pusilla* by Stapf).
- Coelogyne beyrodtiana* Schltr., Orchis 9 (1915) 90, t. 6, f. 1-7; in Fedde, Rep. Beih. 74 (1934) t. 22, f. 85. — Type: Schlechter s.n., 1910, cult. Beyrodt (n.v., probably lost, placed in the synonymy of *Chelonistele perakensis* by Ridley).

Leaves: one per pseudobulb, herbaceous to ± coriaceous; blade (4-)8-25(-35) by 1.5-3.5(-6.5) cm. Median sepal 10-15.5(-18) by 4-5(-6.3) mm. Lateral sepals 10.5-16(-19) by 3.5-6 mm. Petals 10-16(-18.5) by 0.7-1.6 mm; nerves 1(-3). Lip 11-17(-20) mm long.

Distribution. Sumatra (Aceh, Sumatera Utara, Sumatera Barat, Jambi, Bengkulu, Lampung). 8 collections (AMES, BM, K, L). — Malay Peninsula (Kedah, Perak, Pahang, Selangor). 15 collections (CAL, E, K, KLU). — Java (Jawa Barat). 20 collections (BM, CAL, K, L, P). — Borneo: Sarawak (1st, 2nd, 3rd & 4th Division). Sabah (West Coast Residency; Interior Residency, Tawau Residency). Kalimantan (Kalimantan Timur). 39 collections (AMES, BM, E, K, L, NY). — Philippines (Mindanao, Palawan). 2 collections (BO, L).

Ecology. Epiphytes in montane or elfin forest, sometimes at lower elevations in kerangas on sandy soil, several recordings on boles of trees, sometimes recorded growing close to the ground, once rather shaded; altitude 600-2300 m. Fl. probably all year round.

Collector's notes. Scales of the young shoot brownish pink to chocolate brown (twice recorded). Bracts mauve or pinkish (3 times recorded). Sepals and petals more or less translucent, pale: white, yellow(ish), greenish, mauve, brownish, pale buff, pale flesh or pale greenish flesh-coloured. Lip similarly coloured or paler, with a yellow to orange-yellow to brownish, sometimes brown bordered mark on the base of the epichilium, sometimes with a small brownish spot on each lateral lobe. Column coloured like the sepals or paler, sometimes with brownish spots or suffused brownish. Pollinia yellow or pinkish yellow (twice recorded). Fragrant as well as not scented flowers were recorded. The saccate part of the hypochilium filled with nectar (once recorded).

From the Malay Peninsula the entire colour variation has been recorded. In Sumatra the flowers are usually yellowish, but pale greenish and pale salmon flowers were each once recorded. In Java the flowers are according to J. J. Smith brownish or greenish; also yellowish and white flowers were recorded. In Borneo the flowers are most often white, sometimes greenish cream or tinged pink.

Notes. 1. The plants are variable in habit, consistency and index of the leaf, size of the flower parts, shape of the tip (especially the top of the epichilium), the continuation of the keels on the epichilium, and the shape of the column.

2. '*C. perakensis*' and '*Coelogyne croockewitii*' (Malay Peninsula and Java resp.) apply to plants which exactly match the type of *C. sulphurea* in all parts.

3. '*C. pusilla*' (Malay Peninsula) applies to small compact plants with relatively rather small flowers.

4. '*C. cuneata*' (Borneo) applies to plants in which the column gradually narrows to the base, the leaves are rather coriaceous with an acute to obtuse tip, the keels of the tip do not extend beyond the narrowed part of the epichilium.

5. '*C. pinniloba*' (Borneo) applies to rather stout plants with long pseudobulbs, long petioles, rather coriaceous leaves, a lip with a rather narrow base and rather broadly triangular lateral lobes, and a rather broadly winged hood of which the margins, when flattened, run parallel to about halfway the column, where they abruptly narrow into the more slender stalk.

6. '*C. kutaiensis*' (Borneo) applies to rather slender plants with thin, slender pseudobulbs and thin, long, narrow leaves with acuminate top; the keels of the lip extend somewhat on the broad part of the epichilium.

7. '*Coelogyne beyrodtiana*' (Malay Peninsula) applies to plants with relatively rather large, white flowers with linear petals which are somewhat narrowed in the upper half; the lip is relatively broad, the column has a serrate top margin.

b. var. *crassifolia* (Carr) de Vogel – Fig. 19e–g, 20e.

Chelonistele sulphurea (Blume) Pfitzer var. *crassifolia* (Carr) de Vogel, Blumea 30 (1984) 205. – *Chelonistele crassifolia* Carr, Gard. Bull. Str. Settl. 8 (1935) 218. – *Coelogyne crassifolia* (Carr) Masamune, Enum. Phan. Born. (1942) 140. – Type: Carr 3565 = SF 28027 (see note 1).

Leaves: two per pseudobulb, stiff coriaceous, when fresh fleshy; blade (4.5–)6–12(–20) by 0.8–2.5 cm. Median sepal 12–15.5 by 4.5–5.5 mm. Lateral sepals 12–16 by 4–6 mm. Petals 12–16 by 1–1.7 mm; nerves 3. Lip 12–16 mm long.

Distribution. Borneo: Sabah (West Coast Residency). 7 collections (AMES, BM, K, L, SING).

Ecology. Terrestrial on rock and boulders, once recorded exposed to 60% sunlight; altitude 2100–2700 m. Fl. Nov.–Dec.

Collector's notes. Sepals and petals cream-coloured or pale greenish white. Lip similarly coloured, with a yellow patch near the tip, and two brown patches underneath near the column (less detailed notes: with pink or ? purple spots). Sweet scent (once recorded).

Notes. 1. Carr intended to make Carr 3565 = SF 28027 the type. This specimen is annotated as such. Probably by mistake the word 'type' was omitted from the first alinea after the description of *C. crassifolia*.

2. This variety differs from the type variety only in the 2-foliate pseudobulbs and in the more thick-coriaceous leaves. In all other aspects it fits within the variability of the type variety.

11. *Chelonistele unguiculata* Carr – Fig. 21.

Chelonistele unguiculata Carr, Gard. Bull. Str. Settl. 8 (1935) 77. – *Coelogyne unguiculata* (Carr) Masamune, Enum. Phan. Born. (1942) 146. – Type: Syngé S. 399 (holo K; L).

