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A taxonomic revision of *Coelogyne* sect. *Ocellatae* (Orchidaceae)

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Coelogyne section *Ocellatae* Pfitzer and Kraenzlin was revised using macromorphological, DNA sequence and ecological data on phenology and habitat distribution. Altogether 15 taxa (10 species and 5 subspecies) are recognized, including 4 new species and 4 new subspecies. A detailed delimitation of the problematic species *C. nitida* (Wall. ex D. Don) Lindl., *C. punctulata* Lindl., and *C. corymbosa* Lindl. is provided. The three species differ in the structure of the inflorescence and the configuration of the keels on the lip.

Key words: *Coelogyne* sect. *Ocellatae*, Himalaya, molecular phylogeny, Orchidaceae, south-east Asia, taxonomy.

in review with *Ann. Mo. Bot. Gard.*

Introduction

The orchid genus *Coelogyne* Lindl. comprises over 200 taxa and is distributed from the Himalayas throughout southeast Asia and the tropical Pacific with the center of distribution in Borneo (Butzin, 1992; Clayton, 2002). *Coelogyne* species grow in primary forest from sea level up to 4000 m altitude. They are predominantly epiphytes, but in humid environments some species can grow as lithophytes over rocky cliffs or even as terrestrials (Comber, 1990; Clayton, 2002). Many species have inflorescences with numerous medium-sized to large, fragrant and delicately coloured flowers (Gravendeel, 2000). The pollination biology of *Coelogyne* is incompletely understood, but bees (Van der Pijl and Dodson, 1966; Subedi et al. submitted) and wasps (Carr, 1928; Dressler, 1981; Cheng et al., 2009) have been reported as pollinators.

Coelogyne was established by Lindley in 1821. In 1854, Lindley recognized 5 sections within the genus. Reichenbach f. (1861), Pfitzer and Kraenzlin (1907), Butzin (1974; 1992), Pradhan (1979), de Vogel (1992) and Clayton (2002) expanded this division. Presently, 4 subgenera and 19 sections are recognized (Gravendeel et al., 2005). Regional floristic accounts include Banerji and Thapa (1969), Banerji and Pradhan (1984) (both Nepal), Pradhan (1979) and Das and Jain (1980) (both India), Pearce and Cribb (2002) (Bhutan), Seidenfaden (1975) (Thailand), Seidenfaden and Wood (1992) (Peninsular Malaysia and Singapore), Comber (2001) (Sumatra), Cootes (1999) (Philippines), and Chinqi and Clayton (2010) (China). Clayton (2002) provided a synopsis for the whole genus.

Phylogenetic analyses showed that *Coelogyne* is an assemblage of 'leftovers' remaining after delimitation of the other genera of the subtribe Coelogyninae. It lacks the apomorphies that characterize the other genera, and morphological and molecular analysis shows that *Coelogyne* is polyphyletic in its present delimitation (Gravendeel et al., 2001; 2005). Various monophyletic sections of *Coelogyne* have been revised so far including section *Fuliginosae* (Pelser et al., 2000), *Moniliformes* (Gravendeel and de Vogel, 2002), *Speciosae* (Gravendeel and de Vogel, 1999), *Tomentosae* (de Vogel, 1992) and *Verrucosae* (Sierra et al., 2000). Section *Ocellatae* has not yet been revised. Major confusion exists over the identity and delimitation of *C. nitida*, *C. punctulata*, *C. corymbosa* and the correct nomenclature of *C. nitida* (Hunt and Summerhayes, 1966; Seidenfaden, 1975; Seidenfaden and Wood, 1992). The main objective of the present study is to address these problems with the aid of macromorphology and some ecological observations made in the wild. Phylogenetic analyses based on DNA sequences and morphological characters were also carried out to assess monophyly of the section.

Material and Methods

Plant material

This study is based on herbarium, spirit conserved and living material. Sheets were examined from the following herbaria: AMES, BKF, BM, C, CAL, E, K, K-Lindl, K-W, KATH, KUN, L, NY, P, PE, S, TUCH and W. For a few species, little or no material was available, the descriptions of these species were based on the original publications. During fieldwork carried out from 2007-2009 in Central and Eastern Nepal and India (Sikkim, Darjeeling) by the first author, some of the species were also studied in the field. Putative distribution

ranges and distribution maps were prepared using DIVA-GIS version 5.2.0.2 (<http://www.diva-gis.org/>).

DNA extraction and amplifications

Total genomic DNA was extracted from 50 mg of fresh young leaf tissue following the CTAB method of Doyle and Doyle (1987) without further cleaning procedures, or from silica dried leaf material using the DNA Plant Mini Kit extraction protocols of QIAGEN. One individual per species was sampled. A large portion of the *trnK* region (mostly *matK*) was amplified with the primers: -19F (5'-CGTTCTGACCATATTGCACTATG-3') and 881R (5'-TMTTCATCAGAATAAGAGT-3'); 731 F (5'-TCTGGAGTCTTTCTTGAGCGA-3') and 2R (5'-AACTAGTCGGATGGATGGAGTAG-3') (Gravendeel et al., 2001). The thermal cycling protocol comprised 28 cycles, each with 1 min. denaturation at 94 °C, 30 sec. annealing at 48 °C, an extension of 1 min. at 72 °C, concluding with an extension of 7 min. at 72 °C. All PCR products were sequenced directly after purification with QIA quick purification columns (QIAGEN). The nuclear ribosomal ITS1 and ITS2 spacers along with the 5.8S gene were amplified with the primers 17 SE (5'-ACGAATTCATGGTCCGGTGAAGTGTTCG-3') and 26 SE (5'-TAGAATCCCCGGTTCGCTCGCCGTTAC-3') from Sun et al. (1994). The thermal cycling protocol comprised 26 cycles, each with 10 sec. denaturation at 96 °C, 5 sec. annealing at 50 °C and extension of 4 min. at 60 °C. All nrITS PCR products were cloned following the protocol of the TOPO-TA kit (Invitrogen) and then reamplified from transformed bacterial clones by touching them with a sterile pipette tip and using that sample as template.

Amplified, double-stranded DNA fragments were purified using Wizard PCR minicolumns (Promega, Leiden, The Netherlands) and sequenced on an ABI 3730XL automated sequencer at Macrogen, using standard dye-terminator chemistry and following the protocols of PE Applied Biosystems, Inc.

Phylogenetic analyses

All characters were assessed as independent, unordered and equally weighted, using Fitch parsimony (Fitch, 1971). Only discrete morphological characters were used for optimisation on the molecular phylogeny, with multistate coding. Polymorphisms were coded as "all states possible" and inapplicable or unknown characters by a question mark.

A total of 5 (sub)species of *Coelogyne* sect. *Ocellatae* could be sampled for the molecular phylogenetic analysis. Representatives of *Coelogyne* sect. *Elatae*, *Flaccidae*, *Fuliginosae*, *Neogyna*, *Otochilus* and *Pleione* also occurring in Nepal were included as well. *Thunia alba* was selected as outgroup based on Gravendeel (2000).

Sequences were aligned with MacClade version 4.06 (Maddison and Maddison, 2003) and subsequently adjusted by hand. Gaps in the sequence data were coded as missing values. Synapomorphic indels were coded as present/absent characters. The morphological data matrix and *matK* and nrDNA ITS alignments are available from the first author upon request. All sequences were submitted to Genbank (see Appendix I for accession numbers).

Maximum parsimony (MP) analyses were performed on the sequence data with PAUP* version 4.0d100 (Swofford, 2002) using random additions and the MULPARS option. *Thunia alba* was used as outgroup in all analyses. The relative robustness for clades found was assessed by bootstrap support (BS) by performing 1000 replicates of bootstrapping (Felsenstein, 1995), using simple stepwise additions, SPR swapping, MULTREES on, and

holding only 10 trees per replicate. Congruence of the separate data sets was assessed by visual inspection of the individual bootstrap trees. Morphological characters were mapped on the combined molecular consensus tree using MacClade version 4.06 with ACCTRAN optimisation.

Results

The nrITS sequence alignment consisted of 682 positions and included 19 gaps varying in size between 1 and 17 bp. MP analysis resulted in 101 MPTs of 327 steps, CI=0.80 and RI=0.76. The strict consensus (not shown) was completely unresolved.

The *matK* alignment consisted of 1815 positions and included 4 gaps varying in size between 2 and 10 bp. MP analysis resulted in 13 MPTs of 122 steps, CI=0.90 and RI=0.91. In the strict consensus (not shown), three different clades were found comprising all species sampled of *Coelogyne* sect. *Ocellatae* (BS 72%), *Otochilus* (BS 88%) and *Pleione* (BS 100%), respectively.

Since the topologies of both individual bootstrap trees were not incongruent, a MP analysis was carried out of the combined DNA sequence alignment. This resulted in a single MPT of 460 steps, CI=0.80 and RI=0.78 (Figure 2.1). Four clades are present with moderately to high BS, i.e. all species samples of *Coelogyne* sect. *Flaccidae* (99%) and *Ocellatae* (BS 52%), *Otochilus* (BS 74%) and *Pleione* (BS 100%), respectively.

Discussion

According to the molecular phylogenetic analyses carried out here, *Coelogyne* sect. *Ocellatae* is monophyletic for at least the species of which DNA sequences could be analysed. When our morphological dataset (Appendix II) was optimised on the combined molecular phylogeny, the presence of an eye-shaped patch on the lip was found to characterize the molecular based clade comprising the species of *Coelogyne* sect. *Ocellatae* sampled. We could obtain DNA sequences of only a few species in this study and a more elaborate sampling of the section might reveal paraphyly or polyphyly. For the time being, though, we consider *Coelogyne* sect. *Ocellatae* monophyletic.

Taxonomic Treatment

Coelogyne (“Caelogyne”) Lindl., Coll. Bot.: sub t. 33. 1821. Butzin, Willdenowia 7: 245. 1974. Seidenf., Dansk Bot. Ark. 29, 4: 53. 1975. Das and Jain, Fasc. Fl. India 5, Coelogyne: 2. 1980. Clayton, The genus Coelogyne, a synopsis: 15. 2002. Pearce and Cribb, Flora of Bhutan 3, 3: 325. 2002. Chinqi & Clayton, in Flora of China 25: 315. 2010. LECTOTYPE SPECIES (designated by Butzin, 1974): *Coelogyne cristata* Lindl.

Note: Butzin (1974) implicitly lectotypified *Coelogyne* with *C. cristata* Lindl. We do not follow Seidenfaden (1975), Das and Jain (1980) and Pearce and Cribb (2002) who state that *C. punctulata* Lindl., a member of sect. *Ocellatae* Pfitzer and Kraenzlin, is the type species of the genus.

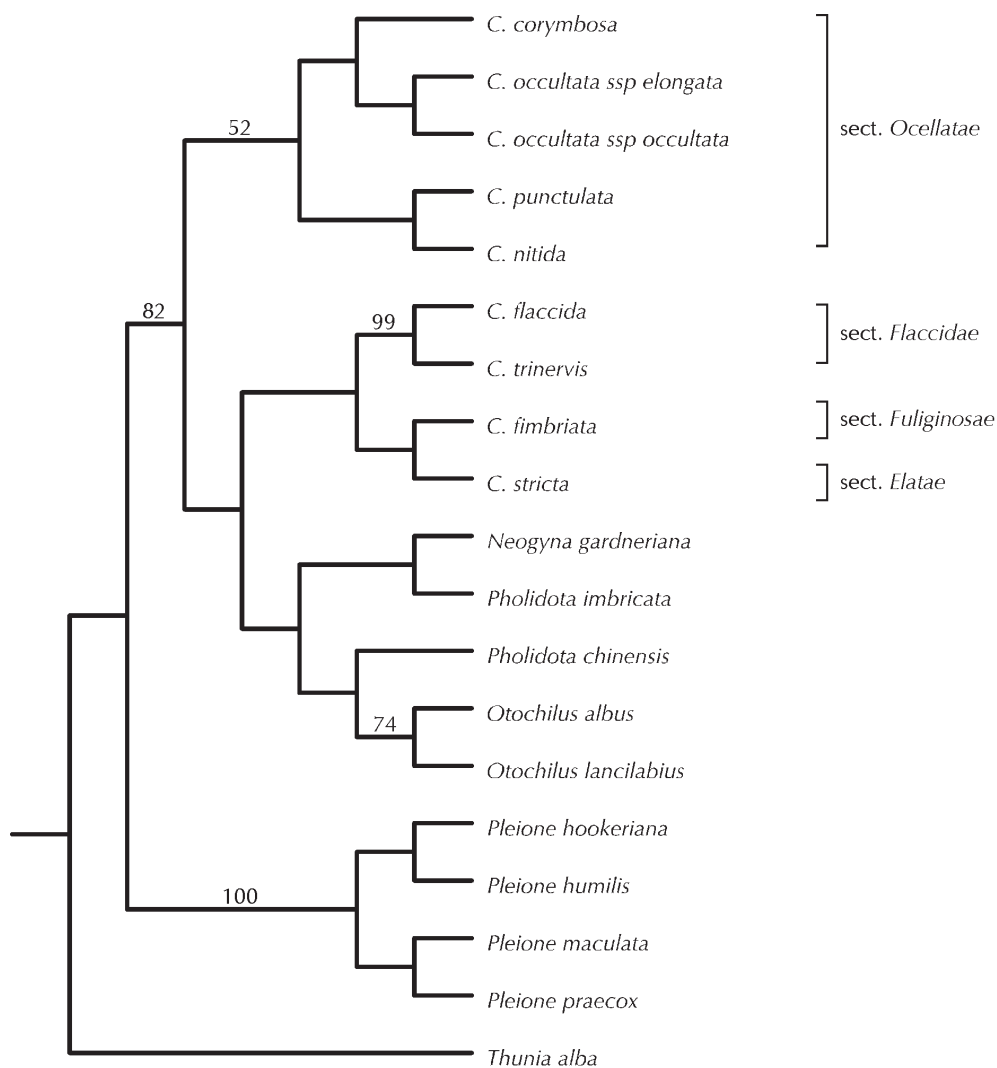


Fig. 2.1. Single MPT resulting from analysis of the combined molecular data. BS values are indicated above the branches.

Coelogyne sect. **Ocellatae** Pfitzer and Kraenzlin, *Coelogyne*. In: H.G.A. Engler (ed.), *Pflanzenr.* IV, 50, IIB7, Heft 32: 56. 1907. Clayton, The genus *Coelogyne*, a synopsis: 185. 2002. Pearce and Cribb, *Flora of Bhutan* 3, 3: 330. 2002. TYPE: *Coelogyne punctulata* Lindl. (= *C. ocellata* Lindl.).

Coelogyne sect. *Coelogyne* auct.: Seidenf., *Dansk Bot. Ark.* 29, 4: 53. 1975.

Plants perennial, small to medium sized epiphytes to lithophytes. *Roots* terete, villose.

Rhizome stout, short to long creeping or pendent (*C. occultata*), branched, scales persistent, the upper as long as or longer than the pseudobulb. *Pseudobulb* 2-leaved, close together to distant, (ob-)ovoid, cylindrical or ellipsoid, tip obtuse to drawn-out, with or without longitudinal ridges. *Leaves*: petiole semi-terete to grooved; blade elliptic to obovate, tip acute to acuminate, margins straight to slightly undulate, base abruptly contracted or gradually narrowing into the petiole, main veins 5-9; membranous to coriaceous. *Inflorescence* proteranthous, synanthous or hysteranthous; erect to arching, 1-8 flowered. *Peduncle* without scales (but partly or entirely covered by the rhizome scales in proteranthous or synanthous plants), circular to elliptic in section, usually elongating after anthesis (not in *C. punctulata* and sometimes in *C. occultata*). *Rhachis* erect or progressively zig-zagging towards the top. *Floral bracts* all fertile and deciduous during anthesis (lowermost sterile and persistent in *C. punctulata*), surrounding the rhachis at the base, tip acute, many veined. *Flowers* medium-sized, conspicuous, opening more or less simultaneously per inflorescence. *Pedicel* straight to curved, glabrous. *Ovary* ribbed, glabrous. *Median sepal* elliptic to ovate, tip acute (acuminate in *C. ttuyuii*), main veins 5-9, sparsely to conspicuously reticulated; glabrous. *Lateral sepals* recurved at the base, oblong-elliptic or ovate, main veins 5-9, otherwise as median sepal. *Petals* elliptic to obovate, inconspicuously to distinctly clawed at the base, main veins 3-5, margin entire to rarely undulate, otherwise as sepals. *Lip* broadly (ob-)ovate to elliptic in general outline when spread, surface smooth or partly minutely papillose. *Hypochile* base lightly saccate (distinctly so in *C. wardii*), main veins 5-9, the middle 3-keeled, the others dichotomously branched; lateral lobes erect, their bases arching over the column, front margin entire or erose to denticulate; sinus rounded or acute; colour patches present (absent in *C. taronensis*, *C. gongshanensis*). *Epichile* ovate to orbicular, tip acute to acuminate (cuspidate in *C. ttuyuii*), margin entire, erose or denticulate, 5-main veined, the middle 3 reaching the tip; the others sparsely to conspicuously reticulate, colour patches present (absent in *C. taronensis*), 2 separate or more or less joined (1 in *C. nitida* subsp. *myanmarensis*), (ob-)cordate in outline. *Keels* 3, starting at the base (near the base in *C. gongshanensis*); the laterals continuing up to the colour patches of the epichile, erect or spread out on the surface of the lip, single or consisting of two parallel crests; rod-like or clavate or plate-like shaped, in cross section entire or crenulate or with finger-shaped projections, glabrous to coliculate; the middle usually restricted to the hypochile, continuous or interrupted approximately halfway, rod like or clavate shaped, entire to crenulate in section. *Column* spatulate in outline when flattened, erect to curved, margins and base glabrous to papillose; hood 3-lobulate when flattened (obscurely so in *C. gongshanensis*), the lateral lobules short, denticulate, the median lobule transversely rectangular, erose or denticulate. *Anther* projecting (concealed in hood in *C. gongshanensis*), bell-shaped, tip straight or slightly recurved, obtuse. *Pollinia* 4, inner pair smaller and wider than the outer pair, ellipsoid to oblong; caudicle broadly ovate to rectangular. *Stigma* semi-circular, proximally rounded or emarginate; rostellum broadly elliptic. *Fruit* ellipsoid to oblong, with distinct stalk, in cross section circular to triangular in outline. *Seeds* fusiform.

Colours. Root hairs white (blackish in herbarium). Rhizome scales pale green, drying straw-coloured to dark brown. Pseudobulbs pale green to light yellowish. Pedicel creamy white. Ovary pale green. Flowers white (pale yellow in *C. gongshanensis*, or yellowish-ochraceous in *C. taronensis*). Lip hypochile veins flushed with dark reddish; lateral lobes with eye-shaped or rounded yellow colour patches bordered with orange-reddish. Column

and anther striated pale green, pollinia yellow. Mature fruits yellowish-green, seeds white.

Distribution, habitat, and phenology. The species of *Coelogyne* sect. *Ocellatae* show its center of diversity in the Himalayas (Bhutan, China (Yunnan), India (Arunachal Pradesh, Darjeeling, Meghalaya, Sikkim), Nepal and Myanmar (Figure 2.14). Also occurring in Laos, Thailand, and Vietnam. The species grow in temperate forest dominated by *Quercus* and *Rhododendron* in the Himalaya (Nepal, India and Bhutan), in evergreen *Quercus* forest (China), or *Abies-Rhododendron* forest (northern Myanmar) and are found growing epiphytic on tree trunks, sometimes lithophytic on cliffs near water bodies. They grow on 915-3500 m elevation. Flowering occurs from April to August, also in November and December (*C. hysteraantha*, *C. punctulata*).

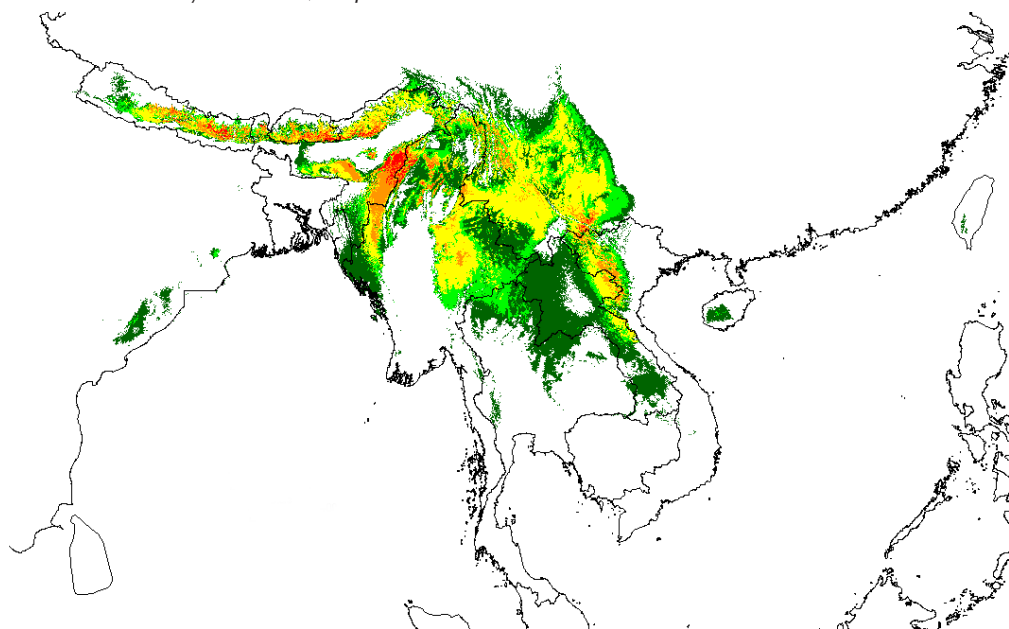


Fig. 2.14. Putative distribution range of *Coelogyne* sect. *Ocellatae* in the Himalaya and Southeast Asia as predicted by DIVA-GIS analyses. Areas where occurrence of species is predicted are indicated in red (20-33 percentile), orange (10-20), yellow (5-10), light green (2.5-5) and dark green (0-2.5).

