Muelleria

42: 49–62

Published online in advance of the print edition, 24 June 2024

ROYAL BOTANIC GARDENS VICTORIA

Circumscribing *Propolis farinosa* (Fungi, Ascomycota) I: Typification and notes on the identity of *Propolis alba*, a synonym

Jason M. Karakehian[1,2], Andrew N. Miller[1]

[1] Illinois Natural History Survey, University of Illinois at Urbana-Champaign, 1816 South Oak Street, Champaign, IL 61820, USA; e-mail: jasonmk3@illinois.edu, amiller7@illinois.edu

[2] Department of Plant Biology, University of Illinois at Urbana-Champaign, 505 South Avenue, Urbana, IL 61801, USA

Introduction

Propolis farinosa (Pers.) Fr. is the type of *Propolis* (Fr.) Corda (Leotiomycetes, Marthamycetales), a widespread and commonly occurring apothecial fungus that is associated with numerous species of woody plants (Fig. 1). A presumed saprobe, *P. farinosa* produces apothecia that are erumpent through wood, bark, and seed cones of *Pinus* species. Although small, a gregarious fruiting of *P. farinosa* can be conspicuous to the naked eye. A developing apothecium is immersed within plant tissues, with the hymenium covered by a layer of fungal and dead plant tissues. At maturity, the hymenial elements become turgid, and this action forces the covering layer to split open irregularly and bend back to expose the hymenium. This results in the covering layer becoming a projecting, ragged-edged, reflexed structure that surrounds the exposed hymenium, which we term "marginal flaps" or simply, "flaps". The flaps are somewhat delicate and in some specimens they may be broken off at the level of the surface of the hymenium. Another distinctive feature of *P. farinosa* is a ± thick, farinose layer that covers the surface of the hymenium (pseudoepithecium). This ranges in colour from stark white to cinereous grey or dingy tan. The inner surfaces of the flaps are dark brown to black and ± covered in a light dusting of farinose material. Apothecia do not have an excipulum; rather, the subhymenium is seated directly on degraded plant cells. Paraphyses are filamentous with apices that are immersed in the farinaceous substance and somewhat contorted or with short branches. Asci are cylindric-clavate with undifferentiated apices. When immature the ascus wall is somewhat laterally thickened but thinner at the tip. In mature, turgid asci, the apex becomes dome-like and the ascus wall ± uniformly thin. No

Abstract

To circumscribe *Propolis farinosa* (Pers.) Fr., type of the taxonomically understudied genus *Propolis* (Fr.) Corda, we investigated the nomenclature and taxonomy of the synonym *P. alba* (Fr.) Fr. The basionym of *P. alba* is *Stictis alba* Fr., which has not been typified. We located original material in the form of specimens that are composed of white, powdery, crystalline bodies on rotten wood. We did not observe fungal reproductive structures, tissues, or spores in the materials that we examined. Here, we lectotypify *S. alba*, describe the type specimen, and conjecture as to the origin of the crystalline bodies. We conclude that *S. alba* is not a fungus and therefore not a heterotypic synonym of *P. farinosa.*

***Keywords*:** *Dactylospora*, Elias Magnus Fries, fungal nomenclature, fungus exsiccatae, history, mycology, *Scleromyceti Sueciae*, *Sclerotium*, typification

ISSN: 0077-1813 (print) · ISSN: 2204-2032 (online)

part of the ascus reacts in iodine-based reagents, even after pretreatment in 10% KOH. Ascospores are smooth, aseptate, and cylindric with obtuse poles, and are slightly curved or occasionally straight. In a living ascospore, two large guttules flank the nucleus that is in the middle of the spore (Bellemère 1967: 428–433, Chlebická 2014, Minter 2019).

The circumscriptions of *Propolis* and *P. farinosa* are unclear due to a lack of critical examination of type materials. Minter (2003) produced a nomenclator of *Propolis* based on literature research that provided an exhaustive list of names in the genus, but with a broad-sense circumscription of *P. farinosa* that contained several synonyms. Research by Chlebická (2014) and our preliminary studies indicate that some of these proposed synonyms represent distinct species. A revised circumscription of *P. farinosa* will clarify the definition of this species and refine our current understanding of its distribution and ecology. It will also facilitate the identification of new taxa in *Propolis*, which we believe is more diverse than previously thought.