Plant 13–30 cm high. Roots 1–1.5 mm diam. Scales of the young shoot 6–9; shortest one 5–8 mm long, longest one 6–8 cm long; nerves 30–50. *Pseudobulbs* rather to very slender, (2–)3–7 cm long, when dry rather finely to rather coarsely longitudinally wrinkled. *Leaves*: one per pseudobulb. Petiole (3.3–)5–7(–11) cm by 1–2 mm. *Blade* ovate- to obovate-oblong to (obovate-)lanceolate, (5.5–)9–15 by 1.5–3.8 mm; top acuminate; prob-

ably rather fleshy when fresh, when dried thick, coriaceous with fine longitudinal wrinkles; midrib prominent below, other nerves not conspicuous. *Raceme* proteranthous or synanthous with just emerging very young leaf, 4–8-flowered. Scape erect, 1.5–4 cm beyond the scales, 1–1.5 mm diam. Rhachis probably curved, either or not zigzag, 5.5–9 cm long; internodes 10–17(–20) mm long. *Floral bracts* (one from the top of an inflorescence seen) ovate, 9 by 5.5 mm; nerves 15. *Flowers* probably not opening very widely, tender. Pedicel \pm terete, 6–10 by c. 1 mm. *Median sepal* oblong to lanceolate, 16.5–20.5 by 6–6.5 mm; top acute to obtuse; nerves 5–7, not very conspicuous, midrib bearing a low, thin, wing-like keel; glabrous or with few scattered hairs at the base. *Lateral sepals* ovate-lanceolate, 16.5–20(–23) by 5.5–6 mm; top acute, apiculate; nerves 5–7, midrib bearing a low, thin, wing-like keel; with hairs as on the median sepal. *Petals* lanceolate to linear-lanceolate, 16–20 by 3–4 mm; top acute, obtuse to truncate; nerves 3–5. *Lip* 18–22 mm long. *Hypochilium* slender, at the back shallowly concave, in front probably somewhat convex, 12–14 mm long, in the back part 3.5–4 mm wide; margin either or not with a minute, erect, low, \pm triangular lateral lobe with acute to \pm rounded top on either side near the base; sometimes two incurved or upcurved, narrowly triangular, acute teeth present at the base; in front laterally on each side with a probably erect, \pm rectangular to ligulate lobe 5–5.5 by 1.3–2.5 mm large, of which the top is truncate with rounded corners, width over the spread lobes 11–14 mm; starting 2–5 mm from the back with two longitudinal, laterally slanting, thin, low, wing-like keels 0.5–0.8 mm high, which continue to about halfway the epichilium where they increase to 2–3.5 mm in height, with rounded to acute top margin. *Epichilium* 2-lobed, slightly recurved, \pm spatulate in outline when flattened, 7–9 by 5.5–8 mm; top deeply retuse, the tip triangular, recurved; lateral lobes folded, when flattened \pm rounded, 2.5–3 by c. 6 mm; width of basal part 2–3 mm; nerves finely branched. *Column* obovate-oblong when flattened, lateral margins curved to the front, 15–16 by 6–8 mm; wing thin, top portion \pm triangular with more or less rounded tip, laterally with more or less distinct triangular to \pm rounded lateral lobes; at the base gradually narrowing. Anther in outline more or less cordate to narrowly cordate, 1.5–2 by 1–1.5 mm; top triangular, tip acute to truncate. *Pollinia* not seen. *Stigma* narrowly elliptic in outline, 2–2.5 by c. 0.5 mm; rostellum ligulate, 1.5–2 by 0.5–1 mm. Ovary slender, 4–6 by 1–1.5 mm, rather angular by the more or less rounded ribs, with few scattered hairs. *Fruit* not seen.

Distribution. Borneo: Sarawak (3rd & 4th Division), 3 collections: Burt B. 11326 (E), Richards 2420 (K, L), Syngé S. 399 (K, L).

Ecology. Epiphytes, once recorded on bases of trees, in moss forest (twice recorded); altitude 1100–1350 m. Fl. Feb., Aug., Sept.

Collector's notes. Flower white, with yellow lines or yellow centre on the lip.

Excluded species

Chelonistele apiculata (Lindley) Pfitzer, Pfl. R. Heft 32 (1907) 138 = *Panisea apiculata* Lindley.

Chelonistele biflora (Par. & Rchb. f.) Pfitzer, Pfl. R. Heft 32 (1907) 139 = *Panisea uniflora* (Lindley) Lindley.

Chelonistele keithiana W. W. Smith, Notes Roy. Bot. Gard. Edinb. 13 (1921) 188 = *Nabalua clemensii* Ames.

Chelonistele tenuiflora (Ridley) Pfitzer, Pfl. R. Heft 32 (1907) 138 = possibly *Geesinkorchis phaiostele* (no material seen).

Chelonistele vermicularis (J. J. Smith) Kraenzlin, Pfl. R. Heft 32 (1907) 163 = *Coelogyne vermicularis* J. J. Smith.

THE GENUS ENTOMOPHOBIA

When describing *Pholidota kinabaluensis*, Oakes Ames placed this species without comments in the genus *Pholidota*, notwithstanding the fact that he noted that the lip is at its base 'adherent to the sides of the column nearly up to the stigmatic orifice'. No other author questioned the position of this taxon in the genus *Pholidota*.

After comparing this species with all other species of *Pholidota*, I came to the conclusion that it has some unique morphological characters which all aim at obstructing entrance to the flower by pollinators. The flower remains almost completely closed during anthesis, enclosed by the bract which by then has already been detached. The front opening of the lip is narrow and the lip cannot be pulled backwards due to its adnation to the column. Further, a transverse, swollen callus is present in the lip blocking the entrance of the stigma, a feature which is unique for this species. These structural and morphological differences I considered sufficient to publish in *Blumea* 30 (1984) 199 a new monotypic genus which I named *Entomophobia*, from the Greek *εντομοϕ*, insect, and *φοβοϕ*, fear. Its affinity seems to be with *Pholidota*, viz. the group of *P. nervosa*.

ENTOMOPHOBIA de Vogel

Entomophobia de Vogel, *Blumea* 30 (1984) 199. – Type species: *E. kinabaluensis* (Ames) de Vogel.