Discussion. *Coelogyne* species of various sections may look similar in the field. Main differences are found in the ovary and pedicel (either glabrous or covered with scattered minute hairs), lateral lobes of the lip (either with or without colour patches), keels on the lip (either yellow or white, in cross section crenulate or entire and with fimbriate or lamellate margin). In the field, species of sect. *Ocellatae* are usually recognizable by their white or pale coloured flowers, with bright yellow, red-bordered eye shaped patches on the lateral lobes and midlobe of the lip. These patches remain visible in herbarium specimens, even after boiling of the flowers. The species of sect. *Ocellatae* are distinct in having relatively few flowers (1-7), a glabrous ovary and pedicel, lateral lobes of the lip with distinct colour patches, and white keels on the lip which are rod like or clavate or plate like shaped and in cross section entire or crenulate or lamellate in outline. The epithet *Ocellatae* refers to the eye-shaped spots that are present on the lip of all species of the section.

Pollination biology. No published records exist. In the field, bees have been observed as pollinators of *C. nitida* and *C. flaccida* in central Nepal. Bees are active from early morning to mid-afternoon (Subedi et al., accepted for publication).

Conservation status. The narrowly endemic *C. ttyuii*, *C. wardii*, *C. corymbosa* subsp. *hitendrae* and *C. occultata* subsp. *elongata* can be regarded as vulnerable. More widespread species are threatened by habitat destruction, particularly in the lower temperate regions of Nepal and India. Furthermore, *C. nitida*, *C. punctulata* and *C. corymbosa* suffer from over-collecting for horticultural and traditional medicinal purposes (Subedi et al. in prep.).

Cultivation. *Coelogyne nitida* and *C. punctulata* are commonly cultivated, *C. corymbosa* is less common, *C. occultata* is very rarely found in cultivation. The horticultural requirements of most *Coelogyne* species are given in Clayton (2002). Three different categories based on temperature requirements were identified: a warm group (the tropical species), an intermediate group and a cool group (the temperate or high altitude species). Most of the species of section *Ocellatae* fall in the cool group. They need a winter minimum temperature of 10-13°C. It is essential to avoid higher night temperatures as the plants will produce plenty of vegetative growth under these conditions but are unlikely to flower. A daytime temperature rise of 5-10°C seems to be ideal. In the summer, temperatures exceeding 27°C can easily occur in small greenhouses which need to be avoided if the growth of the plants is to be maintained (Clayton, 2002). A loose mixture of fern root and hardwood bark or charcoal with *Sphagnum* is recommended for a good drainage. Watering should be regular and atmospheric humidity should be rather high. Spraying of the leaves is beneficial for the plants.

Artificial hybrids. None have been reported.

Key to the species of *Coelogyne* sect. *Ocellatae*

1a	Inflorescence hysteroanthous.....	2
1b	Inflorescence proteranthous or synanthous.....	3
2a	Lowermost bract of rhachis with flower.....	3. <i>C. hysteroantha</i>
2b	Lowermost bract of rhachis sterile.....	7. <i>C. punctulata</i>
3a	Pseudobulb obovoid, born distantly, 1.3-5.0 cm apart.....	5. <i>C. occultata</i>
3b	Pseudobulb ellipsoid, born in a short chain, less then 1.3 cm apart.....	4
4a	Keels on lip plate like, fruit shape in cross section distinctly triangular in outline	6. <i>C. platylamellata</i>
4b	Keels on lip clavate or rod-shaped, fruit shape in cross section approximately circular in outline.....	5

- 5a Lip keels starting 0.3 cm away from the base of the hypochile, anther 0.18-0.22 cm, fully concealed by the wings of the column2. *C. gongshanensis*
- 5b Lip keels starting right from the base of the hypochile, anther 0.25-0.5 cm, protruding from the wings of the column.....6
- 6a Lip hypochile length 3-3.2 cm when flattened and top of lateral lobes extending 1-1.2 cm beyond the sinus.....10. *C. wardii*
- 6b Lip hypochile length 0.9-2.5 cm when flattened and top of lateral lobes extending 0.1-0.45 cm beyond the sinus.....7
- 7a Margin of lateral lobes of lip crenulate or crispate8. *C. taronensis*
- 7b Margin of lateral lobes of lip erose or denticulate.....8
- 8a Lateral keels of lip clavate, in longitudinal section with crenulate or lamellate margin.....1. *C. corymbosa*
- 8b Lateral keels of lip rod shaped, in longitudinal section with entire margin.....9
- 9a. Flowers 4-8, midlobe of lip with acute tip.....4. *C. nitida*
- 9b. Flowers 2-3, midlobe of lip with cuspidate tip.....9. *C. tuiyui*

1. *Coelogyne corymbosa* Lindl.

Roots 0.1-0.2 cm diam. *Rhizome* short to long-creeping, 0.5-0.8 cm diam., with 6-10 imbricate scales on young shoot. *Pseudobulbs* close together or distant, up to 1.8 cm apart, oblique, oblong-ellipsoid to ovoid, 2-6 by 1.1-2.5 cm, sparsely reticulately wrinkled. *Leaves* petiole 0.5-1.8 cm long; blade obovate or elliptic, 3-19 by 1.6-4 cm, index 2.3-7.9, tip acute, main veins 5-10, thin to coriaceous. *Inflorescence* proteranthous, flowers 1-4 (-5). *Peduncle* partially covered by the rhizome scales during anthesis, laterally flattened, 3.8-9.8 by 0.1-0.2 cm, elongating after anthesis or not. *Rhachis* suberect or slightly curved, 1.2-8.8 cm long; internodes 2-2.5 cm long, lowermost node angular. *Pedicel* 2-2.4 cm long, straight to slightly curved. *Ovary* 0.5-0.7 cm long. *Median sepal* elliptic to ovate, 2.6-3.5 by 0.8-1.3 cm, index 2-3.1, tip acute, main veins 5-9, conspicuously reticulated. *Lateral sepals* oblong-elliptic or ovate, 2.6-3.7 by 0.7-2.1 cm, index 1.5-3.7, main veins 3-5, otherwise as median sepal. *Petals* narrowly elliptic or obovate, near the base slightly notched along the lower margin, or shortly to distinctly clawed, 2.4-3.2 by 0.55-1.2 cm, index 2.5-4.6, main veins 3-5, otherwise as sepals. *Lip* broadly ovate or elliptic in outline when flattened, 2.1-3.3 by 1.4-2.1 cm, index 1.3-1.7. *Hypochile* slightly saccate (0.15 cm deep), lip attachment 0.21-0.45 cm wide, when flattened 1.3-1.7 cm long; top of lateral lobes extending 0.15-0.47 cm beyond the sinus, margins erose to entire; sinus round to acute. *Epichile* ovate to nearly orbicular, 1.2-1.8 by 0.6-1.35 cm, index 1-1.6, tip acute to acuminate, margin erose to entire, the two outermost veins conspicuously to sparsely reticulated. *Keels* the laterals single or consisting of two parallel crests, clavate,

margin wavy or crenulate in section, 1.3-1.9 cm long, proximally 0.12-0.18 cm high and thickened, lower at the level of the colour patches on the lateral lobes, slightly curved inwards or straight on the epichile; median keel single-crested, clavate, margin entire to slightly undulating in section, 0.5-2.1 cm long, restricted to the hypochile or, if interrupted, continuing up to the epichile and slightly longer than the lateral keels; rarely 2 short additional keels present on epichile. *Column* approximately erect or curved, 1.4-2 by 0.4-0.7 cm, margins glabrous, rarely papillose; the lateral lobules short, erose or denticulate, the median transversely rectangular, erose. *Anther* conical or dome shaped, 0.28-0.33 by 0.23-0.3 cm, tip recurved. *Pollinia* 0.15-0.28 by 0.12-0.21 cm; caudicle orbicular or conical. *Stigma* semi-circular, 0.18-0.3 by 0.19-0.21 cm, proximally rounded or notched; rostellum broadly elliptic, 0.14-0.5 by 0.18-0.2 cm. *Fruit*: stalk c. 1 cm long, body ellipsoid to obovoid, c. 4.3 by 1.8 cm, approximately circular in section.

Colour. The subspecies have similar colours. Scales ochraceous-yellow. Flowers white. Colour patches on lip cordate in outline, those on hypochile sometimes connected to those on epichile. Veins on hypochile dark reddish (Plate 2.1A).



Plate 2.1 A. *Coelogyne corymbosa*; B. *C. hysteroantha*; C. *C. nitida*; D. *C. occultata* ssp. *occultata*; E. *C. platylamellata*; F. *C. punctulata*; G. *C. taronensis*. Photographs by Malcolm Perry, Xiao H. Jin, Abishkar Subedi, Malcolm Perry, Xiao H. Jin, Malcolm Perry and Xiao H. Jin, respectively.

Discussion. 1. This species is similar to *Coelogyne nitida*. It can be distinguished from the latter by the oblong-ellipsoid pseudobulbs and few (1-4) large flowers per inflorescence.

2. Three different subspecies can be recognized based on the pseudobulb shape and their placement on the rhizome, leaf texture, ornamentation of the two lateral keels on the hypochile of the lip and margin of the midlobe of the lip. Subsp. *corymbosa* is widely distributed; the other two subspecies are restricted to two different geographical locations.

3. The epithet *corymbosa* refers to the flat topped inflorescence.

Key to the subspecies of *Coelogyne corymbosa*

- 1 a. Lip keels on hypochile with wavy edge, pseudobulbs born in a long creeping chain, leaves membranous.....1a. *C. corymbosa* subsp. *chiangmaiensis*
- 1 b. Lip keels on hypochile with distinctly crenulate edge, pseudobulbs more or less in a compact chain, leaves coriaceous.....2a.
- 2 a. Midlobe of lip with entire margin, flowers 2-4.....1b. *C. corymbosa* subsp. *corymbosa*
- 2 b. Midlobe of lip with crenulate to crispate margin, flowers 1-2....1c. *C. corymbosa* subsp. *hitendrae*

1a. *Coelogyne corymbosa* Lindl. subsp. *chiangmaiensis* Subedi, subsp. nov. TYPE: Thailand. Chiangmai Prov., Summit of Doi Angka, *H.B.S. Garret* 495 (Holotype, !, isotype, P!, K!). Figure 2.13B.

A subspecies typica rhizomate repenti pseudobulbis distantibus cristis distincte longitudinalibus, foliis tenuiter membranaceis, labelli cristis marginibus undulatis differt.

Rhizome long creeping, 0.5-0.6 cm diameter. *Pseudobulbs* 1-1.8 cm apart, ovoid to ellipsoid, 3-6 by 1.5-2.5 cm; with 4 longitudinal ridges. *Leaves*: blade elliptic, 4-19.5 by 1.6-3.2 cm, 2.7-6.5 index, membranous. *Inflorescence* flowers 2-5. *Peduncle* 3.8-9.8 by 0.12-0.2 cm, not elongating after anthesis. *Median sepal* elliptic, 2.6-3.3 by 0.8-1.3 cm, index 2.7-3.1. *Lateral sepals* oblong-elliptic, 2.6-2.9 by 0.7-1.1 cm, index 2.6-3.7. *Petals* obovate to elliptic, 2.5-2.9 by 0.55-0.75 cm, index 3.5-4.9. *Lip* elliptic in outline when flattened, 2.1-2.7 by 1.3-1.5 cm, index 1.3-1.5. *Hypochile* lip attachment 0.21-0.26 cm wide; when flattened 1.3-1.6 cm long; colour patches restricted to the lateral lobes. *Epichile* ovate, 1-1.2 by 0.6-1.1 cm, index 1.2-1.6, tip acute, margins erose to entire. *Keels*: the two outermost with wavy edge, 1.3-1.5 cm long; median keel entire in section, restricted to hypochile or interrupted in between. *Column* 1.4-1.6 by 0.4-0.6 cm, margin glabrous. *Anther* 0.25-0.33 by 0.23-0.3 cm. *Pollinia* 0.2-0.21 by 0.17-0.18 cm. *Stigma* 0.18-0.2 by 0.18-0.21, proximally rounded. *Fruit* not seen.

Distribution, habitat, and phenology. *Coelogyne corymbosa* subsp. *chiangmaiensis* is a rare species distributed in Thailand (Chiang Mai province; Doi Angka, Doi Ithanond, Doi

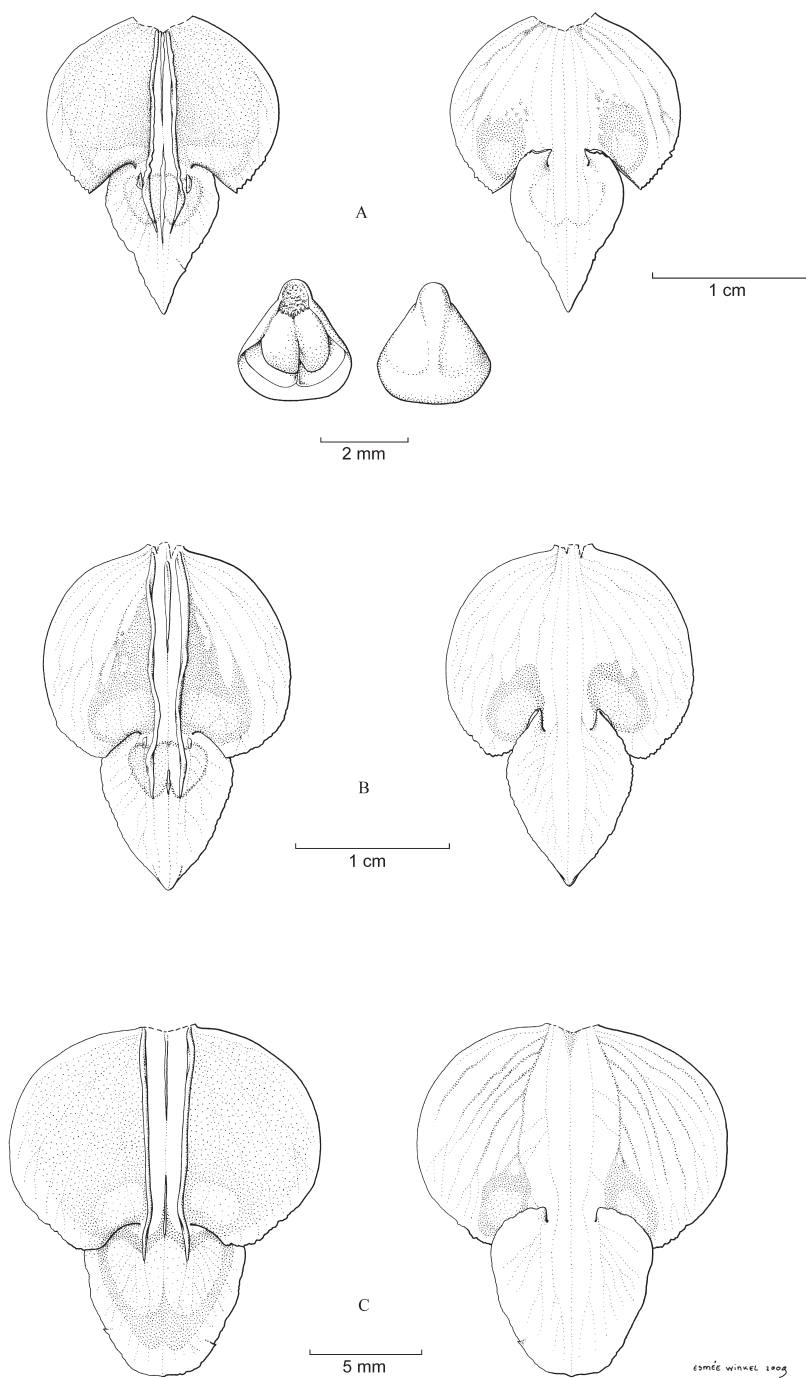


Fig. 2.13. Floral lips of some of the subspecies studied. Lip from above on the left and lip from below on the right. Anther from below on the left and from above on the right. A. *C. punctulata* ssp. *brevipedunculata*. B. *C. corymbosa* ssp. *chiangmaiensis*; C. *C. nitida* ssp. *myanmarensis*. Drawn from Hutchinson 353, India, Assam, Garret 495, Thailand, Chiangmai and Forrest 26625, Myanmar.

Pahompok and Nan Province) and Laos (Figure 2.15). It grows epiphytic on trunks and branches of trees of evergreen forest, between 1800 to 2600 m elevation. Flowering occurs from December to May.

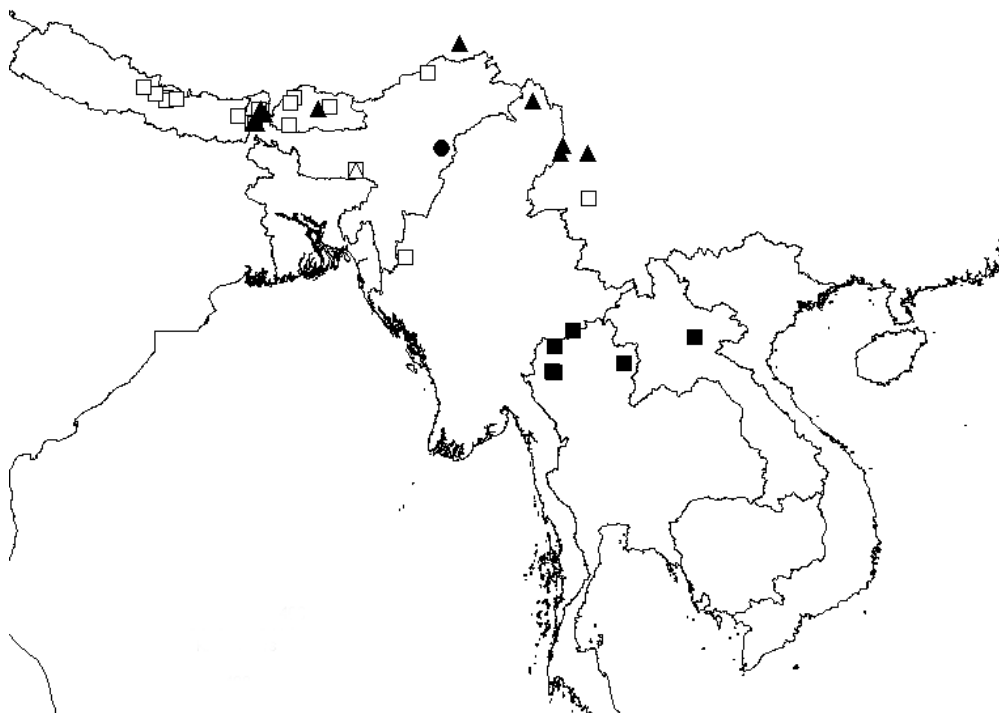


Fig. 2.15. Distribution map of *C. corymbosa* ssp. *chiangmaiensis* (■), *C. corymbosa* ssp. *corymbosa* (□), *C. corymbosa* ssp. *hitendrae* (●), *C. occultata* ssp. *elongata* (△) and *C. occultata* ssp. *occultata* (▲).

Discussion. This subspecies is recognized by its ovoid pseudobulbs and flowering peduncle not elongating after anthesis. The epithet *chiangmaiensis* refers to the locality where the type specimen was collected.

Additional specimens examined. THAILAND. **Northern Chiang Mai Province:** Doi Ithanond, *Smitinand et al.* 10310 (BKF, L); Doi Angka, *Garrett, H.B.G.* 639 (AMES); North Doi Angka, *Coolidge, H.* 103 (AMES); Doi Pahom Pok, *Kerr, A.F.G.* 407 (AMES, K); Doi Pah Hom Pok, *Lojtnant, B. and Niyomdham, C.* 218 (P, K); Doi Ihanond, *Kerr A.F.G.* s.n. (K); Doi Inthanond, *Geesink, R., P. Hiepko and C. Phengklai* 7973 (L, Copen, BKF); Doi Pahom Pok, *Payap, Kerr AFG* 407 (P,L); Doi Inthanond, *Tantisewie, B. and T. Phengklai* 841 (Copen); Doi Inthanond, Northern Chiang Mai, *Smitinand, T. and I. Alsterlund* 6697 (BKF); Doi Inthanond, *Menzies and D. Du Puy* 314 (K); *Koyama, T., C. Phengklai et al.* 15412 (NY); *Coolidge and Carpenter* 103 (AMES). LAOS. Pu Bia, *Kerr, A.F.G.* 0976 (K). Precise locality unknown: *Hosseus C.C.* 356 (P).

1b. *Coelogyne corymbosa* Lindl. subsp. *corymbosa*

Coelogyne corymbosa Lindl., Fol. Orchid. 5, Coelogyne: 7. 1854. Reichb.f., Gard. Chron. 2: 9. 1876. Veitch, Man. Orchid. Plants 6: 33. 1890. King and Pantl., Ann. Roy. Bot. Gard. Calcutta 8: 134. 1898. Pfitzer and Kraenzlin, Coelogyne. In: H.G.A. Engler (ed.), Pflanzennr. IV, 50, IIB7, Heft 32: 58. 1907. Banerji and Thapa, Orchids of Nepal 578. 1969. Hara et al., Enumeration of the Flowering Plants of Nepal 1: 36. 1976. Pradhan, Indian Orchids 2: 273. 1979. Das and Jain, Fasc. Fl. India 5: 9. 1980. Clayton, The genus Coelogyne, a synopsis: 187. 2002. Pearce and Cribb, Flora of Bhutan 3, 3: 330. 2002. Chinqi & Clayton, in Flora of China 25: 325. 2010. *Pleione corymbosa* (Lindl.) Kuntze, Revis. Gen. Pl. 2: 680. 1891. TYPE: India, Sikkim, J.D. Hooker 136 (Holotype, K-Lindl ! except for the two uppermost synanthous plants; isotypes K!). Figure 2.2.

