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CONTRIBUTIONS TO THE KNOWLEDGE OF THE LICHEN FLORA OF THE HIMALAYAS III*. ON *LECANORA SOMERVELLII* PAULSON (LICHENIZED ASCOMYCOTINA, LECANORACEAE)

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Abstract: The lichen *Lecanora somervellii* Paulson, first described from the northern slopes of Mt Everest in Tibet, has been collected at four other localities in the High Himalayas, at altitudes between 3750 and 5540 m. As the type material appears to be missing, a neotype is designated here. The species has an unusual lemon yellow colour due to the pigment calycin; this compound is in addition to usnic acid, which is widespread in *Lecanora*. *Lecanora somervellii* is otherwise very similar in essential characters to the complex including *Lecanora concolor* Ram. and *L. orbicularis* (Schaerer) Vainio, high alpine species well-known, for example, from the Alps. It is supposed, that *L. somervellii* is derived from this aggregate by the production of calycin (in addition to usnic acid), which acts as an additional protective pigment at these very high altitudes.

Introduction

A new species of *Lecanora*, *L. somervellii*, was described by Paulson (1925: 192) from the northern slopes of Mt Everest, Himalayas, at about 17 000 ft and named after the medical missionary and mountaineer, Dr T. Howard Somervell (1890–1975), a member of the British Mount Everest expedition of 1924. The description of the new lichen was accompanied by the following remarks: ' Scattered portions of the thallus, consisting of a few crowded squamules, on which are apothecia, occur on the other portions of the rock. These suggest *L. polytropa* f. *illusoria* Ach., but the immersed citrine-yellow apothecia with thick persistent thalline margin and the moniliform paraphyses point to rather close affinity with the *Aspicilia* group of *Lecanora* '.

The new lichen seemed to be unusual within the genus *Lecanora* due to its very unusual colour. Thirty-seven years after Paulson's studies, Poelt collected a citrine-coloured lichen at the southern side of the Everest massif in Nepal, at 5540 m (Poelt 1977: 449), which appears to be the same species. However, whereas Paulson had described the apothecia as ' immersa, concavo-planiuscula, . . . margo thallinus primum bene prominulus, persistens ' most of the apothecia in this second collection are strongly convex and without a prominent thalline margin (Fig. 1d). Nevertheless some flat (juvenile) apothecia that have a distinct margin are also present, indicating that this collection is the same as the species described by Paulson (see Fig. 1c, arrow). Meanwhile, the same

*II. Poelt, J. & Obermayer, W. (1991): Die Gattung *Bryonora* (Lichenes, Lecanoraceae) zugleich eine Revision aller Arten. *Nova Hedwigia* **53**: 1–26.

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lichen was also located at other localities on both the Tibetan and Nepalese sides of the main ridge of the High Himalayas, permitting a more adequate study of this interesting lichen.

Description

Lecanora somervellii Paulson

J. Bot. **63:** 192 (1925); type: (Nepal, Himalayas, Mt Everest, Rongbuk glacier) 'On rocks at 17 000 ft.' (type—herbarium not cited).

As the holotype is lost or at least not found, the following specimen is designated the neotype: Nepal, Langtang Area: huge rocks near Kyangjin, 3750 m, 8–10 September 1986, *J. Poelt* (N86-L257) (GZU—neotypus).

Thallus (Fig. 1a–c) lemon-yellow, crustose, rosulate, effigurate, marginal areoles distinctly elongated, somewhat detached from the substratum at the margin. Rosettes up to 7 cm diam., marginal lobes usually radiating, 0·4–0·6 mm wide, 1·2–1·8 mm long, convex to (rarely) flattened, ± bifurcately divided. Upper surface slightly roughened or nearly smooth, matt. Prothallus absent. The *cortex* is a 'true cortex' (i.e. lacking collapsed algal cell walls integrated into the cortex) (Fig. 2c), 30–40 µm thick, containing numerous brown-yellow crystals, additionally coloured with a deep yellow, amorphous pigment. Hyphae of the cortex, at least in the outermost part, ± anticlinal. Epinecral-layer 5–8 µm (apparent after dissolving the crystallized lichen compounds in acetone). Tips of the marginal lobes also corticate below, otherwise the lower side of the thallus is entirely ecorticate and completely attached to the substratum. *Photobiont zone* continuous, not interrupted by conical bundles of intrusive hyphae from below, ± uniform in thickness, 70–100 µm; photobiont cells ± spherical, 8–14 µm. *Medulla* white, comprising loosely interwoven thick-walled hyphae, 2·5 µm diam.