Epiphytes or lithophytes. Flower almost entirely closed. Lateral margins of the lip adnate to the basal half of the column. Base of the lip deeply saccate, separated from the front part by a transverse, high, slightly bent, fleshy callus which more or less fits into the stigmatic cavity.

Distribution. West Malesia: endemic in Borneo, 1 species.

Ecology. See under the species.

1. *Entomophobia kinabaluensis* (Ames) de Vogel – Fig. 22.

Entomophobia kinabaluensis (Ames) de Vogel, *Blumea* 30 (1984) 199. – *Pholidota kinabaluensis* Ames, *Orch.* 6 (1920) 68; Carr, *Gard. Bull. Str. Settl.* 8 (1935) 221. – Type: Clemens 279 (n.v.).

Plant 25–85 cm high. Roots 1.5–3 mm diam., branched, some parts villous with root hairs. Rhizome creeping, short. Scales of the flowering young shoot 7–8, imbricate, acute; smallest one 1–1.5 cm long, longest one 7–14 cm long; stiff thin-coriaceous; nerves \pm 25, rather inconspicuous, surface finely wrinkled when dried; soon dry but long persistent around the pseudobulb, then soft papyraceous. *Pseudobulbs* close together, all turned to one side of the rhizome, more or less bulging, 2–5 cm long, when dried finely wrinkled and longitudinally grooved. *Leaves*: two per pseudobulb, petiolate. Petiole channelled, (3.5–) 6–13(–17) cm by 2–3 mm. *Blade* linear, index 15–33, 16.5–65 by 1–1.9 cm; top acute; stiff thin-coriaceous; main nerves 3–7, above rather prominent, the midrib sunken, below all prominent; small nerves 12–50, rather to very inconspicuous. *Raceme* proteranthous to synanthous with the just emerging young leaves, 15–42-flowered. Scape erect, consisting of 1 internode, rather flattened, beyond the scales 4.5–11 cm long, after anthesis up to 30 cm in length. Rhachis straight (to very slightly zigzag), rather angular, 6–14 cm long; internodes 2.5–5 mm long. *Floral bracts* persistent at anthesis, or at least remaining clasped around the flower which they \pm equal in length, shed during fruit setting, folded along the midrib, ovate, 15–25 by 8–16 mm; top acuminate to truncate; stiff herbaceous; nerves

25–35; glabrous. *Flowers*: many opening at the same time, distichous but all turned to one side, almost entirely closed, glabrous. Pedicel 3–6 by 0.5–0.7 mm, rather angular to almost terete. *Median sepal* ovate-oblong, deeply concave, 7–10 by 2.8–4.5 mm when flattened; top truncate to acuminate; nerves 5, midrib more or less prominent. *Lateral sepals* slightly asymmetric, shallowly concave, ovate-oblong, 7–10 by 3.5–4.5 mm; top acute; nerves 5, midrib a more or less conspicuous rounded keel. *Petals* broadly spatulate, 7–9.7 by 4–6 mm; top obtuse to ± apiculate; nerves 3–5, usually giving off lateral branches; tender, more fleshy to the top. *Lip* not clearly divided into hypochilium and epichilium, not exerted from the perianth, laterally more or less flattened, 5–8 mm long, 1.7–3.5 mm wide, 2–3.7 mm high; base deeply saccate, separated from the front part by a transverse, high, slightly bent, fleshy callus which about fits into the stigmatic cavity, thus blocking the entrance to the backside of the lip and the stigma, lateral margins at the base for c. 2 mm adnate to the column; front part recurved, with an acute to rounded top, margins slightly undulating. *Column* laterally more or less flattened, without column foot, 4–5 mm long; hood somewhat widened, 3-lobed, midlobe rounded, lateral lobes more or less triangular. Anther enclosed by the hood, irregularly cordate in outline, 1.2–1.5 by 0.7–1.3 mm; top triangular, acute, distinctly recurved. *Pollinia* 4, ± elliptic, rather flattened with a shallow depression, 0.5–0.7 by 0.3–0.5 mm. *Stigma* rather shallowly cup-shaped, overlying the callus of the lip; rostellum broadly triangular, notched. Ovary angular by 6 ribs, 5.5–7.5 by 0.8–2 mm. *Fruit* ellipsoid, on top the flower parts persistent; fruit body 9–11.5 by c. 5 mm; jugae flat, band-like, in cross-section concave; valvae smooth, in the centre with a low, longitudinal keel. *Seeds* slender, c. 0.7 mm long, on either side terminated by a more or less flattened wing.

Distribution. Borneo: Sarawak (1st & 4th Division). Sabah (West Coast Residency). Kalimantan (Kalimantan Timur). 8 collections (BM, BO, E, K, L, SING).

Ecology. Epiphytes or terrestrials (in litter) on limestone, sometimes exposed; altitude 900–2300 m. Fl. & fr. Jan.–May, July, Sept.

Collector's notes. Bracts pale green. Sepals and petals white or cream-coloured, lip in- or outside greenish or with a pink spot.

Note. A very high percentage of the flowers set fruit; the plant is probably autogamous.

THE GENUS GEESINKORCHIS

In 1910 Ridley described *Coelogyne (Chelonistele) phaiostele* ('*Chelonistele*'). He based this species on three collections, amongst which Hewitt s.n. (from Mount Santubong, not seen). In a note he stated: 'This plant would doubtless have been referred by Pfitzer to his genus *Chelonistele* but it seems almost impossible to break up the genus *Coelogyne* in the way he has done with any satisfaction. His genera run into each other with so many connecting links.'

Later in the same year Schlechter established *Coelogyne ridleyana*, based on two collections, amongst which a duplicate of Hewitt s.n. mentioned above (not seen). Although he pointed to the vivid resemblance in structure of the lip of this species with *Coelogyne sulphurea* and *C. perakensis* (both belonging in *Chelonistele*), he explicitly placed it in *Coelogyne* sect. *Longifoliae*.

J.J. Smith (1931) described *Pholidota triloba*, based on a Clemens collection from one of the type localities of Ridley's *Coelogyne phaiostele*, and stressed its similarity in vegetative parts to *Pholidota ventricosa*; for flower shape, however, he pointed to the similarities with *P. imbricata*, and in some respects with *P. gibbosa*. He rejected affinity with *Nabaluia*, to which '... one might be inclined to ascribe it ...', and gave several differences.

