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.

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.


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'-CTTCTGACCATATTGCACTATG-3') and 881R (5'-TMTTCATCAGATAAGTAGT-3'); 731 F (5'-TCTGGAGTCTTTCTTGAGCGA-3') and 2R (5'-AACTAGTCCGGATGGAGTAGT-3') (Gravendeel et al., 2001). The thermal cycling protocol comprised 28 cycles, each with 1 min. denaturation at 94 ºC, 30 sec. annealing at 48 ºC, an extension of 1 min. at 72 ºC, concluding with an extension of 7 min. at 72 ºC. 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'= TAGAATTCCCCGGTTCGCTCGCCGTTAC-3') from Sun et al. (1994). The thermal cycling protocol comprised 26 cycles, each with 10 sec. denaturation at 96 ºC, 5 sec. annealing at 50 ºC and extension of 4 min. at 60 ºC. 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


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


*Plants* perennial, small to medium sized epiphytes to lithopytes. *Roots* terete, villose.
Rhizome stout, short to long creeping or pendent (C. occultata), branched, scales persistent, the upper as long as or longer then the pseudobulb. Pseudobulb 2-leafed, 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. ttyuii), 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, in conspicuously 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. ttyuii), 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 colliculate; 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.

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 (Arunanchal 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. hysterantha, C. punctulata).

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.

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).
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 hysteranthous.................................................................2
1b Inflorescence proteranthous or synanthous.............................................3

2a Lowermost bract of rhachis with flower...........................................3. *C. hysterantha*
2b Lowermost bract of rhachis sterile......................................................7. *C. punctulata*

3a Pseudobulb obovoid, born distantly, 1.3-5.0 cm apart...................5. *C. occultata*
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. *C. platylamellata*
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 column ..............................................2. 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 crispate ................................8. 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. ttyuii

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 2.2-4.4 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 obovate to 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. hysterantha; 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 coriaceeous...........................................................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, L!, isotype, P!, K!). Figure 2.13B.

A subspecie 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.

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 Niyomdharm, C. 218 (P, K); Doi Ithanond, 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); Collidge 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


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. Sherriff and J.H. Hicks 16357 (BM, AMES); East Bhutan: Rudo La, Ludlow, F., G. Sherriff and J.H. Hicks 20119 (BM); South Bhutan, Gale Chu Valley, Ludlow, F. and G. Sherriff 2954 (BM); Chukka district, Grierson, A.J.C. and D.G. Long 3078 (E); Tamij, Hara et al. s.n. (K);
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); Siklis, 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).


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 then 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.

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 obovate 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 *gongshanensis* 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, *Dulonhjiang Exp. Team 5355* (KUN); Gong Shang County, *Dulonhjiang 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, Seinghku Wang, *Kingdon Ward, F.* 6838 (K); Western flank of North Maikha-Salwin divide, *Forrest, G.* 26558 (E,S, NY).

![Distribution map of C. gongshanensis (●), C. taronensis (▲) and C. ttyui (△).](image)

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, membraneous. Inflorescence hysteranthous, 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 hysterantha 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. hysterantha is similar to C. punctulata in bearing hysteranthous inflorescences. It differs in having ellipsoid to cylindrical pseudobulbs, shorter floral parts (sepals, petals and lip are less then 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 hysterantha refers to the hysteranthous inflorescence.
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, Arunanchal 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 subspecie typica labelli longitudine sepalis petalisque aequilonga, lobo medio macula
maxima unicolori parte maiore tegenti, cristis linearibus angustis differt.

*Pseudobulbs* close together, 2.5-5.5 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).

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**Fig. 2.18.** Distribution of *C. nitida* ssp. *myanmarensis* (●), *C. nitida* ssp. *nitida* (○), *C. punctulata* ssp. *brevipendunculata* (▲) 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, Orleurs, H.D. 409 (P). Precise locality unknown: Farra 852 (E). MYANMAR. Kingdom Ward, F. 20604 (BM); Bogg, C.J. 26 (K); Anonymous 4997 (K); Anonymous 852 (E); Dickinson, F.G. 3249 (AMES); Ah Shai-Hnyin, Ah-Naught Hmyin, Lawk Sawk state, *Dickinson, 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); Hpare pass, Myitkyina, *Kermode, C.W.D. 17177* (AMES); above Langyaw, Myitkyina, *Kermode, C.W.D. 16683* (AMES); Kambatti, Myitkyina, *Malaise, R. 87* (S).

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<tr>
<th>Species</th>
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<td>Rolfe, Gard. Chron. n.s. 3: 314. 1875. TYPE: Myanmar, Moulmein, Parish 150 (Holotype, K-LINDL!).</td>
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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, Arunanchal 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, Sarbang district, Grierson A.J.C. and D.G. Long 3669 (AMES, K); Griffith 24 (K); Griffith s.n. (K-Lindl); Ludlow and Sherrill 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 (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). Garhawal: 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: Dhapmus forest, Barclay, C. and P.M. Synege 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-creeeping, 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, bulge 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 synanthetic 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 section .......................5b. 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!, PI, pro parte, i.e. only the fruiting plant). Figure 2.6.
A subspecie typica pedunculo post anthesin elongato, hypochilii carinis lateralis 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 pantlingii** Lucksom, Orchid Rev. 113: 108. 2005. **TYPE:** India. Sikkim, **Lucksom 456a** (Holotype, CAL!; isotype, K!).
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 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, Sochiei, Yu, TT 19386 (PE); Forrest, G. 26101 (K); Forrest, G. 18425 (BM, E, K) Xizang: Annonymous 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); Nsamlle 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. **Rhzome** 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 1.2-2.1 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. **Pedicel** 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
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 arcurate, 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**

1. Peduncle length 1.3-1.5 cm; sepals 2.2-2.1 cm and petals 1.9-2 cm long; surface of hypochile of lip distinctly papillose ...

1a. 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 glabrous .............

7b. 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 subspecie 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 1.3-1.8 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, 2.1 by 0.7-0.8 cm, index 3.3, tip acute, main veins 5-9, conspicuously reticulated. Lateral sepals narrowly oblong-elliptic, 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, 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 1.45-1.55-0.3-0.35 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 brevifolia Lindl., Fol. Orchid. 5, Coelogyne : 7. 1854. TYPE : India. Meghalaya, Hooker & Thomson s.n. (Holotype, K!).


Pseudobulbs ovoid to pyriform, 1.5-7.1 by 1.3-3.7 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 1.7-2.2 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).


*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-
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.


*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
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, 0.0.8-1.1 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 *ttyuii* 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, membraneous.
**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**
e 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 distinctively 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
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.


Distribution. Myanmar (North triangle, Kachin sate 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.