Rhizome short-creeping. *Pseudobulbs* close together, oblong-ellipsoid, 2-4.5 by 1.1-2.4 cm diameter, without longitudinal ridges. *Leaves*: blade obovate to elliptic, 6-19 by 2-4 cm, index 2.3-7.9, coriaceous. *Inflorescence* flowers 2-4. *Peduncle* 6.5-7.5 by 0.1-0.2 cm, further elongating after anthesis. *Median sepal* elliptic to ovate, 2.6-3.5 by 1.1-1.25 cm, index 2.4-2.8. *Lateral sepals* elliptic to ovate, 2.6-3.7 by 0.9-1.2 cm, index 2.9-3.6. *Petals* narrowly elliptic, 2.4-3.2 by 0.55-1.2 cm, index 2.5-4.6. *Lip* broadly elliptic in outline when flattened, 2.4-3.1 by 1.4-2.1 cm, index 1.3-1.7. *Hypochile* lip attachment 0.35-0.4 cm wide, when flattened 1.4-1.7 cm long; colour patches restricted to the lateral lobes. *Epichile* ovate to nearly orbicular, 1.2-1.8 by 0.85-1.35 cm, index 1.1-1.6., tip acute to acuminate, margins slightly erose to entire. *Keels*: the two outermost with crenulate edge, 1.4-2 cm long; median keel rod shaped, entire or slightly undulate in transverse section, interrupted in between or continuing up to the colour patches of the epichile. *Column* 1.7-2 by 0.6-0.7 cm, margins glabrous or rarely papillose. *Anther* 0.28-0.32 by 0.28-0.3 cm. *Pollinia* 0.22-0.28 by 0.16-0.18 cm. *Stigma* 0.22-0.3 by 0.19-0.2 cm, proximally notched. *Fruit* oblongoid, c. 4.3 by 1.8 cm in diameter.

Distribution, habitat and phenology. *Coelogyne corymbosa* Lindl. subsp. *corymbosa* is a common species distributed in Nepal (Central and eastern Nepal), India (Darjeeling, Sikkim), Bhutan and China (SE Tibet) and Myanmar (Figure 2.15). It grows as epiphyte on moss covered tree trunks or as lithophyte on cliff rocks, between 1524 to 2590 m elevation. Flowering occurs from April to May.

Discussion. 1. This subspecies is similar to subsp. *hitendrae* but can be distinguished by its elliptic lip (when flattened) and colour patches on the lateral lobes which never merge with the colour patches of the epichile.

2. The shape of the midlobe of the lip varies from nearly orbicular to ovate with acute tip in the specimens of Nepal, India (Sikkim) to narrowly ovate and acuminate in India (Sikkim), Bhutan and China (Yunnan).

Additional specimens examined. BHUTAN. **West Bhutan:** Below Barshong, Ludlow, F., G. Sherrieff and J.H. Hicks 16357 (BM, AMES); **East Bhutan:** Rudo La, Ludlow, F., G. Sherrieff and J.H. Hicks 20119 (BM); South Bhutan, Gale Chu Valley, Ludlow, F. and G. Sherrieff 2954 (BM); Chukka district, Grierson, A.J.C. and D.G. Long 3078 (E); Tamij, Hara et al. s.n. (K);

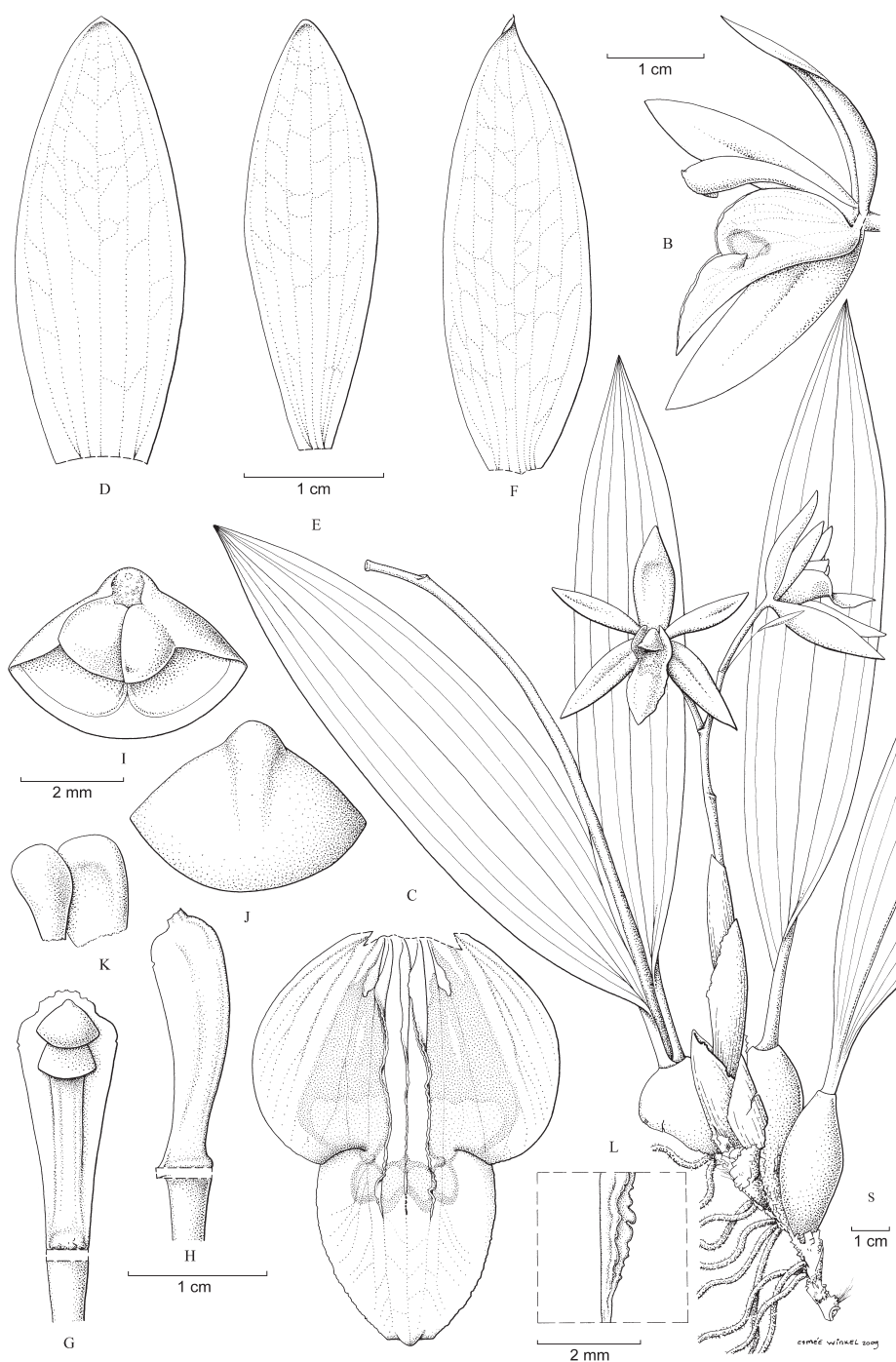


Fig. 2.2. *Coelogyne corymbosa* ssp. *corymbosa*. A. Habit. B. Flower lateral view. C. Lip. D. Dorsal sepal. E. Petal. F. Lateral sepal. G. Gynostemium front view. H. Gynostemium lateral view. I. Anther from below. J. Anther from above. K. Pollinia. L. Detail of keel on lip. Drawn from *Stainton, Syres and Williams 4871*, Nepal, Pokhara.

Griffith 5098 (K). CHINA. **Yunnan**: Mengtong, *Henry, A. 11114* (E, K, NY); **Xizang**: Lhalung, Pachakshri district, *Ludlow, F. G. Sherriff and G. Taylor 3682* (BM); Pamakochung, Rainbow falls, Tsangpo gorge *Ludlow, F. and G. Sherriff 13616* (BM). MYANMAR. *Kingdon Ward, F. 22251* (K); Chin hills, *Daun, L. 22* (K); Chin Hills, Folam, *Daun, L. 22* (K). NEPAL. **East Nepal**: Memeng, *Stainton, J.D. 8275* (K); Kosi watershed; *Proud, D. 247* (BM). **Central Nepal**: *Herklots 314* (K); *Scully, J. s.n.* (E); Sikllis, Northern Pokhara, *Stainton, Sykes and Williams 4922* (BM); North of Pokhara, *Stainton. Sykes and Williams 4871* (P, AMES, E); South of Gossaikund, *Nicolson 3343* (BM, AMES, S); Shivapuri, *Proud, D. 144* (BM); *Anonymous s.n.* (E). INDIA. **Sikkim**: *Hooker, J.D. s.n.* (K); *Pantling, R. 77* (AMES, BM, L, P); *Huttleston 2112* (AMES); **Darjeeling**: *Clarke, C.B. 35630* (BM); *Hort. Kew 21041* (K); *Griffith 5099* (NY, K); **Assam**: *Kingdon Ward, F. 17386* (NY); **Meghalaya**: *Clarke, C.B. 38229A* (BM); *Griffith 15* (K); *Hooker and Thomson, T. s.n.* (BM, E, L, P, S).

1c. *Coelogyne corymbosa* Lindl. subsp. *hitendrae* (Das and Jain) Subedi, comb. nov. Basionym: *Coelogyne hitendrae* Das and Jain, *Orchid Rev.* 86: 195. 1978. Das and Jain, *Fasc. Fl. India* 5: 15. 1980. Clayton, *The genus Coelogyne, a synopsis*: 188. 2002. TYPE: India. Nagaland, *Kataki 60202A* (Holotype CAL!).

Rhizome short creeping. *Pseudobulbs* close together, oblong-ellipsoid, 2.5-3.5 by 1.2-1.6 cm diameter, without longitudinal ridges. *Leaves* blade elliptic, 8-10 by 1.5-2.5 cm, index 4-5.3, coriaceous. Inflorescence flowers 1-2. *Peduncle* 5-6.5 by 0.1-0.15 cm., further elongated after anthesis. *Median sepal* elliptic, 3-3.2 by 1.5 cm, index 2-2.1. *Lateral sepals* ovate, 3-3.1 by 2-2.1 cm, index 1.5-2.4. *Petals* elliptic, 3-3.1 by 0.9-1.1 cm, index 2.8-3.3. *Lip* broadly ovate in outline when flattened, 3-3.3 by 2-2.1 cm, index 2.8-3.3. *Hypochile* lip attachment 0.4-0.45 cm wide, when flattened 1.5 cm long; colour patches continuous to epichile. *Epichile* broadly ovate, 1.3 by 1-1.3 cm, index 1-1.2, tip acute, margins distinctly crenulate to crisped. *Keels* the two outermost with crenulate edge, 1.8-1.9 by 0.12-0.18 cm; median keel continuous from base to epichile, longer than others. *Column* 2-2.1 by 0.5-0.6 cm, margin smooth. *Anther* 0.29-0.31 by 0.28-0.3 cm. *Pollinia* 0.15-0.18 by 0.12-0.14. *Stigma* 0.2-0.21 by 0.15-0.17 cm, proximally rounded. *Fruit* not seen.

Distribution, habitat, and phenology. *Coelogyne corymbosa* Lindl. subsp. *hitendrae* is an endemic epiphytic orchid species of India (Pulebadje, Nagaland) (Figure 2.15). Flowering occurs during March.

Discussion. 1. This subspecies is similar to subsp. *corymbosa*. It can be distinguished from the latter by the colour patches on the lateral lobes continuing to the epichile and the median keel extending beyond the lateral keels. The number of flowers is comparatively low (1-2). We therefore considered this as a separate subspecies of *C. corymbosa* not warranting the status of a separate species.

2. The epithet *hitendrae* refers to Prof. Hitendra Kumar, an eminent Indian botanist.

2. *Coelogyne gongshanensis* H.Li ex S.C. Chen, *Fl. Republ. Popularis Sin.* 18: 412. 1999. H. Li, *Fl. Dulongjian Reg.*: 341. 1993, nomen nudum. Clayton, *The genus Coelogyne, a synopsis*: 188. 2002. Chinqi & Clayton, in *Flora of China* 25: 325. 2010. TYPE: China. Yunnan, Gong Shan County, Dulong River, *Nan Shui Bei Diao Exp. Team 8516* (Holotype, KUN!). Figure 2.3.

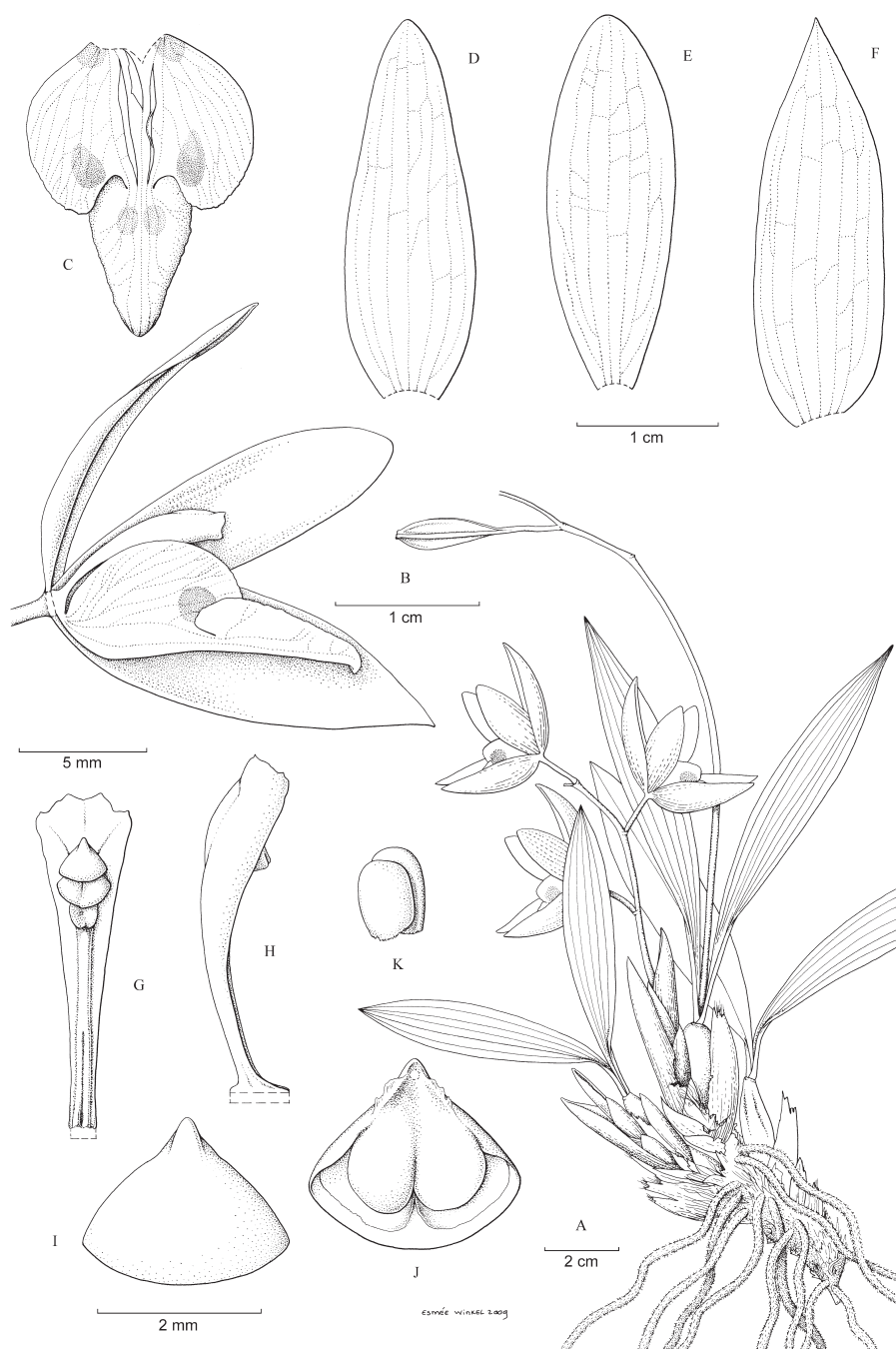


Fig. 2.3. *Coelogyne gongshanensis*. A. Habit. B. Flower lateral view. C. Lip. D. Dorsal sepal. E. Petal. F. Lateral sepal. G. Gynostemium front view. H. Gynostemium lateral view. I. Anther from above. J. Anther from below. K. Pollinia. Drawn from *Forrest 18039*, China, Yunnan.

Roots 0.5-0.15 mm diameter. *Rhizome* short-creeping, 0.5-0.8 cm diameter, with 6-7 imbricate scales on the young shoot. *Pseudobulbs* close together, ellipsoid, slightly bulging at the middle, 1.5-3.5 by 1.2-2.3 cm, sparsely ridged and wrinkled when dry. *Leaves* petiole 0.3-1.3 cm long; blade elliptic, 5.5-10 by 1.3-2.2 cm, index 3.3-6.7, tip acute, main veins 5-6, coriaceous. *Inflorescence* proteranthous, flowers 2-4. *Peduncle* covered with rhizome scales during anthesis, laterally flattened, 4.2-7.5 by 0.07-0.2 cm, further elongating after anthesis. *Rhachis* sub-erect, 1.5-4.5 cm long; internodes 1.2-2.1 cm long, lowermost node angular. *Floral bracts* not seen. *Pedicel* 1.1-1.8 cm long, straight to slightly curved. *Ovary* 0.5-0.7 cm long. *Median sepal* elliptic to ovate, 2.4-3.1 by 0.9-1.2 cm, index 2.3-3.1, tip subacute, main veins 5-6, conspicuously reticulated. *Lateral sepals* oblong-elliptic, 2.2-3.1 by 0.7-1.1 cm, index 2.5-3.9, otherwise as median sepal. *Petals* elliptic to obovate, 2.1-2.8 by 0.7-1.2 cm, index 1.8-3.9, main veins 5, otherwise as sepals. *Lip* broadly ovate in outline when flattened, 1.7-2.5 by 1.1-1.75 cm, index 1.1-1.3. *Hypochile* slightly saccate (0.2 cm deep), lip attachment 0.2 cm wide, when flattened 1.1-1.3 cm long; top of lateral lobes extending 0.1-0.26 cm beyond the sinus, margin erose to denticulate, sinus rounded. *Epichile* ovate, 1.1-1.3 by 0.4-0.8 cm, index 1.6-2, tip acute, margin erose; the two outermost veins sparsely branched and reticulated. *Keels* starting 0.3-0.33 cm away from the base of the hypochile, the laterals single-crested, margin entire in transverse section, 1.1-1.2 cm long, proximally 0.05-0.12 cm high and slightly lower at epichile: median keel single-crested, margin entire in transverse section, 0.4-0.6 cm long, restricted to the hypochile; additional keels on epichile absent. *Column* 1.2-1.5 by 0.4-0.53 cm, margin glabrous; the lateral lobules obscure with small, erect teeth or denticulate, the median lobule transversely rectangular, erose. *Anther* bell-shaped, fully concealed by the wings of the column, 0.18-0.22 by 0.19-0.22 cm, apex obtuse. Pollinia broadly ellipsoid, 0.13-0.18 by 0.09-0.12 cm; caudicle not seen. *Stigma* semi-circular, 0.09-0.1 by 0.1-0.12 cm, proximally rounded; rostellum broadly elliptic, 0.12-0.13 by 0.21-0.24 cm. *Fruit* obovoid, c. 2.5 by 0.9 cm, approximately circular in cross section.

Colour. Two forms are found with differently coloured flowers. A yellow form is reported from the east Tali range of western Yunnan and the north of the Maikha-Salwin divide of northeast upper Myanmar, while a white form is reported from the north of the Maikha-Salwin divide of Yunnan and the Seinghku wang of Upper Myanmar. In both forms, the lip has two circular, chocolate-coloured patches at the base of the hypochile. On the lateral lobes these patches are very obscure, on the midlobe of the lip they are roundish and their margins are not joined. The veins of the lip are colourless.

Distribution, habitat, and phenology. *Coelogyne gongshanensis* is distributed in China (Yunnan) and Myanmar (Figure 2.16). It grows as epiphyte on tree trunks of *Abies-Rhododendron* forest or lithophyte on rock cliffs, between 2438 to 3168 m elevation. Flowering occurs from June to August.

Discussion. 1. This species is similar to *C. platylamellata*. It differs in having broad elliptic to obovate petals, and two coloured patches at the base of the hypochile. The fruit is obovoid and almost circular in cross section. The specimen FKW 6838 (K) has the smallest lip (c. 1.7 x 1.1 cm). The keels on the lip of this specimen are very low and thickened. The lateral lobes of the lip are acute, and a short claw is present between the hypochile and epichile indicating a separate infraspecific taxonomic delimitation. But more material

needs to be studied before a definite decision can be made.

2. The epithet *gongshanesis* refers to Gong Shan County in China, the type locality.

Additional specimens examined. CHINA. **Yunnan:** North Maikha-Salwin divide, *Forrest, G.* 18039 (E); Shwelin-Salwin divide, *Forrest, G.* 12038 (E, BM); *Delavay, M.* 4740 (P); Tali, *Delavay, M.* 3343 (P); *Delavay, M.* 3348 (P); *Ducloux, M. Fr.* 5640 (P); Gong Shang County, *Dulongjiang Exp. Team* 5355 (KUN); Gong Shang County, *Dulongjiang Exp. Team* 6940 (KUN); Eastern flank of Tali, *Forrest, G.* 7135 (E,K); East of Tali range, *Forrest, G.* 4880 (AMES, BM, E); N. Maikha-Salwin divide, *Forrest, G.* 18039 (E); Lali, Laio, Tseing mountain, *McLarens collectors* 10A (BM,K,P), 10B (P,E); RA 889 (E); RA 1561 (E); Yangbi Xian, W side of Diancang Shan mountain range, *Sin. Amer. Bot. Exp.* 252 (AMES, E); *Delavay, M. s.n.* (NY). MYANMAR. Advance base, Seingku Wang, *Kingdon Ward, F.* 6838 (K); Western flank of North Maikha-Salwin divide, *Forrest, G.* 26558 (E,S, NY).