In my opinion all three taxa mentioned above belong to the same species.

After a field trip to Northeast Kalimantan in 1981, R. Geesink (L) brought back herbarium material and an extensive sample of flowers preserved in alcohol of a plant resembling *Coelogyne phaiostele*. Analysis of a flower revealed that the plant belongs to a related, different species. It has a high callus between two keels on the lip; the pollinia do not possess caudicles as is the case in almost all *Coelogyne*inae, but are borne on a minute, thin stipes!

All herbarium material of this group available for this study was then checked on the presence of a stipes, but the material is badly preserved and no trace of it was found. However, a living plant belonging to *Geesinkorchis phaiostele* received from Edinburgh, which flowered in the Leiden Botanic Garden, also appeared to possess a stipes.

Presence of a stipes is, as far as I know, not yet recorded in *Coelogyne*inae. In other small-flowered *Coelogyne*inae the flowers are never produced in succession on an elongating raceme; large-flowered species with a comparable way of flowering have differently structured flowers, the bracts are arranged in a dissimilar way and have a different shape.

The differences described above were in my opinion sufficient to establish *Geesinkorchis* as a separate genus in *Blumea* 30 (1984) 199. It is named after Dr. R. Geesink (Rijks-herbarium, Leiden). Its affinity seems to be with *Pholidota*, viz. *P. nervosa* and *P. sulcata*, with which it has the rather similarly structured two-keeled lip and column in common.

GEESINKORCHIS de Vogel

Geesinkorchis de Vogel, *Blumea* 30 (1984) 199. – Type species: *G. alaticcallosa* de Vogel.

Epiphytes or terrestrials. Roots long, sparsely branched, some parts puberulous. Rhizome creeping, short, sometimes branched; pseudobulbs close together. Scales of the young shoot imbricate, distichous; top acute; papyraceous to thin pergamentaceous, soon dry but long persistent, finally disintegrating into thin fibres; nerves many, fine, all \pm equal. *Pseudobulbs* all turned to one side of the rhizome, more or less flattened; when dried smooth with several longitudinal, rather coarse ridges. *Leaves*: two per pseudobulb, petiolate. Petioles deeply channelled. *Blade* linear-lanceolate; top acute; subcoriaceous to coriaceous, more or less stiff; main nerves rather prominent below, other nerves much less so to rather indis-

tinct. *Raceme* erect, rigid, starting proteranthous, continuing to produce flowers successively till long after the pseudobulb and leaves are fully developed. Scape consisting of one internode, not elongating after anthesis, long, somewhat flattened, rather sturdy. Rhachis much elongating during anthesis, \pm straight to more or less distinctly zigzag; internodes short. Sterile bracts at the base of the rhachis few or absent, caducous at anthesis. *Floral bracts* several together on top of the rhachis, closely imbricate, distichous, folded along the midrib, caducous at anthesis, ovate; top acute; more or less pergamentaceous to papyraceous; nerves many, fine; inside with several groups of minute, stellately arranged, uniseriate hairs. *Flowers* many, one or two open at the same time, rather widely opening, lip turned downwards. Pedicel curved, \pm terete to somewhat angular. *Median sepal* rather deeply concave, ovate; top acute to acuminate; midrib prominent; inside hairy like the bracts. *Lateral sepals* slightly asymmetric, rather deeply concave, ovate or ovate-oblong; top acute to acuminate; midrib a low and rounded keel; inside hairy like the bracts. *Petals* linear, curved or rolled backwards; top more or less truncate, sometimes obliquely so. *Lip* more or less clearly pandurate when flattened. *Hypochilium* at the base somewhat saccate, in front somewhat convex and there laterally on either side with an erect or more or less downwards curved lobe; keels wing-like, 2; either or not with a central callus. *Epichilium* more or less clearly two-lobed, broadly spatulate in outline when flattened; basal part along the margins usually with a rather dense row of hairs or finely lacinate; top portion more or less deeply retuse, sometimes the tip acute; lateral lobes broadly rounded. *Column* short, deeply concave, broadly spatulate when flattened, without column foot; top either or not 3-lobed; lateral lobes if present short. Anther more or less (long-)cordate; top acute or acuminate, its tip acute to truncate. *Pollinarium* consisting of a stipes bearing 4 pollinia; stipes rather slender, thin-walled, either or not bearing 4 lobes near the top. *Pollinia* attached near the top of the stipes, rather flattened, pear-shaped to obovoid, with a shallow depression in the basal portion. *Stigma* shallowly cup-shaped, in outline \pm orbicular to elliptic; rostellum bifid, more or less triangular in outline. Ovary more or less angular by the ribs; ribs 3, rather prominent. *Fruit* ellipsoid, in section \pm triangular, on top the perianth fragments or at least the lignified column persistent; ribs 6: the 3 jugae flat and band-like, the 3 valvae smooth, each one in the centre elevated in a more or less high longitudinal keel. *Seeds* slender, fusiform.

Distribution. West Malesia: probably endemic in Borneo, but one specimen (probably wrongly) labelled Sumatra, Siberut.

Ecology. Epiphytes, or terrestrials on podsolic soil or amongst tree roots; altitude 500–2000 m.

KEY TO THE SPECIES OF GEESINKORCHIS

- 1 a. Hypochilium without a callus. Column with two small but distinct lateral lobes 2. *G. phaiostele*
- b. Hypochilium with an erect, sturdy, laterally compressed callus. Column without distinct lateral lobes 1. *G. alaticcallosa*

1. *Geesinkorchis alaticcallosa* de Vogel – Fig. 23; Plate 4a, b.

Geesinkorchis alaticcallosa de Vogel, Blumea 30 (1984) 201, pl. 1d–i. – Type: Geesink 8965 (holo L; BO).