Apothecia always present at least in the centre of the thallus (0·3–)0·6–1 mm diam., at first slightly immersed and with a distinct margin (Fig. 1c, arrow) but soon becoming notably convex and the margin eventually disappearing (Fig. 1d). Disc almost concolorous with the thallus or slightly darker, slightly roughened, with an indistinct yellow pruina. *Epithecium* containing brown-yellow crystals on and between the tips of the paraphyses. *Hymenium* colourless, 50–65 µm. *Subhymenium* with respect to the upper part of the hypothecium, coloured with a yellow pigment, at least in part; older apothecia have a deep yellow subhymenium. *Hypothecium* conical, up to 200 µm thick in centre, composed of densely compacted hyphae. *Paraphyses* conglutinate, branched at the apices, tips of the paraphyses little or not thickened, without internal or overlying amorphous pigments (best observed after pretreatment with acetone), with a thin, colourless, amorphous epinecral layer; average length of the cells 5 µm. *Asci* clavate, 30–35 × 11 µm; tholus I+ blue, with a distinct 'chambre oculaire' and a relatively broad 'masse axiale' (= *Lecanora* ascus type in the broad sense) (Fig. 2d). *Ascospores* 8 per ascus, colourless, narrowly ellipsoid to almost cylindrical, 9–11 × (3)3·5–4 µm, simple (Fig. 2e), occasionally pseudodiblastic.

Spermogonia and *spermatia* not seen.