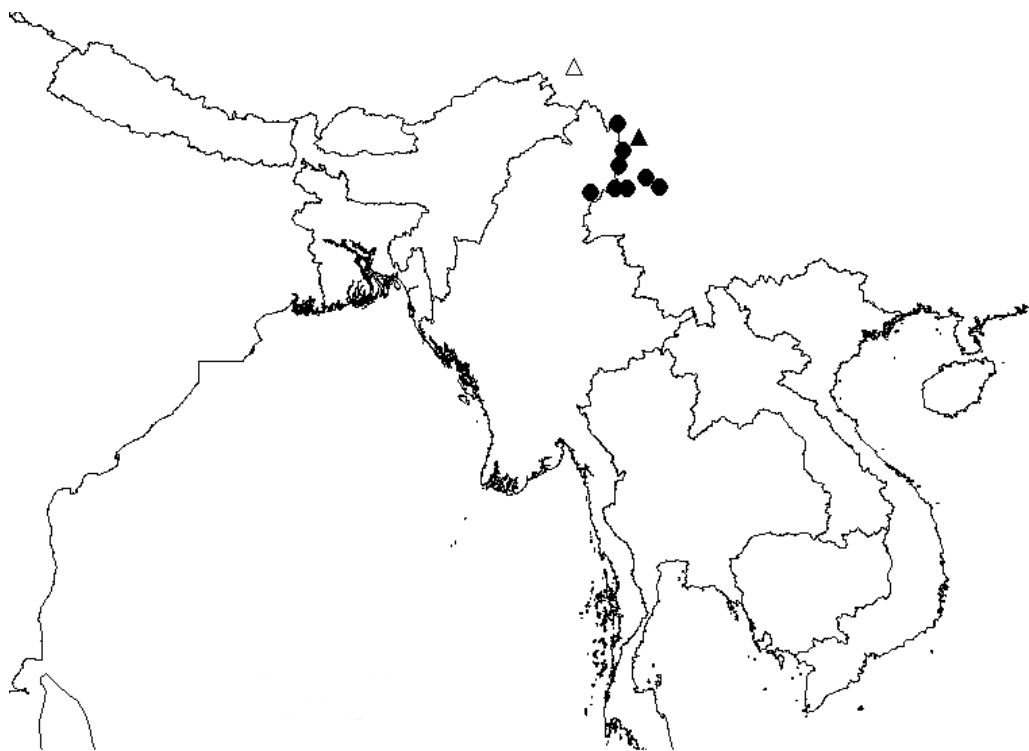


Fig. 2.16. Distribution map of *C. gongshanensis* (●), *C. taronensis* (▲) and *C. tuiyii* (△).

3. **Coelogyne hysternantha** (Tang and Wang) Subedi, stat. nov. Basionym: *Coelogyne punctulata* ('punctata') Lindl. var. *hysternantha* Tang and Wang, *Acta Phytotax. Sin.* 1: 39. 1951. Clayton, *The genus Coelogyne, a synopsis*: 191. 2002, sub *C. punctulata*. TYPE: China. Yunnan, *Forrest* 26146 (Holotype, K!; isotype, E!). Figure 2.4.

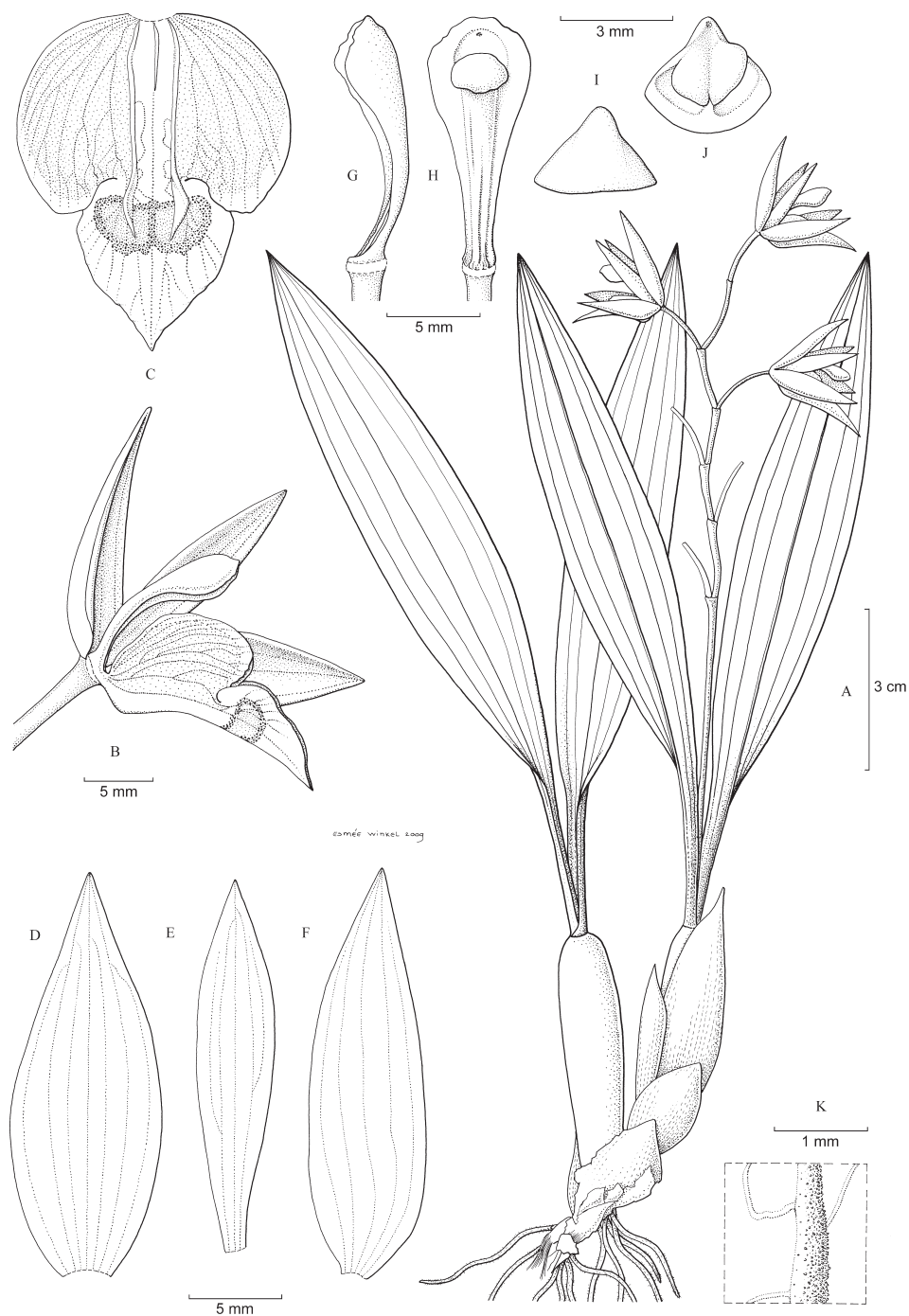


Fig. 2.4. *Coelogyne hysternantha*. A. Habit. B. Flower lateral view. C. Lip. D. Dorsal sepal. E. Petal. F. Lateral sepal. G. Gynostemium lateral view. H. Gynostemium front view. I. Anther from above. J. Anther from below. K. Detail of keel on lip. Drawn from Forrest 26146, China, Yunnan.

Roots 0.8-1 mm diam. *Rhizome* short-creeping, 0.5-0.7 cm diam. *Pseudobulbs* close together, ellipsoid to cylindrical, 1.5-4.5 by 1-1.8 cm, glossy. *Leaves* petiole 0.9-6 cm long; blade elliptic to lanceolate, 6.5-20 by 1.3-2.2 cm, index 4.3-10.5, tip acute, main veins 5, membranous. *Inflorescence* hysteroanthous, flowers 3-7. *Peduncle* without rhizome scales during anthesis, terete, 3-13.5 by 0.07-0.1 cm, not elongating after anthesis. *Rhachis* suberect, 2.5-8.5 cm; internodes 1.1-2.1 cm long, slightly curved. *Floral bracts* 2-3.5 by 0.6-0.8 cm. *Pedicel* 0.8-1.3 cm long, slightly curved. *Ovary* 0.5-0.6 cm long. *Median sepal* elliptic, 1.8-2.1 by 0.6-0.7 cm, index 3, tip acute, main veins 5-9, sparsely reticulated. *Lateral sepals* oblong-elliptic, 2-2.05 by 0.55-0.6 cm, index 3.3-3.6, conspicuously reticulated, otherwise as median sepal. *Petals* elliptic to obovate, base slightly clawed, 1.8-1.9 by 0.22-0.4 cm, index 4.8-7.2, tip obtuse to acute, main veins 3-5, hardly reticulated. *Lip* broadly ovate in outline when flattened, 1.63-1.78 by 1.1-1.5 cm, index 1.1-1.5. *Hypochile* slightly saccate (0.2 cm deep), lip attachment 0.16-0.2 cm wide; when flattened 1-1.1 cm long; top of lateral lobes extending 0.1-0.15 cm beyond the sinus, margin erose, sinus rounded. *Epichile* ovate, 0.7-1 by 0.6-0.8 cm, index 1.1-1.3, tip acute, margin entire or erose, the two outermost veins sparsely reticulated. *Keels* the laterals single-crested, rod-shaped, margin entire to minutely wavy in transverse section, 1-1.1 cm long, proximally 0.04-0.06 cm high and thickened, lower at the level of the colour patches on the lateral lobes, slightly curved inwards on the epichile; median keel single-crested, rod-shaped, margin entire in transverse section, 0.28-0.53 cm long, restricted to hypochile; additional keels on epichile absent. *Column* curved, 1.25-1.3 by 0.3-0.35 cm, basal half of column papillose, most distinctly so along the margin and at the base; the lateral lobules short, distally denticulate, the median lobule transversely rectangular with erose margin. *Anther* conical, 0.25-0.23 cm, apex slightly protruding; lateral surface papillose. *Pollinia* semi-ellipsoid, 0.17-0.19 by 0.1-0.11 cm; caudicle not seen. *Stigma* semi-circular, 0.1 by 0.13 cm, proximally rounded; rostellum broadly elliptic, 0.12 by 0.1 cm. *Fruit* not seen.

Colours. Sepals and petals creamy white. Lip deep velvety brown. Colour patches creamy yellow bordered with deep dark red lines, rectangular in shape on the lateral lobes and cordate on the epichile (Plate 2.1B).

Distribution, habitat and phenology. *Coelogyne hysteroantha* is a rare species in China (Yunnan: Shweli-Salwin divide; Kiukiang Valley, Taron; Muchietu; Mekong) and Myanmar (North Triangle, Laja) (Figure 2.17). It grows as epiphyte on tree trunks or lithophyte on cliff rocks between 1219 to 2743 m elevation. Flowering occurs during June and November.

Discussion. 1. *C. hysteroantha* is similar to *C. punctulata* in bearing hysteroanthous inflorescences. It differs in having ellipsoid to cylindrical pseudobulbs, shorter floral parts (sepals, petals and lip are less than 2.3 cm in length) and a lip with entire lateral keels in cross section. This species is further characterized by its long petioles, rhachis with curved internodes and a column with a distinctly papillose lower half warranting a status as separate species.

2. The epithet *hysteroantha* refers to the hysteroanthous inflorescence.

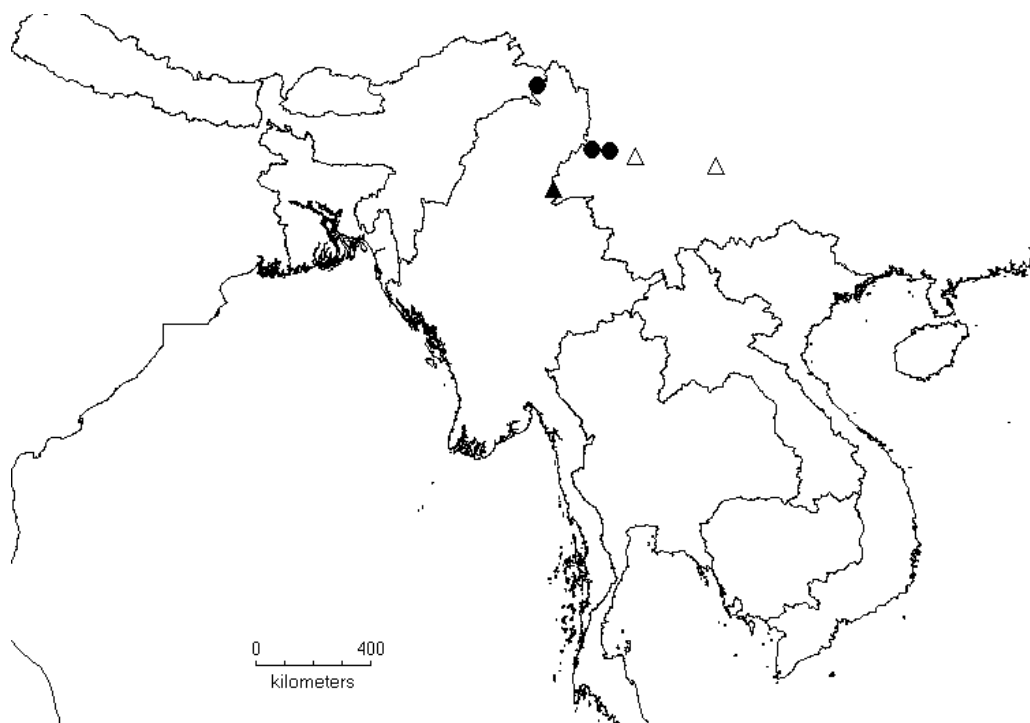


Fig. 2.17. Distribution of *C. hysternantha* (●), *C. platylamellata* (△) and *C. wardii* (▲).

Additional specimens examined. CHINA. **Yunnan:** Kiukiang valley, Muchietu, Yu, T.T. 2109 (PE); Shweli-Saleuci divide, Forrest, G. 26146 (E); Mekong Rei Le, Orleans, Prince, H.D. 407 (P). MYANMAR. North triangle, Laja, North Myanmar, Kingdon Ward, F. 21637 (BM); Taron Gorge, Kingdon Ward, F. 5450 (E).

4. *Coelogyne nitida* (Wall. ex D. Don) Lindl.

Roots 0.08-0.15 cm diameter. *Rhizome* short-creeping, 0.35-0.8 cm diameter, with 6-10 imbricate scales on the young shoot. *Pseudobulbs* close together or shortly distant, cylindrical to ellipsoid, 2-6.5 by 1.3-2.5 cm, tip obtuse, lightly ridged, glossy. *Leaves* petiole, 1-6.2 cm long; blade elliptic or rarely obovate, 4-30 by 1.2-3.7 cm, index 2.6-10.7, tip acute, main veins 5, more or less membranous. *Inflorescence* proteranthous or rarely synanthous, flowers 4-8. *Peduncle* partially covered with rhizome scales, terete or slightly laterally compressed, 3.5-10 by 0.1-0.15 cm, elongating after anthesis (up to 23 cm long). *Rhachis* erect to sub-erect, 2.5-9 cm long, internodes 1-1.6 cm long, upper nodes zig-zagging. *Floral bracts* revolute, 1.4-3.4 by 0.8-1.5 cm, tip acute, many veined. *Pedicel* 0.9-1.4 cm long, slightly curved. *Ovary* 0.4-0.6 cm long. *Median sepal* elliptic, 1.7-2.6 by 0.6-1 cm, index 2.4-3.6, tip acute, main veins 5-9, conspicuously reticulated. *Lateral sepals* elliptic-oblong, 1.8-2.8 by 0.55-1 cm, index 3.1-5, main veins 5-6, otherwise as median sepal. *Petals* obovate to elliptic, distinctly clawed at base, 1.6-2.4 by 0.3-0.75 cm, index 2.9-7.2, main veins 3, margin rarely undulate, otherwise as sepals. *Lip* broadly ovate or elliptic in outline when flattened, 1.6-2.3 by 1.1-1.6 cm, index 1.4. *Hypochile*

slightly saccate (0.1 cm deep), lip attachment 0.22-0.25 cm wide, when flattened 0.9-1.2 cm long; top of lateral lobes extending 0.1-0.2 cm beyond the sinus, margins denticulate to erose, sinus rounded. *Epichile* orbicular or broadly ovate, 0.7-1.1 by 0.6-1.1, index 1.1-1.4, tip acute, margin erose or denticulate; the two outermost veins sparsely branched and reticulated. *Keels* the laterals single crested, rod-shaped, margin entire in section, glabrous or very rarely papillose, 1-1.6 cm long, proximally 0.02-0.07 cm high and thickened, slightly lower around the colour patches on the lateral lobes, sickle-shaped and erected on epichile; median keel single crested, rod-shaped, margin entire in section, 0.1-0.47 cm long; additional keels occasionally present on epichile. *Column* curved, 1.1-1.6 by 0.3-0.6 cm, glabrous or minutely papillose along the margin and base; the lateral lobules short, denticulate. *Anther* bell-shaped, 0.25-0.33 by 0.25-0.4 cm, tip obtuse or acute. *Pollinia* oblongoid, 0.09-0.18 by 0.07-0.1 cm; caudicle not seen. *Stigma* semi-circular, 0.16-0.33 by 0.15-0.28 cm, proximally rounded; rostellum broadly elliptic, 0.16-0.33 by 0.18-0.23 cm. *Fruit* ellipsoid to cylindrical, 2.5-4.5 by 0.8-1.4 cm, stalk 1 cm long, approximately circular in cross section.

Colour. Pseudobulbs pale green or light yellowish. Flowers white and highly fragrant. Pedicel cream white, ovary grass green. Colour patches on lip yellow with reddish orange borders. Column streaked with red, anther grass green, pollinia yellow.

Distribution, habitat and phenology. This species is commonly found in Nepal (central and eastern Nepal), India (Darjeeling, Sikkim, Kalimpong, Arunachal Pradesh), Bhutan, Bangladesh (Sylhet), Myanmar (upper northeastern parts) and China (Yunnan). It grows as an epiphyte.

Discussion. 1. This species is similar to *C. corymbosa*. It is recognized by its cylindrical-ellipsoid pseudbulbs, membraneous leaves and lip keels with entire margin.

2. The epithet *nitida* refers to the brightly white coloured flowers.

3. Two different subspecies can be recognised based on the length of the lip relative to the sepals and petals, the number of colour patches on the midlobe of the lip and the shape of the keels on the lip.

Key to the subspecies of *Coelogyne nitida*

- 1a. Lip equally long as sepals and petals; midlobe of lip with one colour patch.....4a. *C. nitida* subsp. *myanmarensis*
- 1b. Lip shorter than the sepals and petals; midlobe of lip with two colour patches.....4b. *C. nitida* subsp. *nitida*

4a. *Coelogyne nitida* (Wall. ex D. Don) Lindl. subsp. ***myanmarensis*** Subedi, subsp. nov.
 TYPE: Myanmar. Myitkyina, *C.W.D. Kermode 17018* (Holotype, AMES). Figure 2.13C.
 A subspecies typica labelli longitudine sepalis petalisque aequilonga, lobo medio macula

maxima unicolori parte maiore tegenti, cristis linearibus angustis differt.

Pseudobulbs close together, 2-5.5 by 1-2.5 cm diameter. *Leaves* blade 4-14.5 by 1.6-3.7 cm, index 2.6-10. *Peduncle* 3.5-8 by 0.1-0.15 cm, elongating after anthesis (up to 20.5 cm). *Rhachis* 2.5-8 cm long. *Median sepal* elliptic, 1.7-2.2 by 0.6-0.75 cm, index 2.8-3.2. *Lateral sepals* elliptic-oblong, 1.9-2.5 by 0.5-0.7 cm, index 3.1-5. *Petals* elliptic to obovate, 1.6-2.3 by 0.3-0.6 cm, index 4.3-7.2. *Lip* 1.6-2.3 by 0.3-0.6 cm, index 4.3-7.2. *Hypochile* lip attachment 0.18-0.22 cm wide; top of lateral lobes extending 0.04-0.16 cm beyond the sinus. *Epichile* ovate, 0.7-1 by 0.6-1, index 1-1.4. *Keels* the laterals single-crested, rod-shaped, margin entire in transvers section, 1-1.5 cm long, proximally 0.02-0.04 cm high; median keel single-crested, elongated to end of the hypochile or longer than the lateral keels; additional keels absent. *Column* 1.1-1.5 by 0.3-0.5 cm. *Anther* 0.25-0.33 by 0.26-0.31 cm. *Pollinia* 0.13-0.18 by 0.07-0.08 cm. *Stigma* 0.16-0.23 by 0.15-0.22 cm. *Fruit* 2.5-3 by 0.8-1 cm, stalk 0.8-1 cm.

Colours. A single colour patch on the lip, very large, covering most part of the midlobe, dark red.

Habitat and ecology. Epiphytes on tree trunks or lithophytes on rocks. Elevation: 1700-2743 m. Flowering: March to June.

Distribution. Myanmar (northeast upper parts), China (Yunnan) (Figure 2.18).

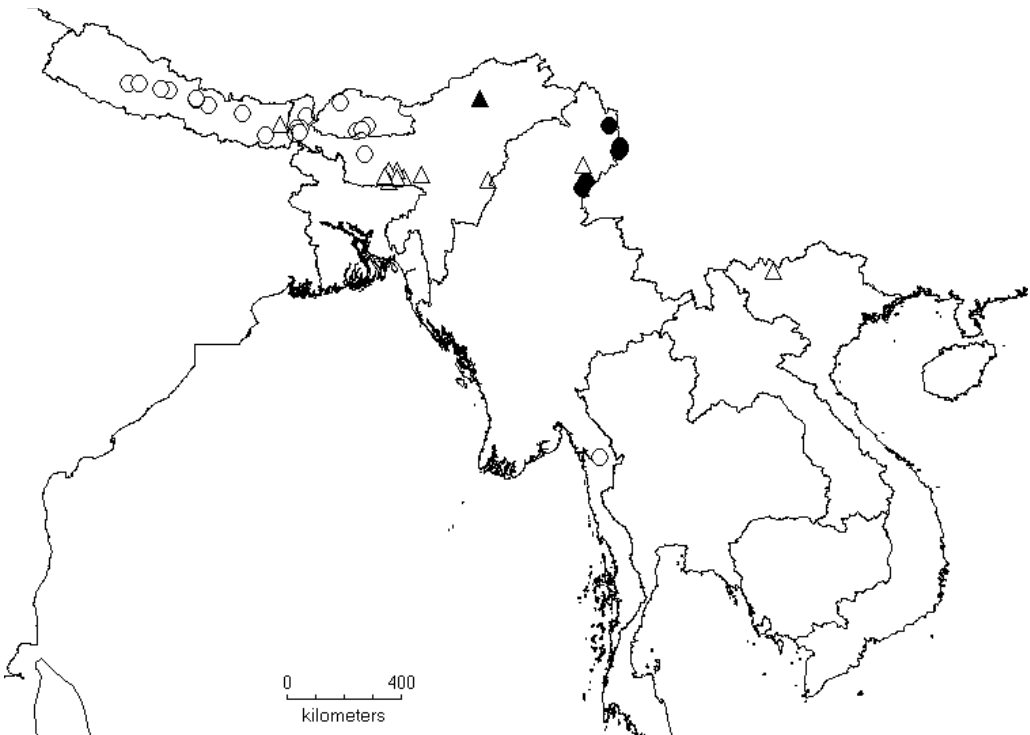


Fig. 2.18. Distribution of *C. nitida* ssp. *myanmarensis* (●), *C. nitida* ssp. *nitida* (○), *C. punctulata* ssp. *brevipedunculata* (▲) and *C. punctulata* ssp. *punctulata* (△).