Plant 50–75 cm high. Roots to more than 25 cm long, 1–3.5 mm diam. Scales of the young shoot 4–6; smallest one 2.5–3.5 cm long, longest one 5–8 cm long; nerves c. 60. *Pseudobulbs* rather sturdy, (5–)7.5–9.5(–12) cm long. Petiole 3–9 cm by 2–4 mm. *Blade*

16–32 by 2.5–5 cm; main nerves 3–7, small nerves 28–80. *Raceme* producing successively up to 75 flowers or more. Scape 27–43 cm long, 3–4 mm diam. Rhachis to 17–27 cm long; internodes 3–6 mm long. Sterile bracts at the base of the rhachis 7–8, only scars seen. *Floral bracts* 13.5–15.5 by 9.9–11.5 mm when flattened; pergamentaceous; nerves 27–34. Pedicel 2–3 by 0.5–0.8 mm. *Median sepal* 7–8 by 3.5–4 mm. *Lateral sepals* ovate-oblong, 7–8.2 by 2.5–3.5 mm. *Petals* c. 7.7 by 1 mm; nerves 3. *Lip* pandurate, 7–8 mm long. *Hypochilium* 3.2–4 mm long; saccate part c. 0.9 mm long; lateral lobes ± triangular, more or less curved downwards 1.5–2 by 1.5–2 mm, with rounded top, width over the spread lobes 5.5–6.5 mm; opening to the stigma for a large part blocked by a central, erect, sturdy, laterally compressed callus 1–1.5 mm long, 0.3 mm wide, 1–1.5 mm high; laterally of this callus on either side with a low, rather thin, laterally slanting, 0.5–1 mm high rather short keel. *Epichilium* 3.5–4 by 4–5.5 mm; basal portion 2–3.4 mm wide, its margin rather densely covered with thin, minute lacinulae; lateral lobes 2.5–4 by 1.5–2.3 mm, with smooth margins which are more or less turned upwards. *Column* c. 4 mm long, 2–2.5 mm wide, 2–3 mm deep; top truncate, rather irregular; lateral margins ± smooth, curved to the front. Anther long-cordate, 2–2.2 by c. 1.5 mm, with acuminate top and acute tip. *Pollinia* c. 0.8 by 0.5 mm, stipes 1.3–1.8 by c. 0.3 mm, the top portion with 4 lobes. *Stigma* c. 1.5 by 1.2 mm; rostellum ± triangular, two-lobed, c. 0.3 mm long. Ovary c. 2 by 1.2 mm; ribs 3, rather prominent. *Fruit body* c. 16 by 11 mm. *Seeds* 0.5–1 mm long.

Distribution. Borneo: Sarawak (4th Division), Sabah (West Coast Residency), Kalimantan (Kalimantan Timur). 3 collections: Geesink 8965 (L, BO), Burt B. 11648 (E), A. Lamb 97/83 (SAN).

Ecology. Terrestrial; in kerangas vegetation on podsolic soil and among tree roots in scrub vegetation on summit of ridge; altitude 500–900 m. Fl. & fr. July, Sept.

Collector's notes. Sepals and petals yellowish brown. Lip whitish to yellowish cream with a central brownish patch, callus whitish or pale brownish. Hood of the column very dark brown. Stigma brownish.

2. *Geesinkorchis phaiostele* (Ridley) de Vogel – Fig. 24; Plate 4c.

Geesinkorchis phaiostele (Ridley) de Vogel, *Blumea* 30 (1984) 201, pl. 1c. – *Coelogyne* (sect. *Chelonistele*) *phaiostele* Ridley, J. Str. Br. R. As. Soc. no 54 (1910) 51 ('*Chelonostele*'). – Syntypes: Lewis s.n., VI-1909 (lecto K, here chosen); Haviland s.n., VI-1890 (K); Hewitt s.n. (n.v.).

Coelogyne ridleyana Schltr. in Fedde, Rep. 8 (1910) 561; *ibid.*, Beih. 74 (1934) t. 21, f. 84. – Syntypes: Brooks 14 (lecto BM, here chosen; K); Hewitt s.n. (n.v.).

Pholidota triloba J.J. Smith, *Brittonia* 1 (1931) 105; Bull. Jard. Bot. Btzg III, suppl. vol. 3 (1949) t. 163. – Type: Clemens 20398 (holo L; NY).

Plant 25–60 cm high. Roots to more than 25 cm long, 1–3 mm diam. Scales of the young shoot 5–11; smallest one 0.5–1 cm long, longest one 6.5–12.5 cm long; nerves 45–80. *Pseudobulbs* very slender to short and thick, 3–8(–24) cm long. Petiole 3–13(–17.5) cm by 2–3.5 mm. *Blade* 6.5–30 by (1.3–)2–3.3(–4.2) cm; main nerves 3–5, small nerves 32–60, the latter sometimes inconspicuous. *Raceme* producing successively up to 50 to over 100 flowers. Scape (8–)25–33 cm long, (1.5–)2–3 mm diam. Rhachis to 20–35 cm long; internodes 3–5 mm long, terete to angular. Sterile bracts at the base of the rhachis (0–)2–6, only scars seen. *Floral bracts* 12–17 by 8–13 mm when flattened; ± papery; nerves 30–47. Pedicel 3.5–5(–8.3) by 0.3–0.5 mm. *Median sepal* 5.5–7.8 by 3–4.2 mm. *Lateral sepals* ovate to ovate-oblong, 5.2–8 by 2.3–4 mm. *Petals* 5–8 by 0.5–1.5 mm; nerves 1–3. *Lip* more or less pandurate when flattened, (4.5–)7–8 mm long. *Hypochilium* 3–4 mm long; saccate part 1–2 mm long, 1–7 mm wide, 1–5 mm high; lateral lobes more or less erect, more or less triangular to ligulate or obliquely spatulate, (0.5–)1–1.8 by (0.5–)0.8–

1.2 mm, width over the spread lobes (2-)4.4-6 mm; between the lateral lobes with two parallel, rather long, more or less fleshy low keels; back of the hypochilium sac either or not with 3 short keels. *Epichilium* (2.7-)3.5-4.9 by 4-5 mm; basal part 1.8-3 mm wide, margins usually with a row of densely placed, minute, uniseriate hairs; top retuse or not; lateral lobes 1.2-2 by 2-3 mm, with somewhat irregular margin. *Column* 3-4.2 mm long; top 3-lobed, median lobe more or less broadly rounded with irregularly serrate to entire top margin, lateral lobes more or less triangular with more or less rounded top, turned to the front. Anther \pm cordate, 1-1.2 by 1-1.2 mm; top acute, its tip more or less truncate. *Pollinia* 0.5-0.7 by c. 0.3 mm, stipes c. 0.7 by 0.2 mm, without lobes. *Stigma* 0.8-1.5 by 1-1.5 mm; rostellum broadly triangular or broadly rounded, more or less incised at the top. Ovary 2-3.2 by 0.7-1.2 mm; ribs 3. *Fruit body* 12 by 7.5 mm. *Seeds* up to 1 mm long.