One species that was listed as a synonym of *P. farinosa* in Minter (2003) is *Propolis alba* (Fr.) Fr. (Fries 1849). The basionym of *P. alba* is *Stictis alba* Fr., which is validly published in Fries ca. 1825, and sanctioned in Fries (1828) (Art. F.3.1. in May *et al*. 2019). *Stictis alba* is a replacement name for *Sclerotium album* DC. (Arts. 6.11 in Turland *et al*. [2018], hereafter cited as *ICN*), a later, illegitimate homonym of *S. album* Schumach. (Art. 53.1 of *ICN*). Although Fries (1828) did not explicitly propose *Stictis alba* as a substitute name for *Sclerotium album*, it is nevertheless a replacement name because Fries (ca. 1825) cited "Sclerotium album. Decand." (Art. 6.12(a) of *ICN*). *Stictis alba* has not been previously typified.

Here we outline our search for original material of *Stictis alba* and provide a description of the specimen that we designate as lectotype. We also provide an analysis of the literature surrounding *Stictis alba* and our conclusions regarding the application and placement of this name.

Methods

Literature research

We compared the handwriting on specimen labels to handwriting samples of various botanists in Burdet (1979). This helped us to judge whether the handwriting on a given label was that of a particular mycologist.

Translations of text in French and Latin were made using Google Translate (https://translate.google.com/) and dictionaries, as well as Stearn (1992).

Fungarium research

We inquired of or examined materials held at the U.S. National Fungus Collections, Beltsville, Maryland, USA (BPI); Natural History Museum of Denmark/ University of Copenhagen (C); Farlow Herbarium of Harvard University, Cambridge, Massachusetts, USA (FH); Conservatoire et Jardin botaniques de la Ville de Genève, Genève, Switzerland (G); Muséum National d'Histoire Naturelle, Paris, France (PC); Academy of Natural Sciences of Drexel University, Philadelphia, Pennsylvania, USA (PH); National Museum, Prague, Czech Republic (PRM); and the Museum of Evolution of Uppsala University, Uppsala, Sweden (UPS).

Other specimen examined

Propolis farinosa. **UNITED STATES OF AMERICA**: Rhode Island, Providence county, Johnston, Snake Den State Park; 41.8389, -71.536, 111 m elev.; on fallen, decorticated log of *Acer* sp.; 10 Jun 2017; *J.M. Karakehian 17061001* (ILLS 00121779).

Morphology

Photomacrographs of specimens were made in a laboratory setting with a Canon EOS 6D digital SLR camera equipped with a Canon EF-S 60 mm or a Canon MP-E 65 mm lens with a ring light. Other macromorphological observations were made using a Motic SMZ-168 stereomicroscope.

Photomicrographs were made using transmitted light microscopy with an Olympus BX51 compound light microscope with 40×, 100×/1.30 oil immersion plan-achromatic objectives together with an Olympus XC50 5.0-megapixel digital camera and Olympus cellSens Standard 1.14 image processing software. Preparations were mounted in tap water, cotton blue stain in lactophenol, or pretreated in 10% KOH, rinsed with tap water, and then mounted in Congo red or IKI. Longitudinal sections of an apothecium of *Propolis farinosa* (ILLS 00121779) were made on an American Optical model 880 sliding microtome with an attached freezing stage (Physitemp BFS-5MP). The apothecium