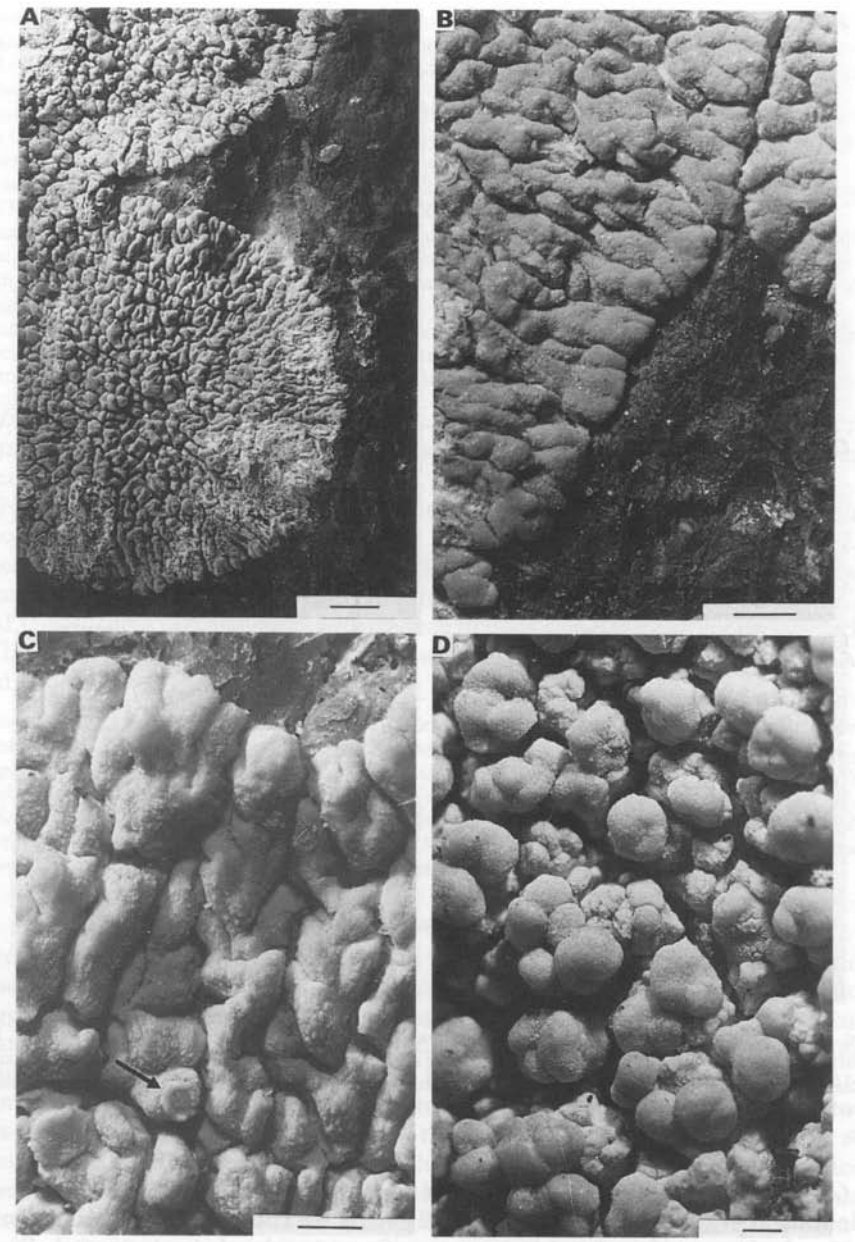

FIG. 1. *Lecanora somervellii* (neotype). A, General habit. B, Marginal lobes. C, Rim of the thallus (arrow points at a young apothecium slightly margined). D, Strongly convex apothecia in the centre of the thallus. Scales: A = 2 mm; B = 1 mm; C, D = 0·5 mm.