Distribution. Borneo: Sarawak (1st Division), Kalimantan (Kalimantan Timur) (see note). 10 collections (BM, CGE, E, K, L, NY, SING).

Ecology. Epiphytes (once recorded), on hill- and mountain tops and ridges; altitude 800-2000 m. Fl. & fr. June (2 records), Aug., Sept. (2 records), Oct., Nov. (2 records).

Collector's notes. Sepals pale greenish white to dull ochre or pale orange-yellow. Petals cream-coloured. Lip white to cream-coloured with a brown blotch in front of the keels, and a brown line on the front margins of the lateral lobes of the hypochilium and the margin of the narrow basal part of the epichilium. Column brown, anther ochre.

Note. One collection made by Boden Kloss (SF 12290) is labelled: Sumatra, Siberut. It is unlikely that this species occurs on that island. All other specimens are from Borneo, where Boden Kloss collected too. If it occurred on Siberut it would also be present on the Barisan mountains in Sumatra; these are thoroughly explored but this species was never found. In addition the altitude of Siberut is at most 300 m.

THE GENUS NABALUIA

When Ames described the genus *Nabaluia* he indicated a relationship with the genus *Coelogyne* through the Philippine *Coelogyne bilamellata* Lindley. One species was described: *Nabaluia clemensii*.

Based on a different specimen of the same species, W.W. Smith described *Chelonistele keithiana*. In an account of the species of *Chelonistele*, C.E. Carr compared the structure of the lip of this species with that of *Chelonistele lamellulifera* and reduced *N. clemensii* to *Chelonistele*. J.J. Smith, when studying a specimen of *N. angustifolia* newly described here, referred it to *Chelonistele keithiana*, but was of the opinion that it belonged in *Pholidota*. However, he never published this combination, and later he followed Carr in naming the specimen *Chelonistele clemensii*.

Although clearly belonging in the Coelogyninae, the affinity of *Nabaluia* is nearer to *Pholidota* (viz. *P. nervosa* and related species) than to *Coelogyne* or *Chelonistele*. The entire structure of the flowers, and more especially the morphological characteristics of the lip, which has a comparable saccate hypochilium, strongly suggest this affinity. The presence of groups of stellately arranged hairs on the inside of the perianth, the long slender lateral lobes in front of the hypochilium, and the peculiar horseshoe-shaped callus between these lobes are the justification to follow Ames in regarding these plants different from *Pholidota* at genus level.

NABALUIA Ames

Nabaluia Ames, Orch. 6 (1920) 71, 250, pl. 87; Butzin, Willdenowia 7 (1974) 246, 254; de Vogel, Blumea 30 (1984) 201. — Type species: *N. clemensii* Ames.

Epiphytes or lithophytes. Roots along the entire rhizome, sometimes branched, some parts villous with root hairs. Rhizome creeping, short. Scales of the (flowering) young shoot imbricate, with many fine equal nerves; top acute; soon dry after flowering, then thin-papyraceous, not soon distintegrating, long persistent around the pseudobulb. *Pseudobulbs* close together, all turned to one side of the rhizome, more or less flattened, smooth. *Leaves*: two per pseudobulb, petiolate. Petiole channelled. *Blade* ovate-oblong to linear; main nerves 3–9, above rather prominent except the \pm sunken midrib, below all prominent, small nerves above rather inconspicuous, below still less so. *Raceme* erect, rigid. Scape consisting of one internode, long, rather flattened, straight, when dried finely, irregularly grooved, elongating after anthesis. Rhachis more or less zigzag, sometimes almost straight, rather angular. Sterile bracts usually absent, once one observed on the lowest node of the rhachis, like the floral bracts but reduced. *Floral bracts* rather loosely imbricate, distichous, caducous at anthesis, folded along the midrib, papyraceous; nerves many, fine, all \pm equal; inside with scattered tufts of minute, stellately radiating, appressed, slender, thin-walled uniseriate hairs. *Flowers* alternating in two rows, rather many simultaneously open, sometimes all turned more or less to one side, ?resupinate, opening somewhat to rather wide. Pedicel slender, more or less angular, longer than the ovary, glabrous. *Median sepal* (ob)ovate to ovate-oblong; top acute, often curved backwards; margins more or less curved backwards; sides rather depressed due to which the back of the blade is more or less sharply folded; inside with minute elevations each bearing a tuft of hairs like on the bract; nerves 5, midrib prominent. *Lateral sepals* ovate to (ob)ovate-oblong, asymmetric, rather deeply concave; bending of top, margins and sides usually like that of the median sepal; nerves 4–5, midrib prominent to wing-like towards the top; inside with elevations and hairs as on the median sepal. *Petals* linear, usually rolled up backwards; nerves 3, midrib most con-

spicuous; inside on the lower half hairy like the bract. *Lip* divided in a short, saccate hypochilium and a long, more or less flat and spatulate epichilium. *Hypochilium* 2- or 4-lobed: each lateral margin in front drawn out into a slender, elongated, concave, obliquely forward projecting lobe, at the back either or not drawn out into a small triangular lobe; callus between the front lobes on the junction between epichilium and hypochilium more or less horseshoe-shaped, its central part more or less projecting over the hypochilium sac, its arms for the largest part adnate to the front hypochilium lobes or more or less free; keels 2–5, low, the lateral ones usually more prominent than the central ones which may be absent. *Epichilium* spatulate, slightly twisted, or \pm straight, somewhat convex; top more or less deeply retuse, its tip sometimes apiculate; lateral lobes with rounded top; 5-nerved, nerves in front branched; without keels. *Column* in outline spatulate, without column foot; hood concave, widened at the top, more or less clearly 3-lobed; median lobe rounded, its margin irregularly serrate to almost entire; lateral lobes small, more or less irregularly rectangular, sometimes almost absent. Anther inserted about halfway the stigma and the top margin of the hood, irregularly cordate to broadly cordate in outline; top more or less triangular, its tip recurved, truncate to acute. *Pollinia* obliquely obovoid to ellipsoid, rather flattened with a shallow depression. *Stigma* rather shallowly cup-shaped; rostellum a triangular to narrow seam, its tip obtuse, acute to minutely 2-lobed. Ovary in section triangular to 6-angular by the ribs. *Fruit* slender ellipsoid, the dry perianth and the lignified column persistent on top; ribs 6, distinct: the 3 jugae flat, band-like, the valvae smooth, in the centre with a low longitudinal keel. *Seeds* slender, fusiform; embryo ellipsoid, in the centre.