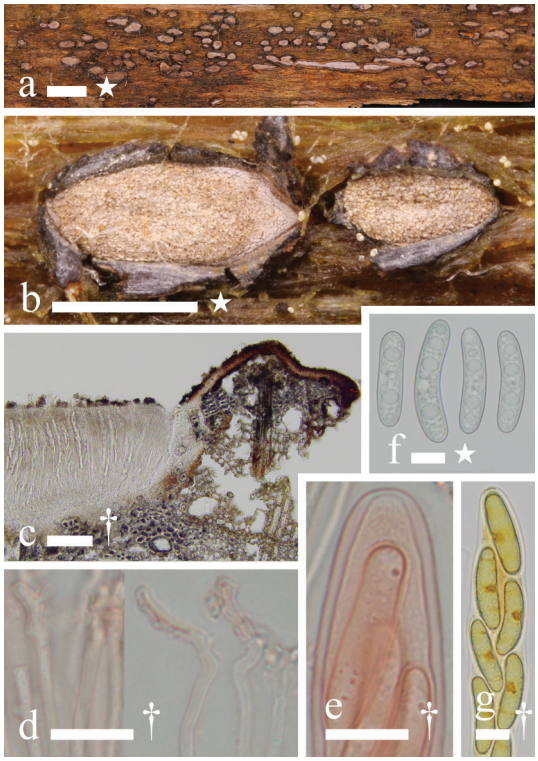


Figure 1. Morphology of *Propolis farinosa*, for comparison to the lectotype of *Stictis alba* shown in Fig. 2. Symbols used: † dead, ★ living. **a** Face view of apothecia in wood (hydrated). **b** Face view of two apothecia showing the erumpent habit and marginal flaps that surround the farinaceous disc (hydrated). **c** Longitudinal section of an apothecium showing apothecial structure and immersion in wood. **d** Apices of paraphyses. **e** Apex of an immature ascus showing immature ascospores and variation in lateral and apical ascus wall thickness. **f** Discharged, mature ascospores, showing nuclei (in the centre of the left two ascospores) and guttulation pattern. **g** Mature ascus with mature ascospores (nuclei stained, guttulation pattern obscured). **Specimen studied**: ILLS 00121779. **Reagents used**: **c**, **f** tap water; **d**, **e** 10% KOH pretreatment followed by water rinse, then dilute Congo red; **g** as in d, e but with IKI. **Scale bars**: **a** 5 mm, **b** 1 mm, **c** 100 µm, **d–g** 10 µm.

was embedded in dilute gum Arabic and sectioned to 15 µm thickness at the middle of the apothecium. Sections were mounted in tap water.

Images were processed in Adobe Photoshop 24.5 and plates made in Adobe Illustrator 27.5. To save space, Fig. 1f is a photomontage.

Results/Discussion

Taxonomy

***Propolis (Fr.) Corda. Icon. fung*. 2: 38 (1838)**.

≡ *Stictis* subg. *Propolis* Fr., *Syst. mycol.* 2(1): 192, 198 (1822); nom. sanct. (l.c. 1822: 192).

Type: *Propolis farinosa* (Pers.) Fr. Summa veg. Scand., Sectio Post.: 372 (1849).

≡ *Stictis farinosa* Pers., Mycol. eur. 1: 339 (1822); nom. sanct. (Fr. Syst. mycol. 2(1): 198 1822); nom. cons. prop. (Karakehian *et al*. 2023).

Type specimen: **FRANCE**: Charente-Maritime, Île de Ré, Saint-Martin-de-Ré, Les Maraises; 46.190157, -1.353115, 16 m elev.; on decorticated branch, diam 6 cm, still attached to snag of *Populus nigra*; 20 Nov 2022; *Hairaud MH71122* (ILLS 00122396!, ex-type culture: CBS 149801); typ. cons. prop. (Karakehian *et al*. 2023).

Taxon excluded from *Propolis*.

***Propolis alba* (Fr.) Fr., *Summa veg. Scand. Sectio Post*.: 372 (1849).**

≡ *Stictis alba* Fr. Fries, *Scleromyc. Suec*., Fasc. 9, decade 34, no. 335 (ca. 1825), nom. nov.; nom. sanct. (Fries Elench. fung. 2: 27. 1828).

Replaced synonym: *Sclerotium album* DC. Fl. franç., 3rd edn. 5/6: 112 [no. 744b] (1815), nom. illegit. (Art. 53.1 of *ICN*).

Competing homonym: *Sclerotium album* Schumach. Enum. pl. 2: 186 (1803).