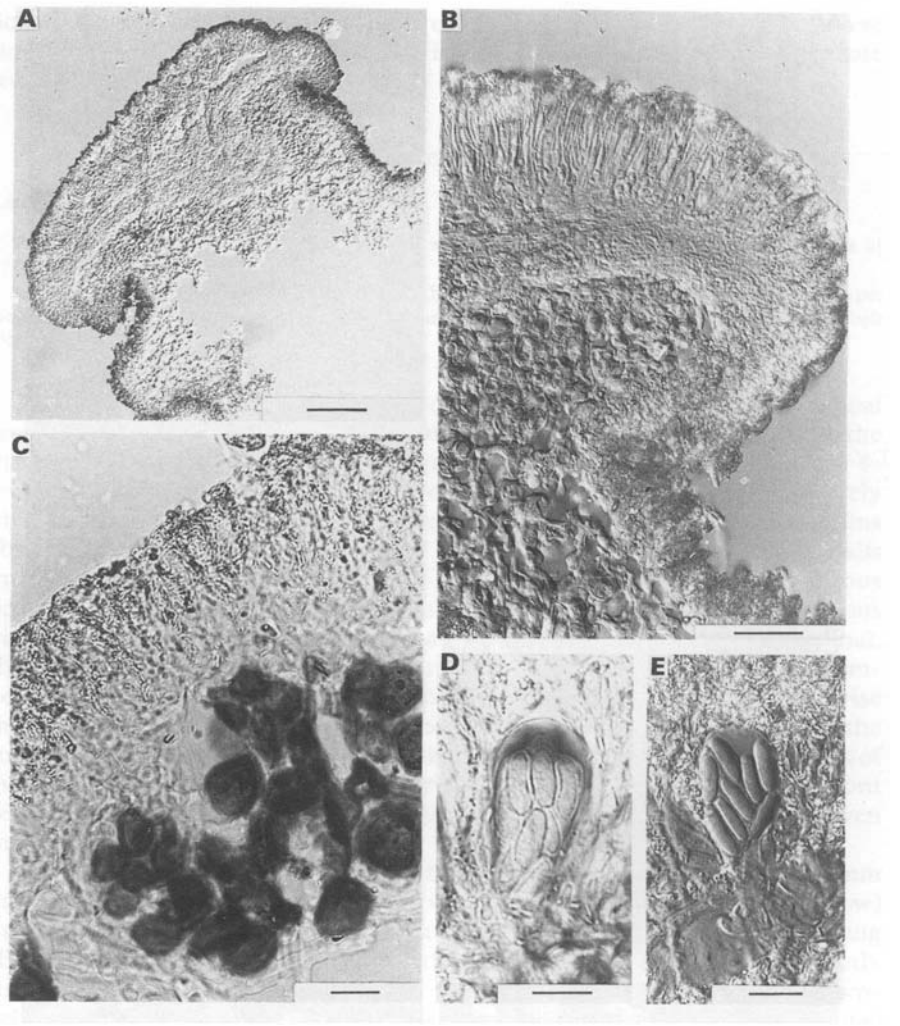

FIG. 2. Vertical section through ascocarp and thallus of *Lecanora somervellii*. A, Apothecium. B, Margin of apothecium. C, ' True cortex ', lacking algal cell walls (in chlor-zinc-iodine). D, Mature ascus (in Lugols iodine), with broad ' chambre oculaire ' and ' masse axiale '. E, Ascospores. Scales: A = 100 μm; B = 50 μm; C–E = 10 μm.

Chemistry: Thallus and apothecia K(+) brown (reddish), C−, PD−, N−; Medulla I(+) pale pink, K−, C−, PD−, N−. Lichen compounds: Usnic acid, calycin, rangiformic acid, ± norrangiformic acid; solvent systems A, B′, C (Culberson 1972; Culberson & Johnson 1982; White & James 1985).

The following specimens have been compared chemically with *L. somervellii:*

Candelaria concolor (in order to identify calycin): **Austria**, Kärnten, Nationalpark Hohe Tauern, Schobergruppe, Gößnitztal, Wirtsbaueralm, Bereich der Wirtsbauerhütte, 1750–1800 m (GF 8942/4), 4 September 1988, *M. Walther* (GZU)—with calycin and pulvinic dilactone.

Cladonia rangiformis (in order to identify rangiformic acid and norrangiformic acid): **Italy**, Ligurien, Pr. La Spezia, N. obh. Monterosso gegen Soviore, *c.* 400 m. 28 April 1962, *M. Steiner* (4331) (GZU)—with atranorin, rangiformic acid, norrangiformic acid (all compounds also detected by *K. Ammann* in adnot.).

Lecanora concolor: **France**, Korsika, Asco-Tal, Haut Asco, Anstieg von Haut Asco zum Grat N des Capo Stanciacone, *c.* 1500–1700 m, auf Porphyr. 9 September 1990, *W. Obermayer* (2211) (hb Obermayer)—with usnic, rangiformic, and norrangiformic acids.

Lecanora diaboli: **France**, Dept. H. tes Alpes, Südosthänge des Grand Area, NNW Briancon, ±2300 m, Kalk, 11 June 1970, *J. Poelt* (8480) (GZU)—with usnic and rangiformic acids.

Lecanora disperso-areolata: **Austria**, Tirol, Rhätische Alpen, Samnaun-Gruppe, Gipfel des Pezid, westlich Serfaus, um 2760–2770 m, Kalkschiefer, 12 September 1972, *J. Poelt* (GZU)—with usnic, psoromic, and rangiformic acids (all compounds also detected by *Michalski & Leuckert*, in adnot.).

Lecanora orbicularis: **Austria**, Steiermark, Niedere Tauern, Anstieg vom Hauser Kaibling auf den Höchstein, S von Haus/Ennstal, südl. Abhänge knapp unter dem Gipfel, *c.* 2450 m, Überhang, 8 October 1977, *J. Hafellner & E. Wind* (GZU)—with usnic, rangiformic, and norrangiformic acids.

Ecology and distribution: Lecanora somervellii grows on steep to ±overhanging sides of very hard siliceous rocks in an altitude range of about 3750 m (neotype) to around 5540 m.

No other collections except those cited are known to us. Wei & Jiang (1986) also failed to report the species from Xizang, Tibet. We believe, that *L. somervellii* is a member of a High Himalayan (?western Chinese) geographical element of lichens, which may include, for example, several species of *Cetraria* and *Umbilicaria* as well as several crustose lichens as yet incompletely studied.

The neotype-collection is associated with an *Acarospora* sp. (thallus brown) and *Protoparmelia badia* coll.