Distribution. West Malesia: endemic in Borneo: Sabah, Sarawak, 3 species.

Ecology. Epiphytic or growing on (mossy) rock; altitude 1450–3150 m.

Note. The species of this genus are closely related. The characters on which they can be distinguished are rather subtle, but since these appear to be constant, even between the two sympatric taxa, I feel justified to keep them separate at specific level.

KEY TO THE SPECIES OF NABALUIA

- 1 a. Leaves herbaceous (sometimes rather stiff), blade index (7.5–)10–21 (but see note 2 under *N. angustifolia*). Lip to 8.7 mm long. Hypochilium 4-lobed: each lateral margin of the hypochilium drawn out into a small, triangular lobe at the back, and a slender, linear one in front (see fig. 25) 1. *N. angustifolia*
- b. Leaves (thick) coriaceous, blade index 3–8. Lip over 9 mm long. Hypochilium 2-lobed: each lateral margin of the hypochilium drawn out into one slender linear lobe in front (see fig. 27) 2
- 2 a. Leaf blade index (3.5–)7–8. Arms of the horseshoe-shaped callus between the lateral lobes of the hypochilium free, broad, flattened, more or less projecting upwards. Pedicel and ovary together more than 19 mm long 3. *N. exaltata*
- b. Leaf blade index 3–5(–8). Arms of the horseshoe-shaped callus between the lateral lobes of the hypochilium not flattened, except for the subulate top adnate to the hypochilium and the base of the lateral lobes. Pedicel and ovary together less than 16 mm long 2. *N. clemensii*

1. *Nabalua angustifolia* de Vogel. – Fig. 25; Plate 4d.

Nabalua angustifolia de Vogel, Blumea 30 (1984) 202, pl. 2d, e. – Type: Clemens 27159 (holo AMES; BM, K, L).

Nabalua clemensii auct. non Ames: Ames, Orch. 6 (1920) 72 (pro spec. Clemens 268).

Plant 20–45 cm high. Roots 2–4 mm diam. Scales of the young shoot (6–)8–9; smallest one 0.5–1.6 cm long, longest one (5.5–)8.5–14 cm long; papyraceous; nerves 35–75. *Pseudobulbs* rather to very slender, 4.5–12 cm long, (when dried) sharply angular by a few longitudinal folds. Petiole 2.5–5.5 cm by 1.5–5 mm. *Blade* linear, index (7.5–)10–21, 14–30 by 1–2 cm; top acute; herbaceous (sometimes rather stiff); main nerves (3–)5–7, small nerves 22–42. *Raceme* synanthous with the just emerging (to sometimes halfway developed) young leaves, 16–30-flowered. Scape beyond the scales 4–12(–22) cm long, after anthesis increasing to 30–40 cm in length. Rhachis (8–)11–16(–20) cm long; internodes 5–9 mm long. Floral bracts (twice observed) ovate-oblong, c. 12–14.5 by 4.5–5 mm; top acute; nerves 11–20. Pedicel 6.5–11 by 0.4–0.7 mm. *Median sepal* ± obovate, (7–)8–8.3 by (3–)3.7–4 mm. *Lateral sepals* ovate-oblong, (7–)7.7–8.5 by (2.5–)3–4 mm. *Petals* (7–)7.3–8.5 by 0.7–1 mm; top truncate to acute. *Lip* 7–8.7 mm long. *Hypochilium* 4-lobed, 1.5–2.5 mm long, 1.5–2 mm high, 1.5–2.3 mm wide; front lobes (1.8–)2.5–3.5 by 0.4–1 mm; back lobes small, (obliquely) triangular, with a more or less rounded top, 0.3–1 by 0.3–1 mm; callus between the front lobes only in the basal portion adnate to the front margin of the hypochilium, the slender subulate to somewhat flattened arms parallel to the lateral lobes, free for 0.8–1.2 mm; keels 3, in the backside of the hypochilium. *Epichilium* 5.5–7 by (2.8–)3.2–4(–4.4) mm. *Column* 5.5–6.2 mm long. Anther 1–1.5 by 1–1.5 mm. *Pollinia* 0.4–0.7 by 0.3–0.5 mm. *Stigma* 1–1.7 by 1–1.5 mm. Ovary 4–6 by 1–1.5 mm. *Fruit body* c. 12 by 16 mm. *Seeds* c. 0.5 mm long.

Distribution. Borneo: Sabah (West Coast and Interior Residencies). 11 collections (AMES, BM, K, L, SING).

Ecology. Once recorded as an epiphyte on big branches; altitude 1450–3000 m. Fl. March, May, Aug., Nov. (5 records), Dec.

Collector's notes. Sepals and petals pale greenish cream, lemon green to greenish yellow. Lip pink or partly pink, sometimes with a brown spot, white and brown, or brown with a yellow spot. Column brownish (once recorded). Arms of the horseshoe-shaped callus once recorded to be yellow.

Notes. 1. Clemens 268 was identified by Ames as *Nabalua clemensii*, notwithstanding that 'Vegetatively the plants are quite unlike the type ...' and '... although the free ends of the callus are elongated ...' This collection was not included by him in the type description of that species; it belongs to *N. angustifolia*.

2. After the publication of *N. angustifolia* two sheets of Carr 3474 were discovered in SING, each containing a mixtum of two different taxa. On each sheet the specimen with the larger leaves belongs to *N. clemensii*. The specimen with the smaller leaves has coriaceous leaf blades with index 5–6, 7.5–11 by 1.1–2 cm. The hypochilium is 4-lobed, like in *N. angustifolia*, but the measurements of the flower parts of the present specimens are smaller or up to the minimum measurements of this species. In spite of these differences I reckon these specimens to *N. angustifolia*. The deviating measurements are not included in the description of this species.

2. *Nabalua clemensii* Ames – Fig. 26.