Typification: Lectotype designated here: On decorticated wood of *Acer pseudoplatanus*. *J. F. de Chaillet no. 235*, G 00584953! (MB 10020421).

≡ *Xylogramma album* (Fr.) Wallr., Fl. crypt. Germ. 2: 510 (1833).

≡ *Hymenula alba* (Fr.) Corda, Icon. fung. 2: 32, Tab. 14, fig. 112 (1838).

Description of lectotype specimen G 00584953 (Fig. 2). Bodies composed entirely of compact, granular crystals; no fungal reproductive structures, tissues, or spores observed. Bodies elliptical or highly elongated, 2–15 × 1–2 mm, convex, chalky white, friable at the outer surface but ± solid below, sessile or immersed in the rotten wood substratum to varying depths, presumably becoming exposed by erosion of the surrounding substratum over time, *crystals* irregular in shape and variable in size, insoluble in water.

Additional original material (Fig. 3a–d): In Fries (ca. 1825), no. 335, issued ca. 1825: C F-109700, UPS (sans number, in bound copy), PRM 735152(?), PH 00083643, BPI 1050201(?).

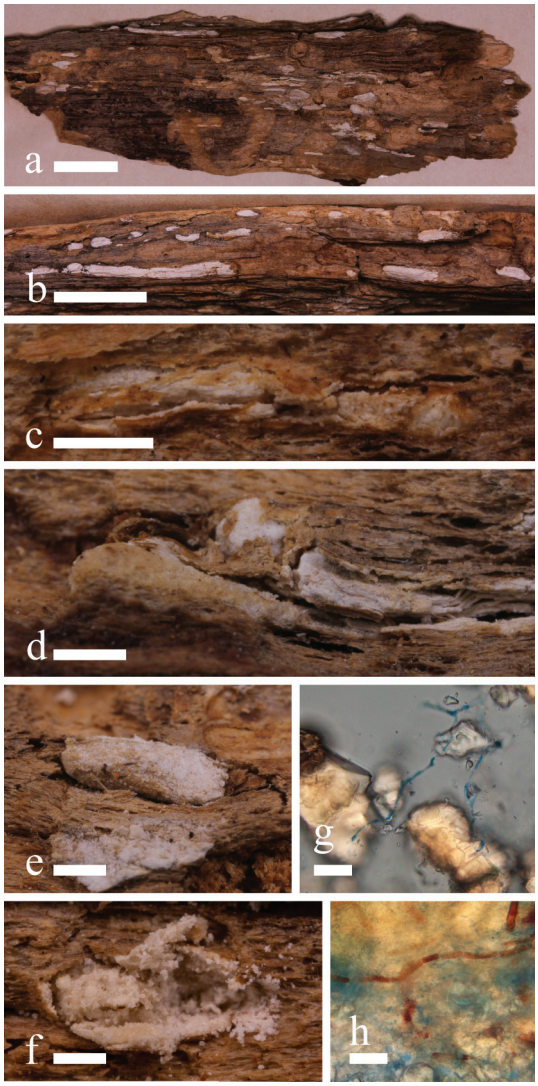


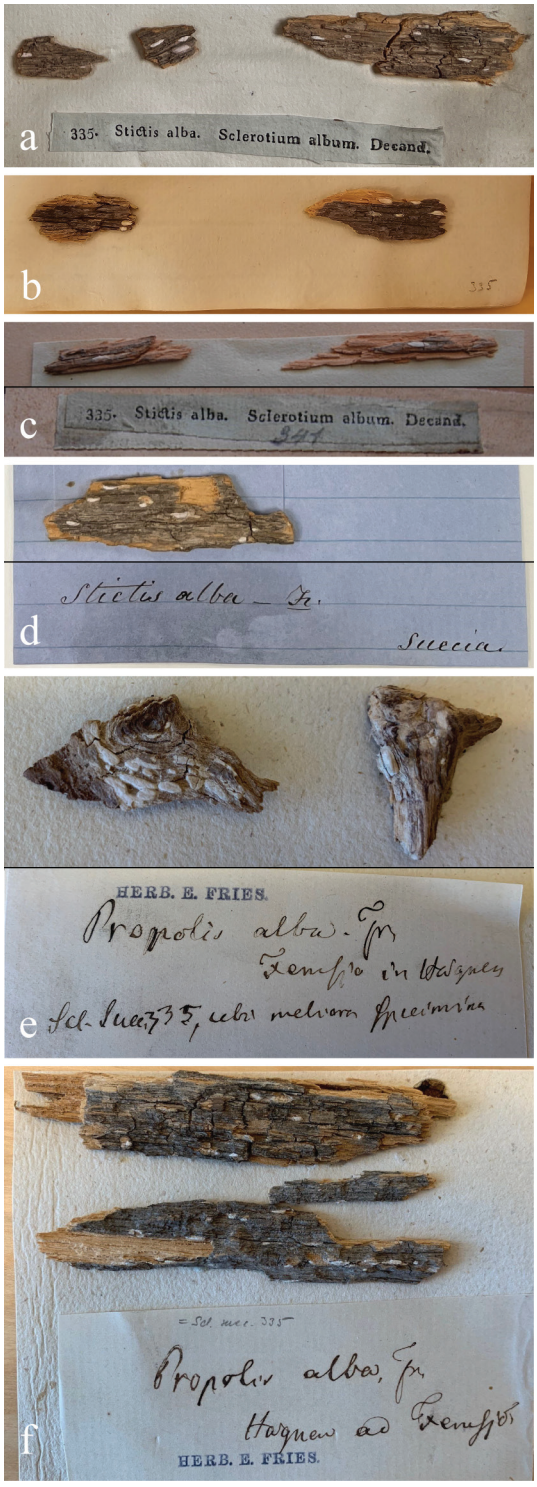
Figure 2. Morphology of the lectotype of *Stictis alba*, G 00584953. **a** Face view of crystalline bodies in wood (dry). **b** detail of crystalline bodies from upper portion of specimen shown in a. **c–e** Details of crystalline bodies with surrounding woody substratum worn away to various degrees. **f** Detail of a crystalline body that has been probed apart on the right side to show the body is composed entirely of crystals and is deeply immersed in the wood. **g** Crystals in cotton blue/lactophenol showing narrow, hyaline hyphae. **h** As in g, but showing somewhat thicker, brown, septate hyphae (blue stained areas are the narrow, hyaline hyphae shown in g). **Scale bars**: **a, b** 1 cm, **c–f** 1 mm, **g–h** 20 µm.