Discussion. 1. Next to the characters given in the key, this subspecies is recognizable by its lateral keels which are elongated to almost the tip of the midlobe of the lip.

2. The epithet *myanmarensis* refers to the type locality.

Additional specimens examined. CHINA. **Yunnan:** North Maikha-Salwesi divide *Forrest, G.* 17949 (E,K), Shweli-Salwein divide, *Forrest, G.* 2425 (E), Tseikou, *Orleans, H.D.* 409 (P). Precise locality unknown: *Farra* 852 (E). MYANMAR. *Kingdon Ward, F.* 20604 (BM); *Bogg, C.J.* 26 (K); *Anonymous* 4997 (K); *Anonymous* 852 (E); *Dickanson, F.G.* 3249 (AMES); Ah Shai-Hnyin, Ah-Naught Hmyin, Lawk Sawk state, *Dickanson, F.G.* 8764 (AMES); Western flank of the north Maikha-Salwesi divide, NE Myanmar, *Forrest, G.* 26567 (BM, E, P); Hills of NW Lenggeeh, *Forrest, G.* 26625 (E,P); Hpore pass, Myitkyina, *Kermode, C.W.D.* 17177 (AMES); above Langyaw, Myitkyina, *Kermode, C.W.D.* 16683 (AMES); Kambatii, Myitkyina, *Maliase, R.* 87 (S).

4b. *Coelogyne nitida* (Wall. ex D. Don) Lindl. subsp. ***nitida***, Gen. Sp. Orch. Pl.: 40. 1830, quoad syn. Wallich. - *Cymbidium nitidum* Wall. (Lindley, Coll. Bot.: t. 33. 1821) ex D. Don, Prodr. Fl. Nepal 3: 35. 1825 (Lindley ex Wallich, Annot. List: # 1954. 1828, nom. nud.). Clayton, The genus *Coelogyne*, a synopsis: 189. 2002. Chinqi & Clayton, in *Flora of China* 25: 324. 2010. - *Pleione nitida* [Roxb.] (Hook.f.) Kuntze, Revis. Gen. Pl.: 680. 1891. LECTOTYPE (designated here): Nepal. *Wallich Cat.* 1954 ("Cymbidium Roxb.") [Holotype, K-LINDL!; isotype, BM!, C!, CAL!, K!, K-W! (IDC microfiche 7394, flowering specimen in upper right corner of sheet), L!, P!, WU!]. Figure 2.5.

Coelogyne conferta Rolfe, Gard. Chron. n.s. 3: 314. 1875. TYPE: Myanmar, Moulmein, Parish 150 (Holotype, K-LINDL!).

Coelogyne goweri H.G. Reichenbach, Gard. Chron. 1869: 443. 1869. Pfitzer and Kraenzlin, *Coelogyne*. In: H.G.A. Engler (ed.), *Pflanzenr.* IV, 50, IIB7, Heft 32: 60. 1907. *Pleione goweri* (Rchb.f.) Kuntze, Revis. Gen. Pl. 2: 680. 1891. TYPE: India. Assam, *Gower s.n.* (Holotype, W!).

Coelogyne nitida Lindl. (Gen. Sp. Orch. Pl.: 40. 1830, quoad syn. Roxburgh) ex Hook.f., Fl. Brit. India 5: 837. 1890, non Lindl. (1830) and nom. superfl. *Cymbidium nitidum* Roxb. (Hort. Beng.: 63. 1814, nom. nud.) Fl. India (Ed. Carey) 3: 459. 1832, non D. Don (1825). TYPE: Bangladesh. Sylhet, *cult. in Hortus Calcutta ex R.M. Smith, A°* 1812, (Holotype, BM!). See also *Icon. Ined.* 2337 (CAL!, K!), referred to by J.D. Hooker (1890).

Coelogyne nitida f. *candida* Roeth, Orchidee (Hamburg) 53: 437. 2002. TYPE: provenance ex cult. N. Popow, J. Röth March 31st 2001, (Holotype, HAL 090935).

Coelogyne ochracea Lindley, Bot. Reg. 11: t. 69. 1846. Lindley, Fol. Orchid. 5, *Coelogyne*: 5. 1852. H.G. Reichenbach, Walp. Ann. Bot. Syst. 226. 1861. J.D. Hooker, Fl. Brit. Ind. 5: 831. 1890. Veitch, Man. Orchid. Pl. 6: 46. 1890. Pfitzer and Kraenzlin, *Coelogyne*. In: H.G.A. Engler (ed.), *Pflanzenr.* IV, 50, IIB7, Heft 32: 56. 1907. Banerji and Thapa, *Orchids of Nepal*: 132. 1969. Hara et al., *Enumeration of the Flowering Plants of Nepal* 1: 36. 1978. TYPE: India. Darjeeling, *Griffith* 24 (Holotype, K-LINDL!).

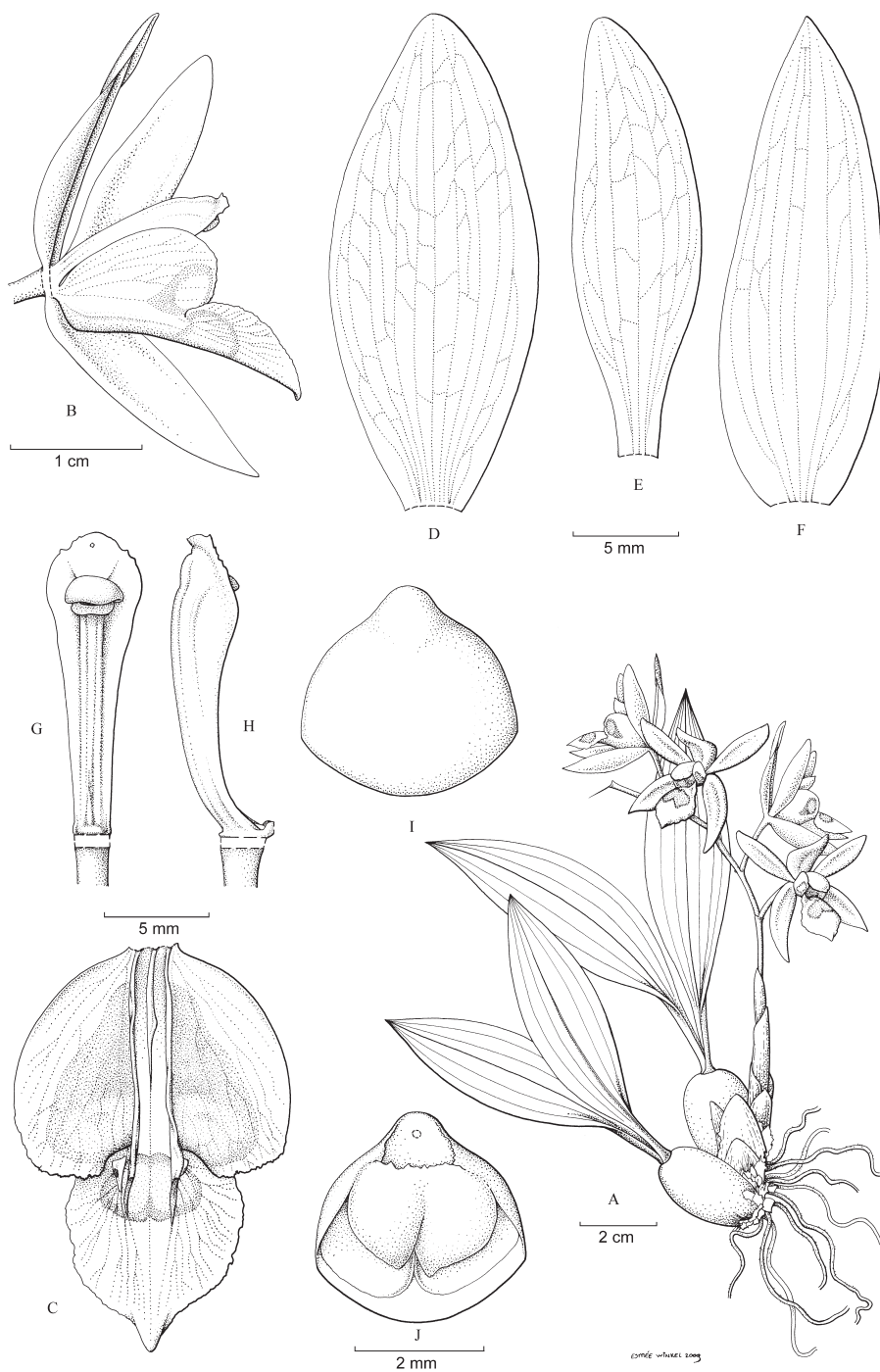


Fig. 2.5. *Coelogyne nitida* ssp. *nitida*. A. Habit. B. Flower lateral view. C. Lip. D. Dorsal sepal. E. Petal. F. Lateral sepal. G. Gynostemium lateral view. H. Gynostemium front view. I. Anther from above. J. Anther from below. Drawn from *Stainton, Syres and Williams 503*, Nepal.

Pleione goweri (Reichb.f.) Kuntze, Revis. Gen. Pl. 2: 680. 1891.

Pseudobulbs close together, 2-6.5 by 1.3-2 cm diameter. *Leaves* blade 5.5-30 by 1.2-3.7 cm, index 6-10.7. *Peduncle* 4-10 by 0.1-0.15 cm, elongating after anthesis (up to 23 cm long). *Rhachis* 3-9 cm long. *Median sepal* elliptic, 1.8-2.6 by 0.75-1 cm, index 2.4-3.6. *Lateral sepals* elliptic, 1.8-2.8 by 0.55-1 cm, index 3.1-4.2. *Petals* elliptic to obovate, 2-2.4 by 0.4-0.75 cm, index 2.9-5. *Lip* 1.6-2.1 by 1.1-1.6 cm, index 1.2-1.8. *Hypochile* lip attachment 0.22-0.25 cm wide, when flattened 0.9-1.2 cm long; top of lateral lobes extending 0.1-0.2 cm beyond the sinus. *Epichile* orbicular, 0.8-1.1 by 0.7-1.1, index 1.1-1.3. *Keels* the laterals single-crested, rod-like, margin in transverse section entire, 1.1-1.6 cm long, proximally 0.03-0.07 cm high; median keel single-crested, restricted to the hypochile; additional keels occasionally present on epichile. *Column* 1.1-1.6 by 0.46-0.6 cm. *Anther* 0.28-0.32 by 0.25-0.4 cm. *Pollinia* 0.09-0.1 by 0.08-0.1 cm. *Stigma* 0.30-0.33 by 0.26-0.28 cm. *Fruit* 3.6-4.5 by 1.2-1.4 cm, stalk 0.8-1.2 cm long.

Colour. This subspecies is found in four different colour forms: lip with colour patches yellowish with light reddish margin (the common wild form), lip with colour patches dominated by orange (a rare horticultural form), a lemon variety and an albino form without any colours. In the coloured forms, the veins are extensively dark-reddish coloured on the hypochile (Plate 2.1C).

Distribution, habitat and phenology. This species is in Nepal (central and eastern Nepal), India (Darjeeling, Sikkim, Kalimpong, Arunachal Pradesh), Bhutan and Bangladesh (Sylhet) (Figure 2.18). It grows as epiphyte on tree trunks or lithophyte on rocks, between 1200 to 2500 m elevation. Flowering occurs from March to July.

Discussion. 1. Don (1825) described *Cymbidium nitidum* based on two elements that have been interpreted by later authors as pertaining to one or two different taxa. This has made its application rather confusing. Note that Don was “librarian” to Lambert (1761-1842) which function included the maintenance of his collections as well. These contained both Roxburgh (some received as early as 1798) and Wallich material from Nepal (received 1818-1819).

First, Don mentioned “Wallich in litt.”. This seems to refer to what later became Wallich 1954, which belongs to what presently has been accepted as *Coelogyne nitida* (Wall. ex D. Don.) Lindl. (Hunt and Summerhayes, 1966; Seidenfaden, 1975; Das and Jain, 1980; Clayton, 2002; Pearce and Cribb, 2002). Lambert’s herbarium was auctioned off after his death and parts are in the Lindley Orchid herbarium (K-LINDL). The Wallich 1954 sheet (K-LINDL) was studied by Clayton (2002) and Pearce and Cribb (2002). These authors did not officially appoint this duplicate as the lectotype. Because Art. 7.11 (McNeill et al., 2006) requires the words “designated here” or equivalents after 1 January 2001 we designate it here.

Secondly, Don mentioned a “Smith” as a collector in Sylhet, Bengal. This seems to be a reference to Roxburgh (1814) where a Mr. R.M. Smith of Sylhet (now Bangladesh) is noted to have sent this species in 1812 to the Botanical Garden of Calcutta (“Hortus bengalensis”). This element was regarded as the “assumed type of Lindley’s *Coelogyne nitida*” by Hooker f. (1890). Unfortunately Hooker, as far as we could find, did not mention

Cymbidium nitidum Wall. ex D. Don or Wallich 1954 anywhere. Later authors have called this *Coelogyne punctulata* Lindl. (l.c. 1821).

Coelogyne nitida Lindl. ex Hook.f. (1890) is a later homonym of Lindley (1830) and a superfluous name as well, because, erroneously, Hooker thought that *Coelogyne nitida* had been published simultaneously with *Coelogyne punctulata* by Lindley (1821), but the latter had retained the epithet in *Cymbidium*, and thus Hooker should have used the oldest combination in his list of synonyms, *Coelogyne punctulata*, instead.

Hunt and Summerhayes (1966) incorrectly regarded *Coelogyne nitida* Lindl. ex Wall. ("1830") as validly published. Seidenfaden (1975: 53) erroneously thought that *Coelogyne nitida* would have been published by Lindley in 1822. In fact, Lindley had a *Cymbidium nitidum* Wallich with a question mark under *Coelogyne*, and without a description, while the year is 1821. He also said (l.c.: 54) that Wallich 1954 belongs to *Coelogyne punctulata* Lindl. and accepted the Smith collection as the (lecto)type of *Cymbidium nitidum* D. Don.

Additional specimens examined. BANGLADESH. **Sylhet:** Wallich, N., 1165 (BM). BHUTAN. Dorji, Y., N. Pearce and P. Cribb, 15 (K); Grierson A.J.C. and D.G. Long 1365 (E, K); Loring falls, Sarbhong district, Grierson A.J.C. and D.G. Long 3669 (AMES, K); Griffith 24 (K); Griffith s.n. (K-Lindl); Ludlow and Sherref 2930 (BM). CHINA. **Yunnan:** Keng-Ma, Wang C.W. 72945 (AMES). INDIA. **Sikkim:** Anonymous 831 (BM, P); Anonymous 6800 (L); Anonymous 831 (BM); Clarke, C.B. 27661 (BM); Brace, L.K. s.n. (NY); Biswas, K. 6720 (AMES); Biswas, K. 1961 (AMES); Gamble, J.S. 8114 (K), Griffith 5096 (L,P); Herb. Kew s.n. (K); Hooker, J.D. s.n. (K); Hooker, J.D. s.n. (AMES, BM, C, NY, P, S); Lyon, B. 3016 (BM); Pantling, R. 76 (AMES, BM, E, K,L,P); Thomson, T. s.n. **Darjeeling:** Clarke C.B. 35175 (BM); Clarke C.B. 11616 (BM); Clarke, C.B. 12009 (BM); Clarke, C.B. s.n. (K); Hooker, J.D. s.n. (K). **Garhwal:** Duthies collectors s.n. (AMES). NEPAL. **East Nepal:** Dhoje, north of Chainpur, Arun valley, Stainton, J.D.A. 110 (BM); Smare Bhanjyang, Stainton, J.D.A. 3807 (BM); Ramche to Dhunche, Rasuwa district, Suzuki, M. and S. Noshiro 541002 (BM); Languri Danda, Williams, L.H.J. 131 (BM). **Central Nepal:** Dhampus forest, Barclay, C. and P.M. Syngé 2311 (AMES, K); Brough, M. A. 572 (BM); Lumle to Dhampus forest, Flatt, H. 51 (BM); Polunin, O., W.R. Sykes and L.H.J. Williams 3761 (BM); Schilling, A.D. and C.D. Sayers 326 (K); west of Phewa lake, Shrestha, T.B. 5005 (BM). **West Nepal:** Charaudi, west of Baglung district, Stainton, Sykes and Williams 503 (AMES, BM, E, P).

5. *Coelogyne occultata* Hook.f.

Roots 0.1-0.12 cm diameter. *Rhizome* long-creeping, 0.5-0.7 cm diameter, with 5-10 imbricate scales on the young shoot. *Pseudobulbs* born distantly, 1.3-5.0 cm apart, oblique, obovoid or rarely ellipsoid, abulge towards tip, 2.3-6 by 0.7-1.8 cm, with 4-5 longitudinal ridges. *Leaves* petiole 0.3-2.5 cm long; blade elliptic, 3-13.5 by 1.2-3 cm, index 1.1-4.7, tip acute, main veins 5-7, coriaceous. *Inflorescence* synanthous with partially to fully developed leaves, flowers 1-4. *Peduncle* fully concealed by the rhizome scales during anthesis, slender, 4-11 by 0.1-0.15 cm, either or not elongating after anthesis. *Rhachis* erect, 0.8-2.4 cm long; internodes 1-2 cm long, lowermost node angular or straight. *Floral bracts* 3-3.6 by 1.2-1.3 cm long. *Pedicel* 0.8-1.1 cm long, straight to slightly curved. *Ovary* 0.55-0.6 cm long. *Median sepal* elliptic, 2.3-4.6 by 0.8-1.5 cm, index 2.9-4.5, tip acute, main veins 5-9, conspicuously reticulated. *Lateral sepals* elliptic or oblong-elliptic, slightly oblique, 2.2-4.3 by 0.6-1.1 cm, index 3.1-5.5, tip acute, main veins 5-7,

otherwise as median sepal. *Petals* narrowly elliptic or obovate, shortly clawed at base, 2.1-4.1 by 0.4-0.7 cm, index 5.3-5.9, tip acute, main veins 3-5, otherwise as sepals. *Lip* elliptic to ovate in outline when flattened, 2.4-3.5 by 1.8-2 cm, index 1.3-1.8. *Hypochile* slightly saccate (0.15 cm deep), lip attachment 0.15-0.38 cm wide, when flattened 1.1-1.7 cm long; top of lateral lobes extending 0.2-0.7 cm beyond the sinus, margin erose; sinus round. *Epichile* ovate, 1-1.8 by 0.6-1 cm, index 1.3-2.5, tip acute, margin erose to entire, the two outermost veins conspicuously reticulated. *Keels* the laterals consisting of one or two crests, clavate or rod-shaped, margin crenulate or lamellate in transverse section, 1.1-2.1 cm long, proximally 0.1-0.12 cm high and thickened, lower at the level of the colour patches on the lateral lobes, slightly divergent or straight on the epichile; median keel single-crested, rod-shaped, margin slightly undulating in transverse section, 0.4-1.3 cm long, restricted to hypochile or, if interrupted, continuing up to the epichile; rarely 2 short additional keels present on epichile. *Column* curved, 1.6-2 by 0.4-0.7 cm, margin glabrous; the lateral lobules short, finely erose or denticulate, the median lobule transversely rectangular, erose. *Anther* conical, 0.28-0.4 by 0.35-0.45 cm, tip obtuse. *Pollinia* obovoid, 0.13-0.28 by 0.11-0.18 cm; caudicle not seen. *Stigma* semi-circular, 0.2-0.22 by 1.7-1.8 cm, proximally rounded or notched; rostellum broadly elliptic, 0.22-0.3 by 0.2-0.3 cm. *Fruit* stalk 0.7-1 cm long, ellipsoid, 2.8-3 by 1-1.3 cm; approximately circular in section.

Colour and scent. The subspecies have similar colours. Scales pale-greenish. Flowers sweetly fragrant. Sepals and petals white. Veins on the hypochile of the lip densely streaked with reddish lines. Lateral lobes of the lip with eye shaped or rectangular bright yellow patches. Epichile patches bordered with reddish line. Column grass white with reddish streaks along the margin (Plate 2.1D).

Discussion. 1. Next to the key characters, this species is further recognized by its creeping, dichotomously branched rhizome, coriaceous leaves and synanthous inflorescences.

2. The epithet *occultata* refers to the peduncle which is concealed by the rhizome scales during anthesis.

3. Two subspecies can be distinguished by the shape of the pseudobulbs, the length of the peduncle and the shape of the lateral keels on the lip.

Key to the subspecies of *Coelogyne occultata*

- 1a. Pseudobulb ellipsoid with a bulge in the middle; peduncle extending from the young developing shoots and elongating after anthesis; margin of lip keels lamellate in transverse section.....5a. *C. occultata* subsp. *elongata*
- 1b. Pseudobulb obovoid with a bulge near the tip; peduncle fully concealed by the young developing shoots, not elongating after anthesis; margin of lip keels crenulate in transverse section5b. *C. occultata* subsp. *occultata*

5a. *Coelogyne occultata* Hook.f. subsp. *elongata* Subedi, subsp. nov. TYPE: India. Khasia Hills, J.D. Hooker and T. Thomson s.n. (Holotype, BM!; isotypes, NY!, P!, *pro parte*, i.e. only the fruiting plant). Figure 2.6.