Additional specimens examined: **Tibet:** *Himalaya*, Langtang-Gruppe: Shisha Pangma, Nordabdachung, 5230 m, 10 September 1984, *G. Miehe* (GZU) (associated with *Aspicilia* sp.).—**Nepal:** *Langtang Area*, above Pemdang Karpo, 5000 m, rock overhang, 5 October 1986, *G. & S. Miehe* (13425 (GZU) (associated with *Lecidea* sp. [thallus brown, medulla I−, K−, KC+ with the typical spot test-colour of lobaric acid]. *Mahalangur Himal*, Khumbu, Höhe westlich über Gorak Shep, 5540 m, September 1962, *J. Poelt* L1586 (M) (associated with *Lecanora* cf. *chondroderma, Sporastatia testudinea* coll., *Umbilicaria hypococcina*).

Discussion

The lemon-yellow colour of the thallus and apothecia of *Lecanora somervellii* (due to calycin) is very unusual in *Lecanora*. The presence of this pigment suggests a possible taxonomic affinity outside the genus *Lecanora*. In shape and colour the species resembles some effigurate yellow species of *Acarospora*, for example *A. oxytona* (Wahlenb.) Massal. or *A. gobiensis* Magnusson. The eight-spored asci of *Lecanora somervellii* might support an octospored precursor of this group but the different structure of the asci forbids such considerations. A second possible relationship may be with *Candelariella*, in which many species have asci with eight spores. However, this hypothesis must also be rejected due to significant differences. The anatomical structure of *L. somervellii* completely differs in having much thicker-walled hyphal cells when compared with *Candelariella*, and the ascus types are also very different. Paulson's assumption of a close affinity of his new lichen with *Aspicilia* cannot be correct because of significant differences in ascus type, thallus structure and chemistry; the paraphyses are not, as he indicates, distinctly moniliform, only somewhat articulated.

Perhaps the closest affinity is to species currently treated within *Lecanora*. *L. sulphurella* Hepp, from Macaronesia and south west Spain, has at least a partly ± yellow colour of the thallus due to the presence of calycin (see Follmann & Huneck, 1976: 13; Leuckert & Mayrhofer 1985: 103). However, the shape and structure of the thallus and other (also chemical) characters exclude any connection with this species. Usnic acid, which, besides calycin, is the main compound in *L. somervellii*, is lacking too. Although usnic acid is fairly common within the genus *Lecanora* (but is absent in the *L. subfusca* group, including the type species of the genus) there are other characters that suggest a closer relationship with the sect. *Petrasterion* subsect. *Concolores* (see Poelt 1958: 473, 488); this subsection should be elevated to a higher taxonomic rank in the future. At the present time this group includes the following species: *L. concolor* Ram., *L. diaboli* Frey & Poelt, *L. disperso-areolata* (Schaerer) Lamy, *L. orbicularis* (Schaerer) Vainio. *Lecanora somervellii* essentially agrees with these last-named species in the shape of the thallus, in having a ' true cortex ', containing usnic (see Eigler & Poelt 1965; Huneck & Follmann 1968), rangiformic and norrangiformic acids (see Ryan 1990: 94), and in having an almost similar structure of apothecia and asci. Ecology and distribution are also in common with the species mentioned: all are lichens of high mountains occurring in extreme conditions on specific rock types, either limestone-marl (*L. diaboli*), calcareous schist (*L. disperso-areolata*) or specific types of siliceous rocks differing somewhat from the normal type of granite, gneiss or schist (*L. concolor, L. orbicularis*). They are confined to alpine areas up to the regions of permanent snow cover.

In *L. somervellii* adaptation to the extreme intensity of radiation at a height of between 3750 and 6000 m above sea level has probably encouraged the synthesis of a pigment of a different chemical group (in addition to usnic acid, which works as the usual light protector within the subsection). That leads to the question of whether such pigment changes can have occurred several times within the evolution of lichens. This aspect is to be thoroughly discussed in a forthcoming paper. It should be noted that in *L. orbicularis* protection against strong light intensity is obtained in another way; in nival habitats the thalli look blue-green tinted or are completely blue-green coloured by an unknown amorphous pigment in the fungal cell walls of its cortex, in addition to the crystallized granules of usnic acid.

Lecanora somervellii, therefore, agrees with subsect. *Concolores* in all main characters except for the presence of calycin, which is lacking in the other species of that group. Within the group, the lichen seems to have closest affinity to *L. concolor* and *L. orbicularis*, having the same morphology and preferring non-calcareous rocks.

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