Additional specimens examined. **SWEDEN**: Småland, Halland, Hylte (Femsjö parish), Hägnen; [approximately] 56.898, 13.338, 158 m elev.; (UPS F-543499, UPS F-117771 [both labelled by Fries as *Propolis alba*]) (Fig. 3e–f). Småland, Halland, Hylte (Femsjö parish), Bökeberg; 56.9003, 13.38158, 167 m elev.; in pastureland, on rotten wooden post of undetermined wood; 20 Sept 2023; *J.M. Karakehian 23092009* (ILLS 00122483).

Additional notes based on observations of the lectotype and additional specimens. Since the crystalline bodies are not erumpent apothecia, they do not produce marginal flaps like those of *Propolis farinosa* (Fig. 1b–c). When a drop of water is applied to the crystals, it quickly flows through them and into the surrounding substratum, but the crystals themselves are not water soluble. The water does not form droplets on the surface of the bodies as it does on the hydrophobic, farinaceous discs of *Propolis* species. We did not attempt to characterise the chemical composition of the crystals. In the lectotype, we observed two types of hyphae that lacked clamp connections and that were sparsely interwoven among and upon the crystals: hyaline hyphae, approximately 2.5 µm diam (Fig. 2g) and brown hyphae, 3.6–4.2 µm diam (Fig. 2h). The substratum of specimens UPS F-543499 and UPS F-117771 appears to be *Quercus* wood (Fig. 3e–f). Fries (1828) noted that *S. alba* occurred on *Quercus* species in northern and southern Europe. Common oak species in Europe include *Q. robur* and *Q. petraea*. Our colleague at UPS examined UPS F-543499 and found only crystalline bodies with no fungal reproductive structures, tissues, or spores (Åsa Kruys, pers. comm. 9 Aug. 2022). We dissected several exposed crystalline bodies with a probe on specimen ILLS 00122483 and observed that occasionally these continued below the substratum, forming short tubes that ran ± parallel to the surface of the substratum. We observed hyaline hyphae, 2.2–3 µm diam and lacking clamp connections, associated with the crystals in this specimen. We studied the macromorphology of the additional original materials listed above using images (Fig. 3a–d).