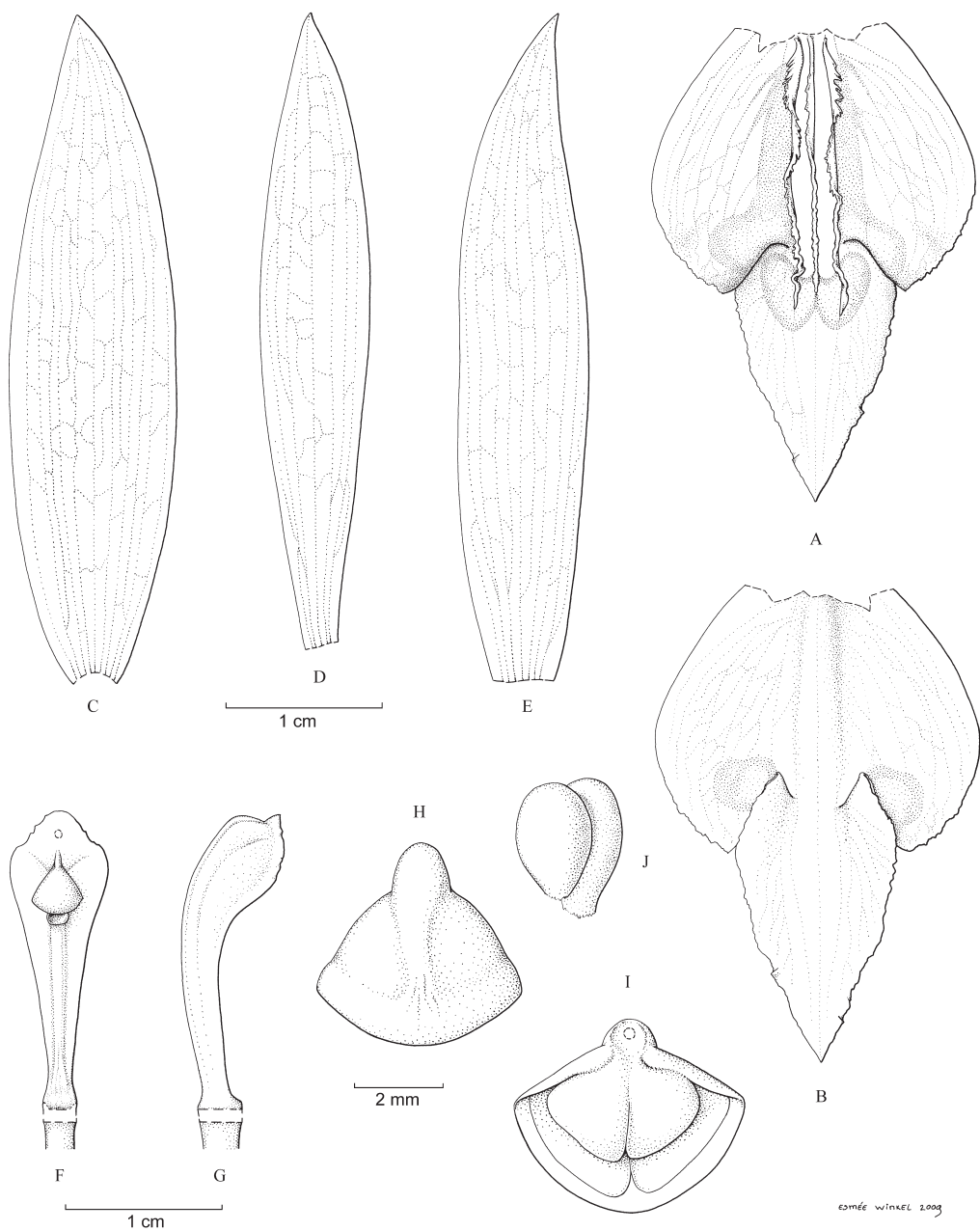


Fig. 2.6. *Coelogyne occultata* ssp. *elongata*. A. Lip from above. B. Lip from below. C. Dorsal sepal. D. Petal. E. Lateral sepal. F. Gynostemium front view. G. Gynostemium lateral view. H. Anther from above. I. Anther from below. J. Pollinia. Drawn from *Hooker f. and Thomson s.n. 1859, India, Meghalaya*.

A subspecies typica pedunculo post anthesin elongato, hypochilii carinis lateralibus bicarinatis processis distincte digitiformibus, labii lobo medio apice acuminato differt.

Pseudobulbs 1.3-3.2 cm apart, ellipsoid, bulged, 2.3-4 by 1-1.5 cm. *Leaves* blade 9-13.5 by 1.3-3 cm, index 3.1-3.7. *Inflorescence* flowers 2-3. *Peduncle* much exerted from the young developing shoots, 4.5-9.5 by 0.12-0.18 cm, further elongating after anthesis (up to 16 cm long). *Rhachis* fully exerted from the young developing shoots, 2.7-5 cm long; internodes 1.5-2 cm long. *Median sepal* elliptic, 3-4.6 by 0.8-1.5 cm, index 2.9-4.5. *Lateral sepals* oblong-elliptic, 3-4.3 by 0.7-1.1 cm, index 3.8-5. *Petals* narrowly elliptic, 3-4.1 by 0.5-0.55 cm, index 1.7-1.8. *Lip* ovate in outline when flattened, 2.9-3.5 by 1.8-2 cm, index 1.7-1.8. *Hypochile* slightly saccate (0.15 cm deep), lip attachment 0.35-0.38 cm wide, when flattened 1.65-2.1 cm long. *Epichile* 1.4-1.6 by 0.7-0.9 cm, index 1.8-2. *Keels* the two outermost keels double crested, lamellate margin in transverse section.

Distribution, habitat, and phenology. This subspecies is endemic to India (Meghalaya) (Figure 2.15). It grows as epiphyte on moss covered tree trunks or lithophyte on rock cliffs, between 1524 to 2124 m elevation. Flowering occurs from June to July.

Discussion. 1. Next to the characters in the key, this subspecies is further recognised by its elliptic leaves longer than 9 cm and long rhachis.

2. The epithet *elongata* refers to the rhachis elongating after anthesis.

Additional specimens examined. INDIA. **Meghalaya:** Maphlang, Clarke, C.B. 44305D (BM); Boga Pani, Clarke, C.B. 7203 (BM).

5b. *Coelogyne occultata* Hook.f. subsp. **occultata**

Coelogyne occultata Hook.f., Fl. Brit. India 5: 832. 1890. King and Pantl., Ann. Roy. Bot. Gard. Calcutta 8: 134. 1898. Pfitzer and Kraenzlin, *Coelogyne*. In: H.G.A. Engler (ed.), Pflanzenr. IV, 50, IIB7, Heft 32: 57. 1907. Pradhan, Indian Orchids 2: 273. 1979. Das and Jain, Fasc. Fl. India 5: 20. 1980. Clayton, The genus *Coelogyne*, a synopsis: 190. 2002 („*occulata*“). Pearce and Cribb, Flora of Bhutan 3, 3: 331. 2002. Chinqi & Clayton, in Flora of China 25: 324. 2010. TYPE: India. Sikkim, Griffith 5159 (Holotype, K!; isotype, CAL!). Figure 2.7.

Coelogyne occultata var. *uniflora* Balakr., J. Bomb. Nat. Hist. Soc. 75: 159. 1978. Clayton, The genus *Coelogyne*, a synopsis: 190. 2002 („*occulata*“). Pearce and Cribb, Flora of Bhutan 3, 3: 331. 2002. TYPE: Bhutan, Nyath Forest, Balakrishnan 43041 (Holotype, CAL, not located; isotype, ASSAM!).

Coelogyne pantlingii Lucksom, Orchid Rev. 113: 108. 2005. TYPE: India. Sikkim, Lucksom 456a (Holotype, CAL!; isotype, K!).

Pseudobulbs 2.3-5.0 cm apart, obovoid or ellipsoid, with swollen bulging near the tip, 2.3-6 by 0.7-1.8 cm. *Leaves* blade 3-7.5 by 1.2-3 cm, index 1.1-4.7. *Inflorescence* flowers 1-4. *Peduncle* fully concealed by young developing shoots, 4-11 by 0.1-0.15 cm, not elon-

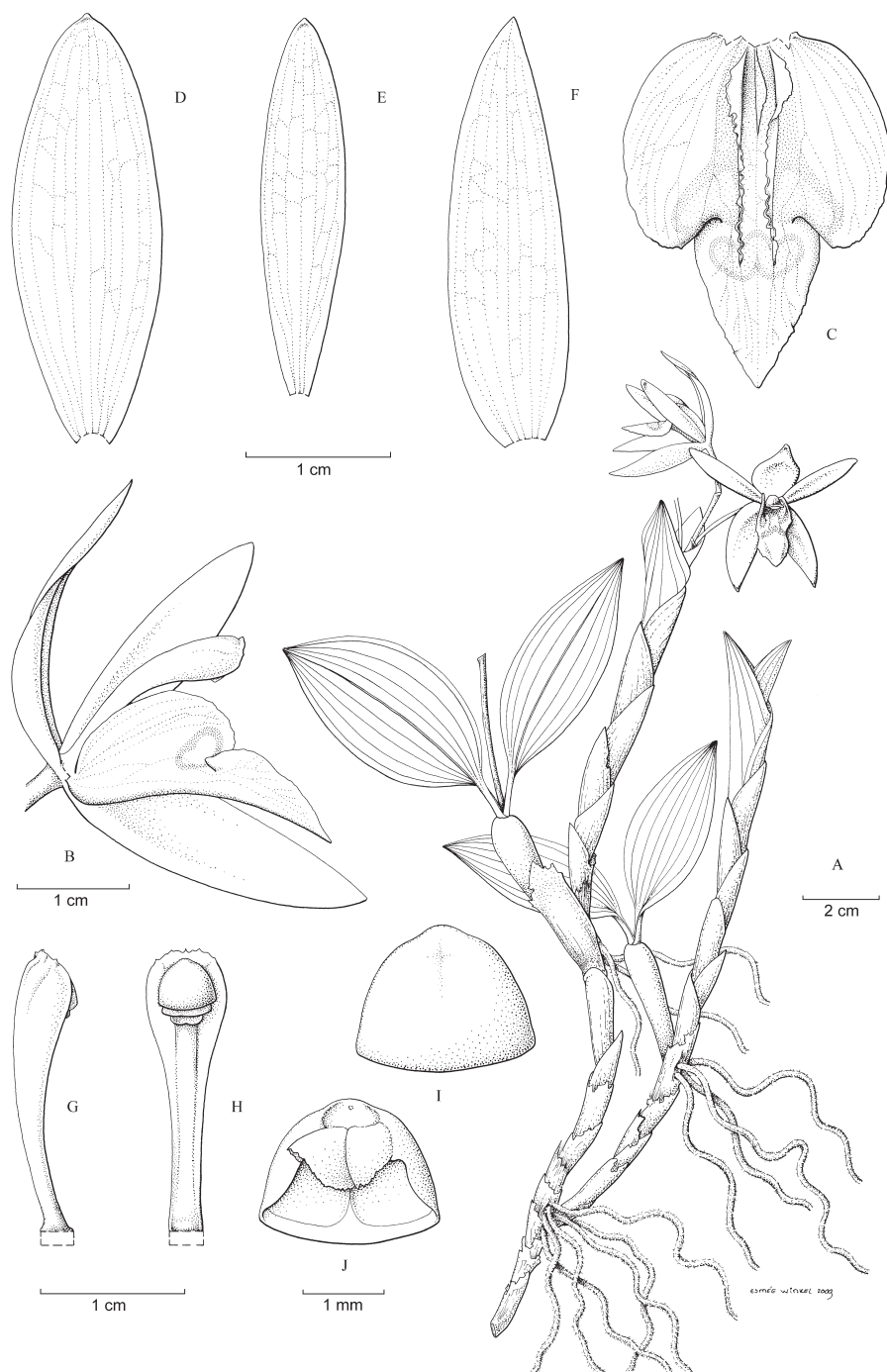


Fig. 2.7. *Coelogyne occultata* ssp. *occultata*. A. Habit. B. Flower lateral view. C. Lip. D. Dorsal sepal. E. Petal. F. Lateral sepal. G. Gynostemium lateral view. H. Gynostemium front view. I. Anther from above. J. Anther from below. Drawn from Ludlow, Sherrif and Elliot 13223, China, Yunnan.

gating after anthesis. *Rhachis* 0.8-2.4 cm long, fully concealed or protruding 1-2 cm beyond the young developing leaves; internodes 0.9-1.1 cm long. *Median sepal* elliptic, 2.3-3.5 by 0.8-1.1 cm, index 2.9-3.8. *Lateral sepals* elliptic, 2.2-3.5 by 0.6-1 cm, index 3.1-5.5. *Petals* obovate to elliptic, 2.1-3.5 by 0.4-0.7 cm, index 4.2-8.3, tip acute. *Lip* elliptic to ovate in outline, 2.4-3.2 by 1.8-2 cm, index 1.3-1.8. *Hypochile* lip attachment 0.15-0.2 cm wide; when flattened 1.1-1.7 cm long. *Epichile* 1-1.8 by 0.6-1 cm, index 1.3-2.5. *Keel* the two outermost keels single-crested, margin crenulate in section.

Distribution, habitat, and phenology. The subspecies is distributed in India (Darjeeling, Sikkim), Bhutan, China (Yunnan, Tibet) and Myanmar (Figure 15). It grows as epiphyte on trees, or lithophyte over rocks and boulders in forests, between 1828 to 2438 m elevation. Flowering occurs from June to July.

Discussion. The diagnostic characters mentioned for *C. pantlingii* in the type description overlap with *C. occultata* in geographical areas such as Darjeeling and Sikkim (India). We therefore consider it conspecific with *C. occultata*.

Additional specimens examined. BHUTAN. Futo La to Trongsa, *Gould, B.J.* 618 (K); Tsoung La near Trongsa, *Ludlow, F. and G. Sherriff* 243 (K). CHINA. **Yunnan:** Lushui Xian, west of Gaoligong shan between the Salween and Pianma, *Heng, Li, B. Bartholomew and D. Zhilin* 10377 (AMES); Kiukiang valley, Sochieh, *Yu, TT* 19386 (PE); *Forrest, G.* 26101 (K); *Forrest, G.* 18425 (BM, E, K) **Xizang:** *Anonymous* 342 (PE); Trulung, Pome, *Ludlow, F., G. Sherriff and H.H. Elliot* 13223 (BM, E). INDIA. **Sikkim:** Gangtok, *Chatterjee, D.* 141 (L, CAL); *Hooker, J.D.* 136 (K); Tendong peak, *Lucksom, S.Z.* 456a (K), Tendong, *Pantling, R.* 213 (AMES, BM, CAL, K, L); *Herb. Kew s.n.* (K) **Assam:** *Hort. Kew s.n.* (K). MYANMAR. West flank of the north Maikha-Salusin divide, *Forrest, G.* 27060 (BM, E, K, NY, PE, S); Ridge above Laktang, *Kingdon Ward, F.* 3046 (E). Specific locality unknown: *Hort. Kew s.n.* (K); *Nsamille* 789A (BM).

6. *Coelogyne platylamellata* Subedi, sp. nov. TYPE: China. Yunnan, *Forrest* 15941 (Holotype, E!). Figure 2.8.

Coelogyne gongshanensi similis, labelli carinis e hypochilii basi, lobis lateralibus maculis distincte coloratis, fructibus ellipsoideis distincte triangularibus in sectione transversali differt.

Roots 0.5-2 mm diameter. *Rhizome* short-creeping, 0.5-0.8 cm diameter, with 5-6 imbricate scales on the young shoot. *Pseudobulbs* close together, rhomboid to ellipsoid, 1.5-4 by 1.1-2.1 cm, sparsely longitudinally ridged and wrinkled when dry. *Leaves* petiole 0.6-3 cm long; blade elliptic to rarely obovate, 3.4-13 by 1.1-2.5 cm, index 2.1-5.4, tip acute, main veins 5-6, sub-coriaceous. *Inflorescence* proteranthous to synanthous, flowers 2-4. *Peduncle* covered with rhizome scales during anthesis, laterally flattened, 4.5-8.5 by 0.15-0.25 cm, elongating further (10-12.5 cm long) after anthesis. *Rhachis* erect, 1.1-5.5 cm; internodes 1.3-1.8 cm long, lowermost node angular. *Floral bracts* not seen. *Pedice* 1-2.5 cm long, straight to slightly curved. *Ovary* 0.5-0.8 cm long. *Median sepal* elliptic to obovate, 2.2-3.4 by 0.8-1.3 cm, index 2.1-3.1, tip sub-acute, main veins 5-9, sparsely reticulated. *Lateral sepals* oblong-elliptic, 2.2-3.5 by 0.7-1.3 cm, index 2.5-3.6, otherwise

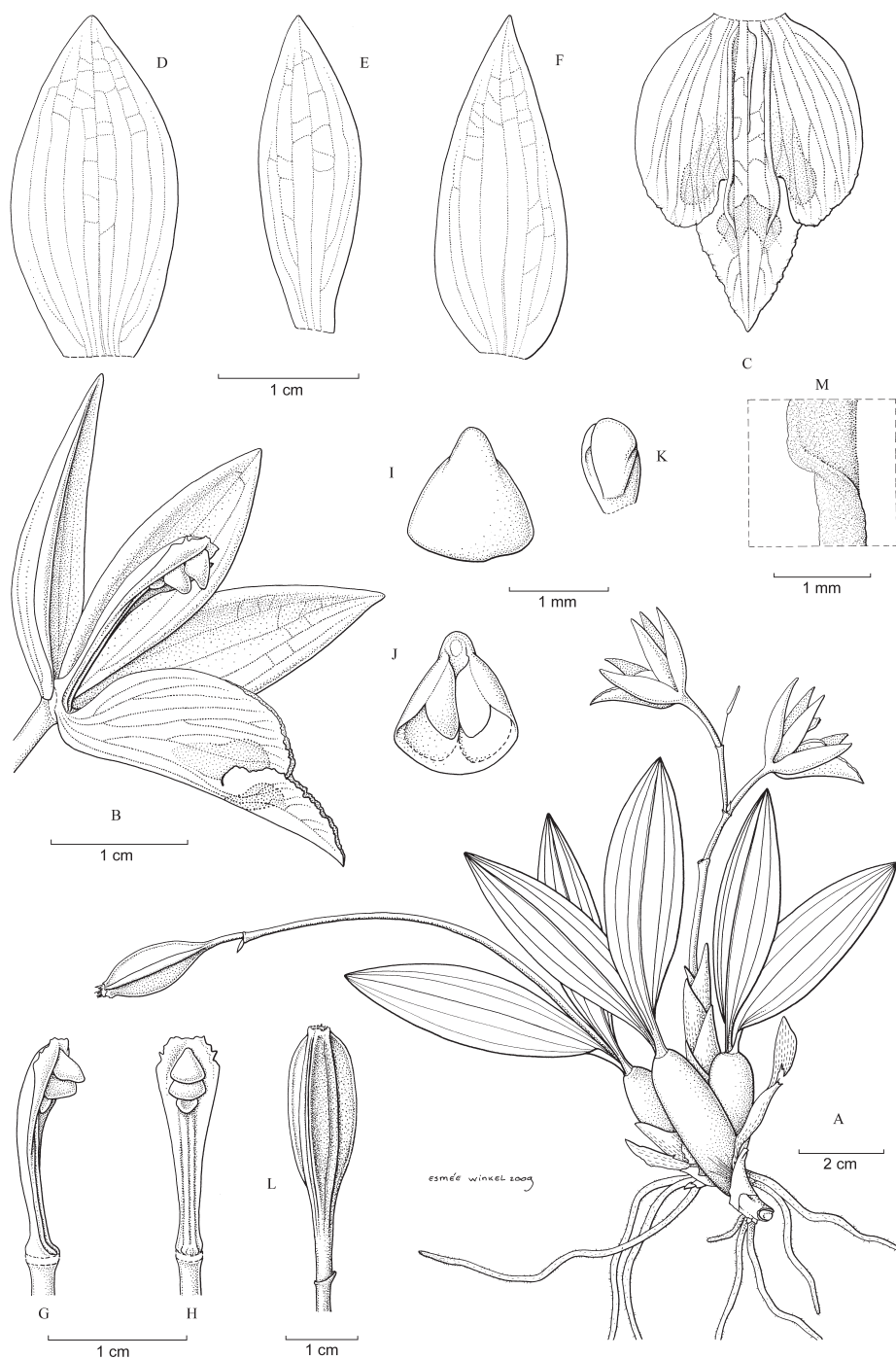


Fig. 2.8. *Coelogyne platylamellata*. A. Habit. B. Flower lateral view. C. Lip. D. Dorsal sepal. E. Petal. F. Lateral sepal. G. Gynostemium lateral view. H. Gynostemium front view. I. Anther from above. J. Anther from below. K. Pollinia. L. Fruit. M. Detail of keel on lip. Drawn from *Forrest 15941*, China, Yunnan.

as median sepal. *Petals* elliptic to obovate, slightly clawed at base, 2.2-3.2 by 0.5-0.8 cm, index 3.1-4.8, main veins 3-5, otherwise as sepals. *Lip* broadly ovate in outline when flattened, 2.1-2.5 by 1.4-1.7 cm, index 1.4-1.5. *Hypochile* slightly saccate (0.2 cm deep), lip attachment 0.2 cm wide, when flattened 1.4-1.6 cm long; top of lateral lobes extending 0.2-0.5 cm beyond the sinus, margin erose to denticulate, sinus rounded. *Epichile* ovate, 0.8-1.2 by 0.5-0.8 cm, index 1.4-2, tip acute, margin erose; the two outermost veins sparsely branched and reticulated. *Keels* starting near the base of hypochile, the laterals single-crested, plate-like, margin entire to slightly undulate in transverse section, 1.2-1.8 cm long, proximally 0.1-0.2 cm high, approximately equal in height throughout; median keel single-crested, plate or rod-like, 0.5-1.6 cm long, restricted to the hypochile or continuing to the colour patches on the epichile; very rarely 2-3 short additional keels present on the apex of the midlobe. *Column* erect, 1.3-1.5 by 0.3-0.54 cm, margin glabrous or sparsely papillose; the lateral lobules with erect teeth or denticulate, the median lobule transversely rectangular, erose to denticulate; *Anther* bell-shaped, 0.26-0.28 x 0.23-0.26 cm, apex obtuse. *Pollinia* 4, semi-ellipsoid, 0.13-0.18 by 0.09-0.12 cm; caudicle ovate, 0.04 by 0.07 cm. *Stigma* semi-circular, 0.1 by 0.13 cm, proximally rounded; rostellum broadly elliptic, 0.21-0.38 by 0.21-0.3 cm. *Fruit* ellipsoid, 2.1-3 by 1-1.5 cm, stalk 0.8-1 cm long, distinctly triangular in cross section.