Nabalua clemensii Ames, Orch. 6 (1920) 71, 250, pl. 87. – *Chelonistele clemensii* (Ames) Carr, Gard. Bull. Str. Settl. 8 (1935) 217, 220. – Type: Clemens 210 (holo AMES; BM, BO).

Chelonistele keithiana W.W. Smith, Notes Roy. Bot. Gard. Edinb. 13 (1921) 188. – Type: Moulton 103 (holo E; K).

Plant 21–38 cm high. Roots 2.5–4 mm diam. Scales of the young shoot 7–8; smallest one c. 1.2 cm long, longest one (6–)9–10 cm long; rather tough herbaceous; nerves 30–65. *Pseudobulbs* rather sturdy, 5–11.5 cm long, when dried angular by irregular longitudinal

folds. Petiole (1.8–)4–9 cm by 2–3.5 mm. *Blade* ovate-oblong to (ob)ovate-lanceolate, index 3–5(–8), 10–16 by (1.9–)2.5–3.5 cm; top acute to acuminate; stiff thick coriaceous, the surface when dried often with coarse, irregular cross-ridges or with irregular depressions; main nerves 5–7, small nerves (22–)26–42, in the adult leaf inconspicuous. *Raceme* synanthous with the young, ± halfway or less emerged leaves, 18–25-flowered. Scape beyond the scales 10–20 cm long. Rhachis 10–18 cm long; internodes 4–10 mm long. *Floral bracts* not observed, one sterile reduced scale at the base of the rhachis once present. Pedicel (4–)7–12 by 0.5–0.7 mm. *Median sepal* (ob)ovate to ovate-oblong, 8.5–10 by 4.5–5.5 mm. *Lateral sepals* ovate-oblong, 8.5–10 by (3–)3.5–5 mm. *Petals* 8–9.5 by 1–1.8 mm; top truncate to acute. *Lip* 9–10.5 mm long. *Hypochilium* 2-lobed, 1.5–2 mm long, c. 1.5 mm high, 2–3 mm wide; lobes 3–4.2 mm long, 0.4–0.8(–1) mm wide; callus projecting over the hypochilium sac, its arms except for the 0.4–1 mm long subulate top adnate to the hypochilium and the base of the lateral lobes; keels 3–5, more or less prominent. *Epichilium* 7–9 by (3.5–)4–5 mm. *Column* 6–8 mm long. Anther 1.5–1.8 by 1.5–1.8 mm. *Pollinia* 0.5–0.7 by c. 0.4 mm. *Stigma* 1.2–2 by 1.2–1.8 mm. Ovary 3–4.5 by 0.8–1.7 mm. *Fruit* not seen.

Distribution. Borneo: Sabah (West Coast Residency). 8 collections (AMES, BM, BO, E, K, L, LAE, SING).

Ecology. Not known. Altitude 1200–3150 m. Fl. May, June, Aug. (2 records), Nov.

Collector's notes. Sepals yellow, often suffused pale brown except the yellow-green margins and midrib. Petals yellow suffused pale brown on either side of the median line. Lip base and calli pure white or dark brown; side lobes white outside, pale brown inside except on the margins; midlobe white with a pale brown spot at the base, a large yellow-brown spot below the apex of the lateral lobes on either side. Column pale brown or white with brown margins, hood brown. Anther cream-coloured with brown margins. Ovary and pedicel green. Less detailed notes: Flower pale pink. Flower yellow, centre white.

3. *Nabalua exaltata* de Vogel – Fig. 27.

Nabalua exaltata de Vogel, *Blumea* 30 (1984) 202, pl. 2a–c. – Type: Burt & Martin B. 5259 (holo E).

Plant (18–)32–77 cm high. Roots to 3 mm diam. Scales of the young shoot 8; smallest one 10–12 mm long, longest one 9–21 cm long, stiff herbaceous with papyraceous margin; nerves 40–70. *Pseudobulbs* rather to very slender, (6–)10–18 cm long, when dried with several rather coarse, longitudinal folds. Petiole (2.5–)6–24 by 2.5–4 mm. *Blade* (lanceolate to) linear, index (3.5–)7–8, (8.5–)15–37 by 2.2–4.7 cm; top acute; stiff coriaceous; main nerves 7–9, small nerves 42–80, the latter more or less inconspicuous. *Racemes* synanthous with the young, to halfway emerged leaves, 25–41-flowered. Scape sturdy, beyond the scales 12–20 cm long. Rhachis 14–30 cm long; internodes 4–10 mm long. *Floral bracts* ovate, c. 27 by 15 mm; top truncate; nerves c. 40. Pedicel 14–17 by c. 1 mm. *Median sepal* (ob)ovate, (10–)11.5–12 by c. 6 mm. *Lateral sepals* (10–)11–12 by 5–5.5 mm. *Petals* (10–)11–11.5 by 1.5–2 mm; top more or less obtuse. *Lip* (9–)10–12 mm long. *Hypochilium* 2-lobed, 2–2.5 mm long, 1.5–1.8 mm high, 2–2.7(–3.5) mm wide; lobes 3.5–4 mm long, 0.8 mm wide, with a more or less acute top; callus projecting over the hypochilium sac, with free, more or less erect, flattened, quadrangular to ± ligulate arms c. 1–1.5 by 1–1.5 mm which project more or less upwards behind the lateral lobes of the hypochilium; keels 5, of which 3 hardly conspicuous and 2 thick and swollen. *Epichilium* (7–)8–9.5 by (3–)3.7–4 mm; top deeply retuse, its tip ± apiculate, recurved. *Column* (7–)7.5–8 mm long; lateral lobes of the hood distinct, 1–1.3 by c. 0.7 mm, with rounded top. Anther 1.8–2 by c. 1.8

mm; top \pm acute. *Pollinia* c. 1 by 0.7 mm. *Stigma* c. 2 by 2 mm. Ovary 6–7 by c. 1.5 mm. *Fruit* not seen.

Distribution. Borneo: Sarawak (5th Division). 3 collections: Burt & Martin B. 5259, B. 5260 (E), S 26466 (Ilias Paie) (K).

Ecology. Growing on boulders (once recorded); altitude 2000–2350 m. Fl. Oct., Nov.

Collector's notes. Leaves very brittle. Sepals and petals yellow or pale green. Lip white, with or without a brown centre.