***Nomenclatural history: The date of valid publication of* Stictis alba**. While the name *Stictis alba* is sanctioned in Fries (1828), we suspected that it could have been validly published earlier because Fries (1828) cited specimens in his published fungus exsiccata, *Scleromyceti Sueciae*

(Fries ca. 1825). Fries's (1828) citation was minimal, giving only "Fries exs. fasc. IX", which is a reference to fascicle nine of this exsiccata (Fries ca. 1825, Holm & Nannfeldt 1962, Karakehian *et al*. 2024a). It was only later in 1849 that Fries provided the species number, 335 (Fries 1849). Fortunately, prior to 1849, a reader could have located the distributed collection in fascicle nine that Fries (1828) called *S. alba* because it was labeled as such at the time this fascicle was issued; this was not the case for other of Fries's citations of specimens in the *Scleromyceti Sueciae* (Holm & Nannfeldt 1962, Karakehian *et al*. 2024a [e.g., *S. atrocyanea*]). We verified that *S. alba* was validly published ca. 1825 by examining images of the printed index and a specimen of number 335 (C F-109700) in a complete copy of fascicle nine held at C (Karakehian *et al*. 2024a, Figs. 3–4). The specimen bears an original, printed label that was cut out from a single-sided print of the index (l.c. Fig. 4, Fig. 3a here). Because the index and the label are printed, the name *Stictis alba* is effectively published (Art. 30.8 of *ICN*). It is validly published because an additional note in the index and label gives "Sclerotium album. Decand.", which is a reference to Candolle's (1815) effectively published description and diagnosis (Art. 38.1 of *ICN*).



***Nomenclatural considerations toward a typification of* Stictis alba**. Because *Stictis alba* is a sanctioned name, it may be typified by the type of the replaced synonym (Art. 7.4 of *ICN*), *Sclerotium album*, or a lectotype (Art. 9.3 of *ICN*) may be chosen from elements associated with the sanctioning treatment (Art. F.3.9 in May *et al*.

LEFT: Figure 3. Original material and additional specimens of *Stictis alba* originating from Elias Fries. **a–d** Original material held in various fungaria, from Elias Fries's fungus exsiccata *Scleromyceti Sueciae*, fascicle nine, number 335 (Fries ca. 1825); printed labels were cut out from single-sided prints of the index that was included in the fascicle (cf Karakehian *et al*. 2024a). **e–f** additional specimens. **a** C F-109700, this specimen is part of a bound, complete copy of Fries (ca. 1825) at C (first edn.). **b** UPS (sans number), in an incomplete, bound copy of fascicle nine that is missing printed labels; this copy is a preliminary or "specimen copy" given to Göran Wahlenberg by Fries around 1823 (Holm & Nannfeldt 1962, Karakehian *et al*. 2024a). **c** PRM 735152, presumably from the first edition, loose specimen. **d** PH 00083643, presumably from the first edition, specimen sent to L.D. von Schweinitz by Fries, remounted by E. Michener (Shear *et al*. 1917, Shear & Stevens 1917) **e** UPS F-117771, label written by Fries: "Femsjo in Hagnen. Scl. Suec. 335, ubi meliora specimina [Femsjö in Hägnen. Scleromyceti Sueciae 335, wherein better specimens]." **f** UPS F-543499, label written by Fries: "Hagnen ad Femsjo", the annotation "= Scl. suec. 335" is is a later addition. **Images courtesy of**: **a** Christian Lange at C, **c** Markéta Šandová at PRM, **d** Chelsea Smith at PH.