Colour. Pseudobulb glossy green. Flowers in two different colour forms: the majority of the collections are reported with pure white sepals and petals and a white lip with orange-yellow coloured patches while a few collections are reported with distinctly greenish-yellow sepals and petals with dark reddish coloured patches on a yellowish lip.

Distribution, habitat, and phenology. This species is endemic to China (Yunnan) (Figure 2.17). It grows as lithophyte on rock cliffs or epiphyte on tree trunks, between 2438 to 3048 m elevation. Flowering occurs from April to August. The white flowered forms are reported from the Shaolin-Salwin divide, the Western side of the Diancang Shan mountain range, the Dapingdi above Yangbi, and the footpath along Longguan to Dali while the greenish-yellowish flowered forms are reported from the eastern side of the Tali range.

Discussion. 1. The species is similar to *C. corymbosa* but distinct by the entire keels on the lip which are fleshy, almost equal in height throughout, and by the straight column.

2. The epithet *platylamellata* refers to the plate-like keels on the lip.

Additional specimens examined. CHINA. **Yunnan:** Forrest, G. 17542 (K); Longquan to Dali, Sino-Brit. Exp. Cangshan 624 (E); Dapingdi above Yangbi, Sino-Brit. Exp. Cangshan 113 (K); Wang, C.W. 847 (PE); Ta-li-Hsien, Wang, C.W. 63299 (AMES)

7. *Coelogyne punctulata* Lindl.

Roots 0.05-0.1 cm diameter. *Rhizome* short-creeping, 0.5-0.8 cm diameter. *Pseudobulbs* close together, ovoid to pyriform, 1.5-7.1 by 1-3.7 cm, gradually tapering towards the tip or obtuse, glossy or lightly longitudinally ridged. *Leaves* petiole 0.4-3.5 cm long; blade elliptic or obovate, 6-22.3 by 1.5-3.2 cm, index 2.9-7, tip acute to acuminate; main veins 6-8, (sub)coriaceous. *Inflorescence* hysteranthous, 2-6 flowered. *Peduncle* not covered

by rhizome scales during anthesis, ellipsoid, laterally compressed, 1.3-14.5 by 0.1-0.2 cm, not elongating after anthesis. *Rhachis* erect, 3.1-9.3 cm long; internodes 0.5-2.1 cm, weakly zig-zag or angular towards tip. *Floral bract* lowermost one sterile and persistent, others fertile and caducous during anthesis, convolute, elliptic-oblong in outline when flattened, 2.6-4.1 by 0.8-1.8 cm, tip acute to acuminate, many veined. *Pedicel* 1.6-2.8 cm long, slightly curved. *Ovary* 0.6-0.8 cm long. *Median sepal* elliptic or oblong-elliptic, 2-3.6 by 0.7-1.2 cm, index 3-3.3, tip acute or obtuse, main veins 5-11, conspicuously reticulated. *Lateral sepals* elliptic or narrowly oblong-elliptic, 2-3.6 by 0.55-1.1 cm, index 3.3-4, otherwise as median sepal. *Petals* oblong-elliptic, 1.9-3.4 by 0.26-0.6 cm, index 5.7-7.7, tip acute or obtuse, main veins 3-5, sparsely reticulated. *Lip* broadly elliptic in outline when flattened, 1.9-3 by 1.4-2.5 cm, index 1.2-1.4. *Hypochile* slightly saccate (0.1-0.2 cm deep), lip attachment 0.33-0.53 cm wide, when flattened 1.2-2.0 cm long, main veins 7-9, outermost much branched, conspicuously reticulated; top of lateral lobes extending 0.2-0.4 cm beyond the sinus, margin entire or finely erose or irregularly denticulate; sinus rounded. *Epichile* orbicular or broadly ovate in outline, 0.9-1.7 by 1.1-1.5 cm, index 1.1-1.5, tip acute to sub-acute, margin entire or slightly wavy; the two outermost veins branched and sparsely reticulated. *Keels* the laterals single crested, clavate shaped, margin crenulate in transverse section, glabrous to papillose, 1.1-1.7 cm long, proximally 0.05-0.14 high with thickened margin; slightly lower around the colour patches on the lateral lobes, slightly curved or wavy in outline and erect on the epichile; median keel single crested, rod shaped, margin entire or slightly wavy in transverse section, 0.6-1.8 cm long, often extending to the epichile; additional two short keels present on epichile. *Column* apical half slightly arcuate, 1.5-2.1 by 0.35-0.8 cm, margin glabrous or minutely erose at basal part; the lateral lobules short, minutely notched or erose, rarely denticulate. *Anther* dome-shaped, 0.28-0.40 by 0.23-0.44 cm, apex obtuse or slightly erected, glabrous. *Pollinia* semi-ellipsoid, 0.1-0.26 by 0.12-0.28 cm; caudicle 0.09 by 0.11 cm, rectangular. *Stigma* flat or semi-circular, 0.1-0.16 by 0.13-0.3 cm, emarginate; rostellum broadly transversely elliptic, 0.19-0.25 by 0.3-0.47 cm. *Fruit* not seen.

Discussion. 1. Next to the key characters, this species is further recognized by its ovoid or pyriform pseudobulbs and crenulate keels on the lip. The lowermost sterile bract of the rhachis is persistent.

2. Intermediates have been found in the same geographical areas.

3. The epithet *punctulata* refers to the spots on the lip. Two different subspecies can be recognized by differences in the peduncle length, size of the flowers, and ornamentation on the hypochile of the lip. Subspecies *punctulata* is widely distributed whereas subsp. *brevipedunculata* is restricted to Assam (India).

Key to the subspecies of *Coelogyne punctulata*

- 1a. Peduncle length 1.3-1.5 cm; sepals 2-2.1 cm and petals 1.9-2 cm long; surface of hypochile of lip distinctly papillose... 7a. *C. punctulata* subsp. *brevipedunculata*
- 1b. Peduncle length 3.5-14.5 cm; sepals 3-3.6 cm and petals 2.7-3.4 cm long; surface of hypochile of lip glabrous7b. *C. punctulata* subsp. *punctulata*

7a. *Coelogyne punctulata* Lindl. subsp. *brevipedunculata* Subedi, subsp. nov. TYPE: India. Assam, Subansiri division, South corner of Apa Tani Valley, *Cox and Hutchinson* 353 (Holotype, K!; isotype, E!). Figure 2.13A.

A subspecies typica pedunculo brevissimo (ad 1.5 cm longo), foliis coriaceis, sepalis patalibusque quam 2.2 cm brevioribus, hypochilio distincte papilloso differt.

Pseudobulbs ellipsoid to ovoid, 2.3-2.5 by 1-1.3-1.8 cm, tip obtuse. *Leaves* 1.3-1.8 cm long; blade obovate to elliptic, 6-7 by 1.7-2.4 cm, index 2.9-3.5, tip acuminate, coriaceous. *Inflorescence* 3-4 flowered. *Peduncle* 1.3-1.5 by 0.1-0.15 cm. *Rhachis* 3.5 to 4.5 cm long; internodes 0.5-1.3 cm long. *Floral bracts* 2.5-2.6 by 0.7-0.8 cm. *Pedicel* 1.2-1.4 cm long. *Ovary* 0.45-0.6 cm long. *Median sepal* oblong-elliptic, 2-2.1 by 0.7-0.8 cm, index 3-3.3, tip acute, main veins 5-9, conspicuously reticulated. *Lateral sepals* narrowly oblong-elliptic, 2-2.1 by 0.55-0.6 cm, index 3.5-4, otherwise as median sepal. *Petals* oblong-elliptic, 1.9-2 by 0.26-0.3 cm, index 6.7-7.3, tip acute, main veins 2, and reticulated. *Lip* 1.9-2.1 by 1.4-1.5 cm, index 1.4, minutely papillose throughout. *Hypochile* lip attachment 0.33-0.35 cm wide, when flattened 1.2-1.25 by 1.4-1.5 cm long; top of lateral lobes extending 0.22-0.25 cm beyond the sinus, with erose or finely irregularly denticulate margin. *Epichile* ovate, 0.9-1 by 0.6-0.7 cm, index 1.4-1.5. *Keels* 1.4-1.45 cm long, proximally 0.05-0.07 cm high; median keel 0.6-0.65 cm long. *Column* 1.45-1.55-0.03-0.35 cm long. *Anther* 0.26-0.28 by 0.21-0.23 cm. *Pollinia*, 0.1 by 0.12 cm, caudicle minute. *Stigma* 0.1 by 0.13 cm. *Fruit* not seen.

Colour. Lip deep velvety brown. Colour patches on each side of the lateral lobes of the lip nearly orbicular.

Distribution, habitat, and phenology. This subspecies is endemic to India (Assam: South corner of Apa Tani valley, Subansiri division) (Figure 2.18). It grows as epiphyte on tree trunks on 1615 m elevation. Flowering occurs during April.

Discussion. 1. Next to the key characters, this subspecies is further recognized by its ellipsoid to ovoid pseudobulbs.

2. The epithet *brevipedunculata* refers to the short peduncle which is the diagnostic feature.

7b. *Coelogyne punctulata* Lindl. subsp. *punctulata*

Coelogyne punctulata Lindl., Coll. Bot. sub. t. 33. 1821. Hunt and Summerh., Kew Bull. 20: 53. 1966. Pradhan, Indian orchids 2: 272. 1979. Das and Jain, Fasc. Fl. India 5: 24. 1980. Seidenf., Dansk Bot. Ark. 29, 4: 55. 1975. Clayton, The genus *Coelogyne*, a synopsis: 191. 2002. Pearce and Cribb, Flora of Bhutan 3, 3: 332. 2002. Chinqi & Clayton, in Flora of China 25: 324. 2010. TYPE: Nepal, *Wallich s.n.* (holotype, BM!, *pro parte*, the plant in the middle on the lowest part of the sheet with the hysteranthous inflorescence). Figure 2.9.

Coelogyne brevifolia Lindl., Fol. Orchid. 5, *Coelogyne* : 7. 1854. TYPE : India. Meghalaya, *Hooker & Thomson s.n.* (Holotype, K!).

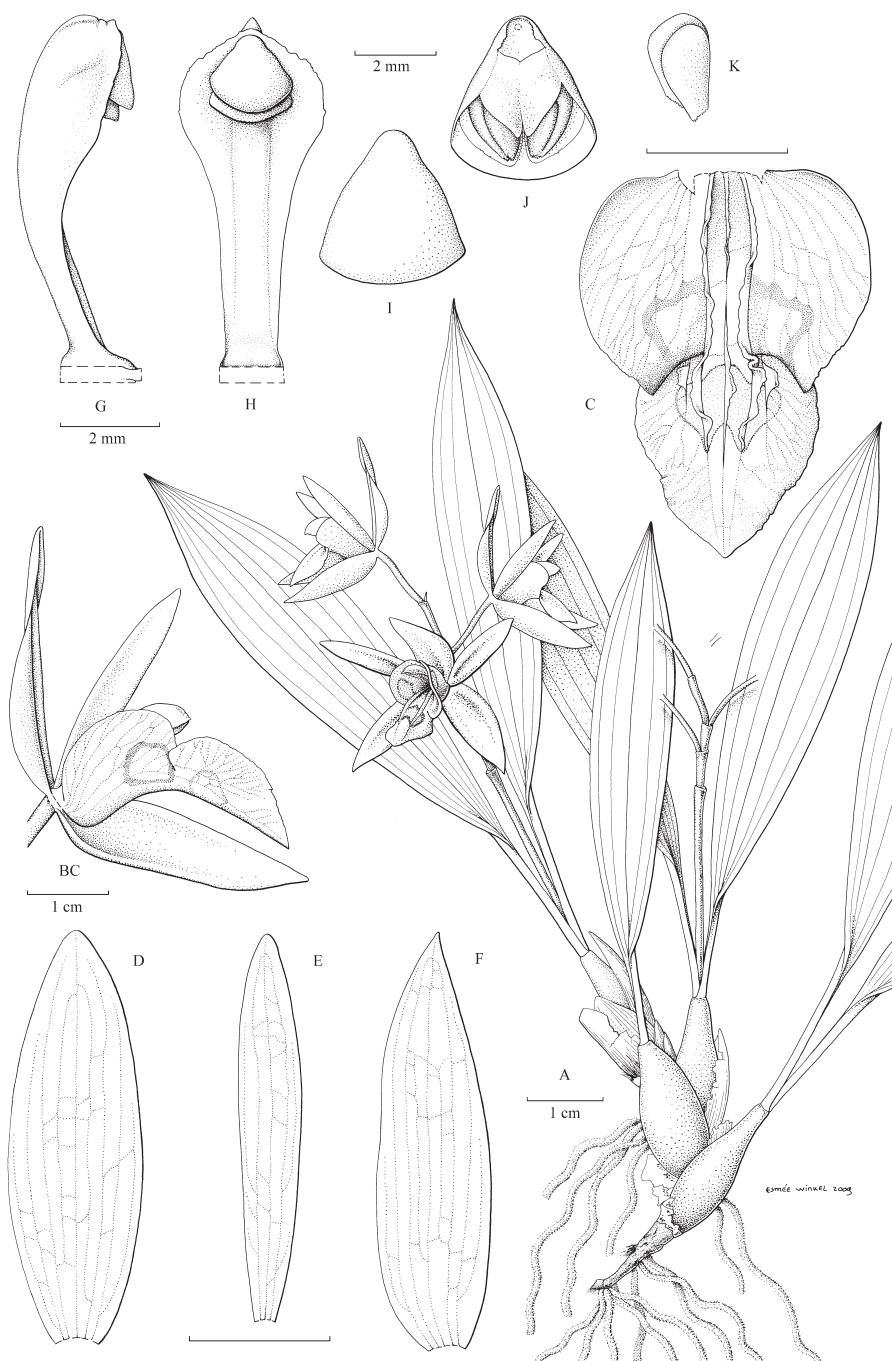


Fig. 2.9. *Coelogyne punctulata* ssp. *punctulata*. A. Habit. B. Flower lateral view. C. Lip. D. Dorsal sepal. E. Petal. F. Lateral sepal. G. Gynostemium lateral view. H. Gynostemium front view. I. Anther from above. J. Anther from below. K. Pollinia. Drawn from *Petelot A. 5432*, Vietnam.

Coelogyne nitida (Roxb.) Hook.f., Fl. Brit. India 5 : 837. 1890. TYPE: India, Khasia Hills, Griffith s.n. (Holotype, K!; isotype, CAL).

Coelogyne ocellata Lindl. var. *maxima* H.G. Reichenbach, Gard. Chron. n.s. 11: 524. 1879. Veitch, Man. Orchid. Pl. 6: 44. 1890. Rolfe, Lindenia 1: 268. 1890. TYPE: provenance unknown, cult. B.S. Williams (Holotype, W?, not seen).

Coelogyne ocellata Lindl., Gen. Sp. Orchid. Pl.: 40. 1830. Lindl., Fol. Orchid. 5, Coelogyne: 7. 1854. Hook.f., Bot. Mag. 66: t. 3767. 1840. Veitch, Man. Orchid. Pl. 6: 45. 1890. TYPE: Bangladesh. Sylhet, Wallich Cat. No. 1953, pro parte, the plant with the hysteranthous inflorescence and two drawings at the bottom) (Holotype, K-LINDL!).

Coelogyne ocellata Lindl. var. *boddaertiana* Reichb.f., Gard. Chron. n.s. 18: 776. 1882. TYPE: Provenance unknown. Boddaert van Cutjem cult., Ghent, Belgium s.n. (Holotype, W, not seen).

Pleione nitida (Lindl.) Kuntze, Revis. Gen. Pl. 2: 680. 1891.

Pseudobulbs ovoid to pyriform, 1.5-7.1 by 1-3.7 cm, tip acuminate. *Leaves* petiole 0.4-3.5 cm long; blade elliptic or obovate, 10-22.3 by 1.5-3.2 cm, index 6.7-7, tip acute to acuminate, subcoriaceous. *Inflorescence* 2-6 flowered. *Peduncle* 3.5-14.5 by 0.12-0.2 cm. *Rhachis* suberect, 3.1-9.3 cm long; internodes 1.3-2.1 cm, weakly zig-zagging towards apex. *Floral bracts* 3.1-4.1 by 1.4-1.8 cm. *Pedicel* 1.6-2.8 cm long. *Ovary* 0.6-0.8 cm long. *Median sepal* elliptic, 3-3.6 by 0.9-1.2 cm, index 3-3.3, tip acute or obtuse, main veins 9-11, conspicuously reticulated. *Lateral sepals* elliptic, 3-3.6 by 0.8-1.1 cm, index 3.3-3.7, otherwise as median sepal. *Petals* narrowly elliptic, 2.7-3.4 by 0.35-0.6 cm, index 5.7-7.7, tip acute or obtuse, main veins 3-5, sparsely reticulated. *Lip* 2.5-3 by 1.8-2.5 cm, index 1.2-1.4. *Hypochile* lip attachment 0.45-0.53 cm wide, when flattened 1.5-2.0 cm long; top of lateral lobes extending 0.2-0.4 cm beyond the sinus, with entire or finely erose margins; sinus round or subacute. *Epichile* orbicular or broadly ovate in outline, 1.2-1.7 by 1.1-1.5 cm, index 1-1.1. *Keels* 1.7-2 cm long, proximally 0.1-0.14 cm high; median keel 0.6-1.8 cm long. *Column* 1.8-2.1 by 0.4-0.8 cm, margin glabrous or minutely erose at basal part. *Anther* 0.35-0.40 by 0.3-0.44 cm. *Pollinia* 0.1-0.26 by 0.15-0.28 cm. *Stigma* 0.12-0.16 by 0.16-0.3 cm; rostellum 0.19-0.25 by 0.3-0.47 cm. *Fruit* not seen.

Colour and scent. Sterile bracts pale-brown or white. Flowers smell like terpentine or coconut oil. Pedicel white, ovary orange. Lip colour patches yellowish bordered with reddish orange, rectangular in outline on each side of the lateral lobes, while cordate in outline on the epichile. Keels white, flushed with red proximally (Plate 2.1F).

Distribution. Nepal, India (Sikkim, Darjeeling, Assam, Meghalaya, Manipur), Bangladesh (Sylhet), Myanmar and Vietnam (Figure 2.18).

Habitat and Ecology. Epiphytic on trees or rarely lithophytic on rocks, Elevation: 915-1768 m. Flowering: March-May, September and November.

Discussion. 1. This subspecies can easily be recognized by the obovoid or pyriform

pseudobulbs with pronounced acuminate tip, the narrowly elliptic petals, and crenulate and thickened outermost keels of the lip.

2. Specimens from Khasia hills (Meghalaya, India) show variability in shape and size of the leaves and pseudobulbs. The type of *C. brevifolia* has elliptic, small leaves. However, its floral morphology is similar to *C. punctulata*.

Additional specimens examined. BANGLADESH. **Sylhet:** Larmore, Wallich, N. 1953 (K) INDIA. **Meghalaya:** Mamloo, Clarke, C.B. 43835 (BM); Kullong, Clarke, C.B. 40496B, 40496C (BM); Clarke, C.B. 40496A (K); Griffith 5093 (P); Griffith 5097 (K); Griffith 5203 (K); Griffith 5101 (E); Lobb 51 (BM); Jharani Jaintea hills, Prains collector 58 (AMES, BM, L,P); Cal. Bot. Gard. s.n. (L); Hooker and Thomson s.n. (P,S); Hooker and Thomson 2531 (K); Bor, N.L. 226 (K); Moore, W.J.W. s.n. (K). MYANMAR. Kalmang valley, Glo lake, Mishmi Himal, Kingdon Ward, F. 18463 (BM); Myitkyima, Raufer 15 (K). VIETNAM. Chapa (Sa pa), Petelot, A. 5432 (AMES).

8. *Coelogyne taronensis* Hand.-Mazz., Anz. Akad. Wiss. Wien, Math.-Naturwiss. Kl. 59: 254. 1922. Chinqi & Clayton, in Flora of China 25: 323. 2010. TYPE: China. Yunnan: Salwin and Irrawadi, Handel-Mazzetti 9163 (Holotype, WU!). Figure 2.10.

Coelogyne weixiensis X.H. Jin, Ann. Bot. Fenn. 42: 135. 2005. Chinqi & Clayton, in Flora of China 25: 325. 2010. TYPE: China. Yunnan: Weixi, Bilou Snow Mountain, X.H. Jin 6502 (holotype, KUN!, isotypes, KUN!, PE!).

Roots 0.05-0.1 cm diameter. *Rhizome* short-creeping, 0.5-0.8 cm diameter, with 6-8 imbricate scales on the young shoot. *Pseudobulbs* close together, ovoid, 2-2.5 by 1.3-1.8 cm, wrinkled when dry. *Leaves* petiole 0.8-1.2 cm long; blade elliptic or obovate, 9.8-13.5 by 2.2-2.3 cm, index 4.5-5.9, tip acute, main veins 5-10, coriaceous. *Inflorescence* synanthous or proteranthous, flowers 2-3. *Peduncle* partially covered by the rhizome scales during anthesis, laterally flattened, 8-8.5 by 0.1-0.15 cm, either or not elongating after anthesis. *Rhachis* sub-erect, 2.5-5.5 cm long; internodes 2.5-3.1 cm long, sub-erect. *Pedicel* 2.3-2.4 cm long, straight to slightly curved. *Ovary* 0.6-0.8 cm long. *Median sepal* elliptic to ovate, 3-3.5 by 1.3-1.7 cm, index 2.1-2.3, tip acute, main veins 5-7, conspicuously reticulated. *Lateral sepals* oblong-elliptic or ovate, 3.2-3.5 by 0.8-1.2, index 2.9-4, tip acute, otherwise similar with median sepal. *Petals* narrowly elliptic-oblong, distinct clawed at base, 2.8-3.5 by 0.6-0.8, index 5.8-3.5, main veins 3-5, sparsely reticulated. *Lip* broadly ovate in outline when flattened, 2.8-3.9 by 2.1-2.6 cm, index 1.3-1.5. *Hypochile* slightly saccate (0.2 cm deep), lip attachment 0.45-0.7 cm wide, when flattened 2-2.6 cm long; top of lateral lobes extending 0.35-0.45 cm beyond the sinus, margin denticulate to crenulate; sinus sub-acute. *Epichile* ovate, 1.3-1.8 by 0.8-1.2 cm, index 1.2-2, tip acute to acuminate, margin crenulate to crispate, the two outermost veins conspicuously to sparsely reticulated. *Keels* the laterals single-crested, margin crenulate to wavy in transverse section, slightly papillose, 2.6 cm long, proximally 0.15 cm high, slightly wider at the level of the colour patches on the lateral lobes, straight on the epichile; median keel single-crested, margin crenulate to wavy in section, 1 cm long, 0.1 cm high, restricted to the hypochile; additional keels on epichile absent. *Column* curved, 2-2.2 by 0.4-0.45 cm, margins glabrous; the lateral lobules obscure, erose or denticulate, the me-

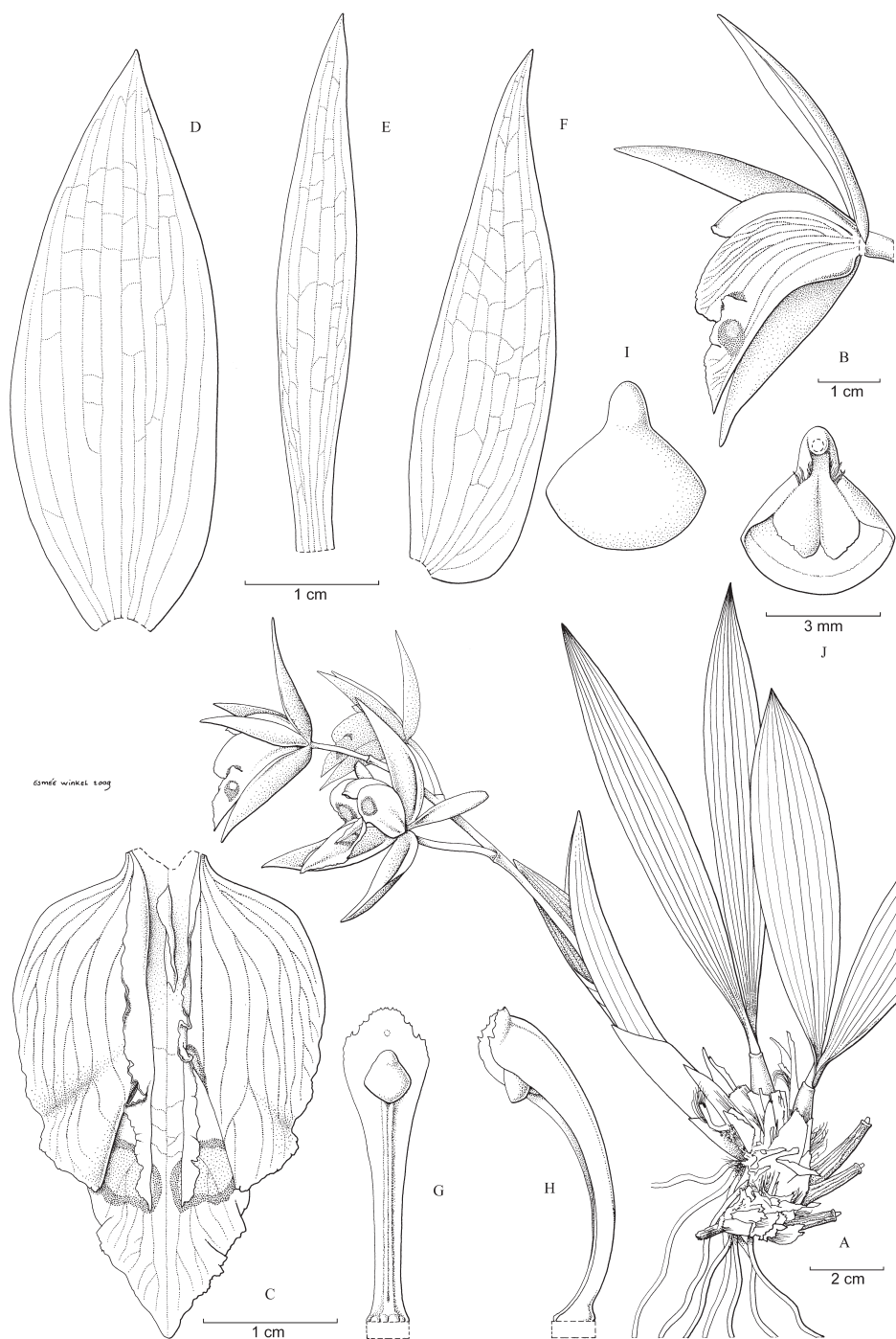


Fig. 2.10. *Coelogyne taronensis*. A. Habit. B. Flower lateral view. C. Lip. D. Dorsal sepal. E. Petal. F. Lateral sepal. G. Gynostemium front view. H. Gynostemium lateral view. I. Anther from above. J. Anther from below. Drawn from Handel-Mazzetti 9163, China, Yunnan.

dian transversely rectangular, erose. *Anther* conical or dome-shaped, 0.28-0.34 by 0.32-0.35 cm, tip erect. *Pollinia* 0.2-0.21 by 0.15-0.18 cm; caudicle orbicular. *Stigma* semi-circular, 0.23-0.3 by 0.19-0.21 cm, proximally rounded or notched; rostellum broadly elliptic. *Fruit*: not seen.

Colour and scent. Scales ochraceous-yellow when dry. Flowers creamy-yellow with chocolate-like smell. Sepals and petals with light reddish veins. Colour patches on lateral lobes dark red (Plate 2.1G).

Habitat and ecology. Epiphytes on forest tree trunks. Elevation: 2600-3450 m. Flowering: May-July.

Distribution. China (Yunnan; Salwin and Irrawadi, Bilou snow mountain, Weixi) (Figure 2.16).

Discussion.

1. This species is similar to *C. corymbosa* Lindl. but can be readily distinguished by its pale-yellow flowers and a lip which has lateral lobes which are crenulate to crispate.

2. The epithet *taronensis* refers to the Taron Gorge in Yunnan, China, the type locality.

Additional specimens examined. CHINA. **Yunnan:** Forrest, G. 14354 (K); Bilou snow mountain, Weixi, X.H. Jin 6502 (KUN, PE).

9. *Coelogyne ttyuii* Subedi, sp. nov. TYPE: China, Yunnan, T.T. Yu 17007 (holotype, PE!; isotype, PE!). Figure 2.11.

Coelogyne nitidae similis, inflorescentia synantha foliis maturis floribus ad 3 gaudenti, labello carinis tabularibus, lobo medio apice cuspidato differt.

Roots 0.8-1 mm diameter. *Rhizome* short-creeping, 0.35-0.45 cm diameter. *Pseudobulbs* close together, ellipsoid, 2.8-2.9 by 2-2.2 cm, wrinkled when dry. *Leaves* petiole 1-1.2 cm long; blade elliptic to obovate, 6-6.8 by 2-2.3 cm, index 3, tip acute, main veins 5-6, coriaceous. *Inflorescence* synanthous with fully developed leaves, flowers 2-3. *Peduncle* without rhizome scales during anthesis, slender, 5.5-8.3 by 0.1-0.13 cm, not elongating after anthesis. *Rhachis* sub-erect, 1.2-2.3 cm; internodes 1-1.2 cm long, straight. *Floral bracts* not seen. *Pedicel* 0.9-1.2 cm long. *Ovary* 0.6-0.9 cm long. *Median sepal* elliptic, 2.7-2.8 by 0.6-0.7 cm, index 4-4.5, tip acute, main veins 7, median vein keeled, sparsely reticulated. *Lateral sepals* elliptic, 2.8-2.9 by 0.7-0.8 cm, index 3.6-4, otherwise as median sepal. *Petals* slightly reflexed, elliptic to lanceolate, distinctly clawed at base, 2.4-2.5 by 0.4-0.45 cm, index 5.3-6.2, tip acuminate, main veins 3, hardly reticulated, otherwise as sepals. *Lip* broadly elliptic in outline when flattened, 2.2-2.3 by 1.15-1.28 cm, index 1.8-1.9. *Hypochile* slightly saccate (0.15 cm deep), lip attachment 0.35 cm wide; when flattened 1-1.2 cm long; top of lateral lobes extending 0.25-0.3 cm beyond the sinus, margin minutely erose, sinus rounded. *Epichile* ovate, 1-1.3 by 0.67-0.72, index 1.5-1.8, tip cuspidate, margins entire or minutely erose; the two outermost veins sparsely reticulated. *Keels* starting near the base of the hypochile, the laterals single-crested, rod

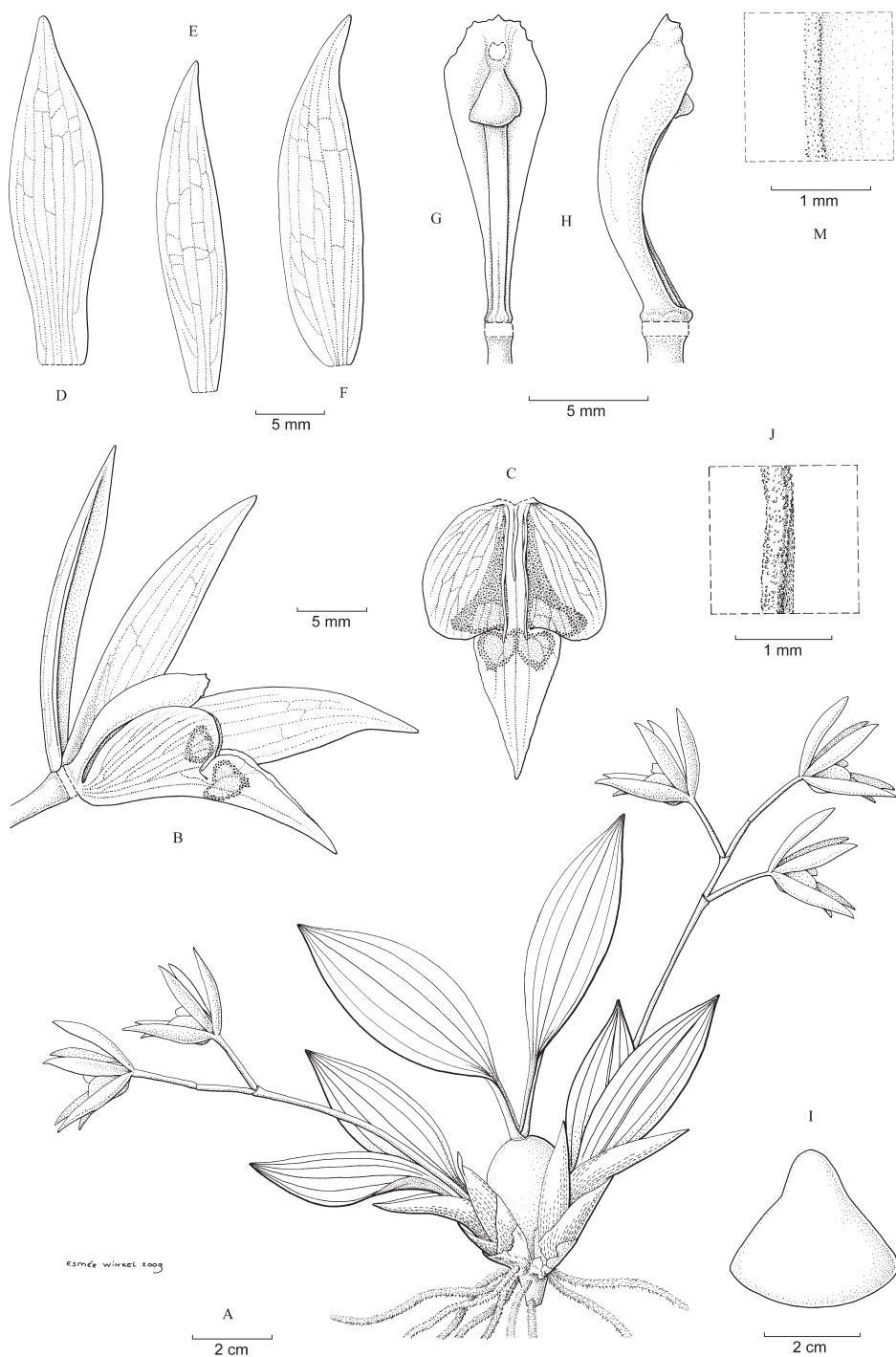


Fig. 2.11. *Coelogyne ttyuii*. A. Habit. B. Flower lateral view. C. Lip. D. Dorsal sepal. E. Petal. F. Lateral sepal. G. Gynostemium front view. H. Gynostemium lateral view. I. Anther from above. J. Detail of front surface of gynostemium. M. Detail of keel on lip. Drawn from Yu 17007, China, Yunnan.

shaped, margin entire to wavy in transverse section, 1.1-1.2 cm long, proximally 0.07-0.1 cm high, distally slightly lower and slightly curved on the epichile; median keel single-crested, rod shaped, margin entire in transverse section, 0.08-1.1 cm long; two additional keels present on epichile. *Column* curved, 1.35-1.4 by 0.38-0.42 cm, basal half papillose; the lateral lobules very short, erose distally, the median lobule transversely rectangular. *Anther* conical, c. 0.21 by 0.22 cm. *Pollinia* 4, semi-ellipsoid, 0.16-0.17 by 0.1-0.11 cm; caudicle not seen. *Stigma* semi-circular, 0.16-0.18 by 0.13-0.15 cm, proximally rounded; rostellum broadly elliptic, 0.24 by 0.21 cm. *Fruit* not seen.

Colour. Lip deep reddish. Colour patches on the lip creamy yellow bordered with deep dark red lines.

Habitat and ecology. Epiphytic on trees. Elevation: 2750 m. Flowering: July.

Distribution. China, Yunnan (Chengkong snow range) (Figure 2.16).

Discussion. 1. This species is similar to *C. nitida* but can be distinguished by the fewer flowers born on synanthous inflorescences with mature leaves.

2. The epithet *tyuui* refers to T.T. Yu who collected the type specimen in Yunnan.

10. *Coelogyne wardii* Subedi, sp. nov. TYPE: Myanmar. Kachin state above Ahbail, North triangle, *F. Kingdon Ward 20820* (holotype, BM!). Figure 2.12.

Coelogyne corymbosae et *C. platylamellatae* similis, floribus maximis (sepalis petalisque plus quam 4.5 cm longis), labelli carinis membranaceis processis distincte digitiformibus, lobis lateralibus praeter sinus plus quam 1 cm extensis, lobo medio apice anguste lineari differt.

Roots, rhizome and pseudobulbs not seen. *Leaves* petiole 0.9-6 cm long; blade elliptic to obovate, 8-11 by 1.5-2.5 cm, index 4.4-5.3, tip acute, main veins 4-5, membranous. *Inflorescence* proteranthous, flowers 2-3. *Peduncle* covered with 2-3 imbricate rhizome scales, laterally flattened, 4.5-7.5 by 1.5-2 cm, not elongating after anthesis. *Rhachis* erect, 2.1-52 cm; internodes 1.8-3.3 cm long, straight. *Floral bract* not seen. *Pedicel* 1.5-2.1 cm long, slightly curved. *Ovary* 0.5-0.7 cm long. *Median sepal* ovate, 4.8-5.4 by 1.8-1.9 cm, index 2.5-3, tip acuminate, main veins 8-10, conspicuously reticulated. *Lateral sepals* elliptic, 4.5-5.3 by 1.6-1.8 cm, index 2.8-2.9, main veins 7, conspicuously reticulated, otherwise as median sepal. *Petals* elliptic, distinctly clawed, 4.5-4.9 by 1-1.2 cm, index 4.1-4.5, main veins 3-5, otherwise as sepals. *Lip* elliptic in outline when flattened, 3.5-4.8 by 2.8-2.9 cm, index 1.3-1.7. *Hypochile* saccate (0.5 cm deep), lip attachment 0.35 cm wide; when flattened 2.7-3.2 cm long; top of lateral lobes extending 1-1.2 cm beyond the sinus, margins erose, sinus acute. *Epichile* ovate, 2.1-2.4 by 1.1-1.3 cm, index 1.8-1.9, tip further elongated as very narrow linear projection, margin erose, the two outermost veins branched and sparsely reticulated. *Keels* starting near the base of the hypochile, the laterals single-crested, thin, membranous, margin in transverse section wavy at basal half but distinctly lamellate around the lateral lobes and on the epichile, 2.5-2.7 cm long, 0.25-0.3 cm high; median keel single-crested, thin-membranous, margin

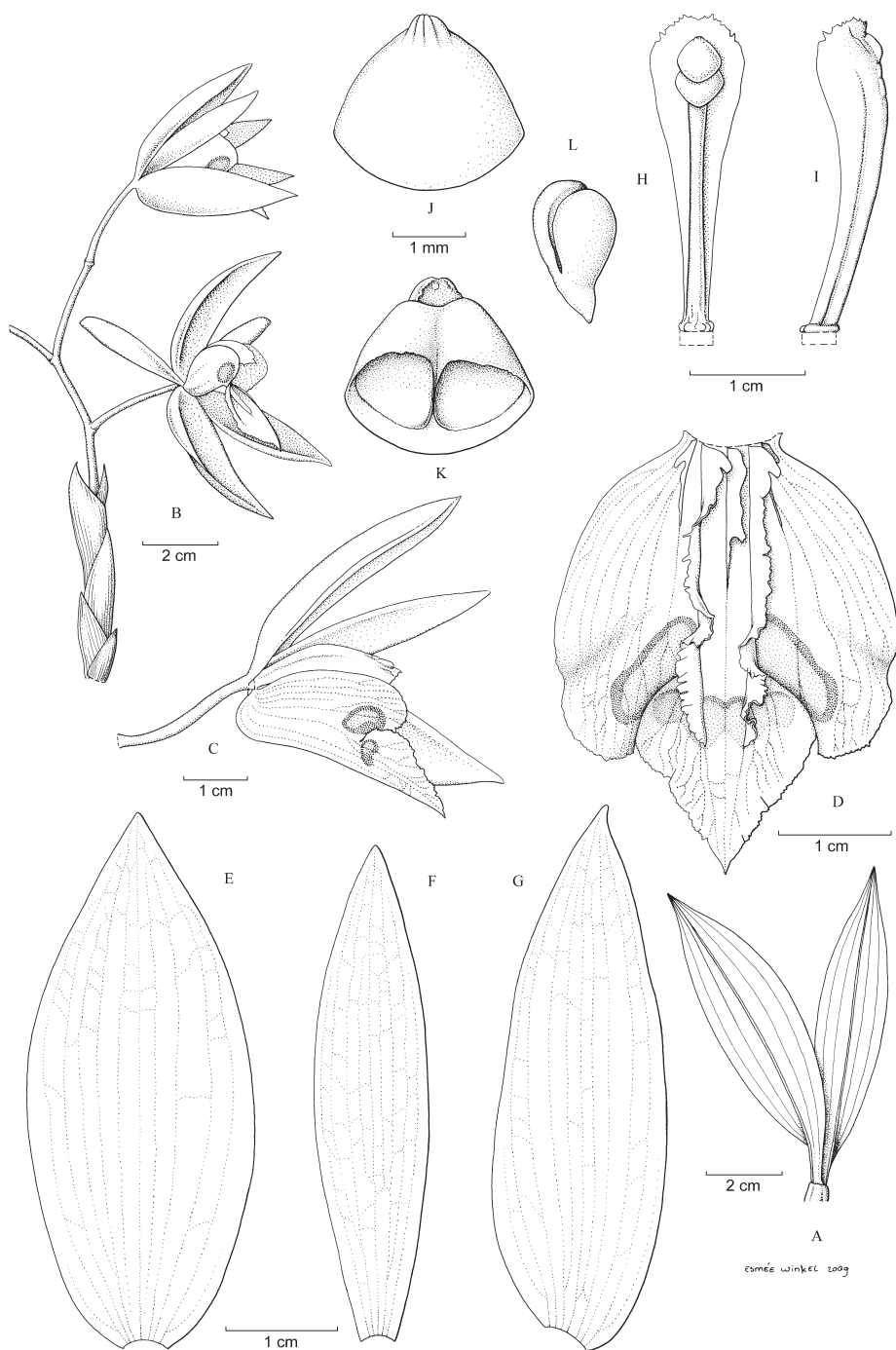


Fig. 2.12. *Coelogyne wardii*. A. Leaves. B. Peduncle. C. Flower lateral view. D. Lip. E. Dorsal sepal. F. Petal. G. Lateral sepal. H. Gynostemium front view. I. Gynostemium lateral view. J. Anther from above. K. Anther from below. L. Pollinia. Drawn from *Kingdon-Ward 20820*, Myanmar.

entire in transverse section, 0.45-0.5 cm long, restricted to the hypochile; additional keels on epichile absent. *Column* curved, 2.8-3.1 by 0.6-0.7 cm; the lateral lobules short, distally denticulate, the median lobule transversely rectangular, denticulate; *Anther* conical, 0.45-0.5 by 0.4-0.42 cm, apex distinctly protruding (0.15 cm long). *Pollinia* obovoid, 0.25-0.27 by 0.18-0.2 cm; caudicle not seen. *Stigma* semi-circular, 0.25-0.3 by 0.2-0.28 cm, proximally rounded; rostellum broadly elliptic, 0.5 by 0.3 cm. *Fruit* not seen.

Colour and scent. Sepals, petals and lip white. Flowers fragrant. Colour patches on the lip are either i) lemon-yellow without reddish stripes, ii) gamboge with reddish stripes or iii) reddish-brown without stripes. Column streaked red.

Habitat and ecology. Epiphytic on tree trunks. Elevation: 2438-2743 m. Flowering: May.

Distribution. Myanmar (North triangle, Kachin state above Ahbail) (Figure 2.17).

Discussion. 1. This species is recognized by its long sepals and petals (4.5 cm or longer) and saccate lip base.

2. The epithet *wardii* refers to F. Kingdon Ward who collected the type specimen in Myanmar.