744b. Sclérote blanc. *Sclerotium album.*

S. immersum γ clandestinum. Tode Mekl. 1, p. 3, f. 4? — *S. ægerita.* Hoff. Germ. 2, t. 9, f. 1?

Il croît dans l'intérieur et à la surface du bois pourri, enfoncé dans de petites cavités qu'il remplit en tout ou en partie : il est de couleur blanche, de consistance charnue et comme un peu farineuse à la surface ; sa forme est ovale, un peu aplatie, et il est couché sur sa plus grande surface. Sa longueur est d'environ 2 lignes. M. Chaillet l'a trouvé sur l'érable faux platane. Le nom et la figure de Tode lui conviennent très-bien; mais comme cet auteur dit que sa plante est d'un jaune paille, et qu'elle se trouve sur les feuilles du chêne et dans les fentes de l'écorce, je doute qu'elle puisse être la même que la mienne.

Figure 4. Protologue of *Sclerotium album* DC (Candolle 1815: 112).

2019) that are considered equivalent to original material (Art. F.3.9 Note 2 in May *et al*. 2019). Neither *Stictis alba* nor *Sclerotium album* have a holotype (Art 9.1 of *ICN*, McNeill 2014) and we found no previous typifications by searching under these names using online fungus name databases (http://indexfungorum.org, https://mycobank.org), Sherwood (1977: 149), and general internet queries.

***Elements cited in the protologue of* Sclerotium album *and in the sanctioning treatment of* Stictis alba**. No original material in the form of illustrations were cited in the protologue of *Sclerotium album* (Candolle 1815) or in the sanctioning treatment of *Stictis alba* (Fries 1828). We note that Candolle (1815) cited illustrations in Tode (Tode 1790: 3, Tab. 1, Fig. 4) and Hoffmann (Hoffmann 1796: Tab. 9, Fig. 1), but these are not original material because they are doubtfully included and then only for the purpose of comparison to his new species (Art. 52.2, Note 1 of *ICN*). For ease of reference in the analysis of original materials in the form of specimens that follows, the protologue and sanctioning treatment are reproduced here with English translations (with our editorials given in brackets).

Sclerotium album (Fig. 4).

744b. *Sclerotium album.*

S. immersum γ clandestinum. Tode Mekl. I, p. 3, f. 4? [Tode 1790: 3, Tab. 1, Fig. 4] — *S. aegerita.* Hoff. Germ., 2, t. 9, f. 1? [Hoffmann 1796: Tab. 9, Fig. 1]

It grows in the interior and on the surface of rotten wood, buried in small cavities which it fills in whole or in part: it is white in color, fleshy in consistency and somewhat floury on the surface; its shape is oval, a little flattened, and it lies on its largest surface. Its length is approximately 2 lines [4.2 mm]. Mr. Chaillet found it on the false plane maple [*Acer pseudoplatanus*]. The name and figure of Tode suit it very well; but as this author says that his plant is of a straw yellow, and that it is found on the leaves of the oak and in the cracks of the bark, I doubt whether it can be the same as mine (Candolle 1815).

No specimens or gatherings are cited in this protologue. However, the information concerning an observation by Jean Frédéric de Chaillet (Stafleu & Cowan 1976) on *Acer pseudoplatanus* could be helpful to identify original material in the form of a specimen.

Stictis alba (Fig. 5).

17. c. *S[tictis] alba,* erumpent, projecting, elongate, immarginate, constantly snow-white, disc convex, farinaceous.

Sclerotium album. *Dec.! Fl. Franc. et in Mem. Mus. d'Hist. Nat.* 1816. p. 411. *Chaillet! in correspondence* (What others, forced by the authority of *Wallroth*, sent under this name is Stictis versicolor). Stictis alba. *Fries exs. fasc. IX.*

And the affinity of this with *Stictis versicolor* is clear, yet the species is clearly different and remarkable, almost in the habit of the sclerotia, especially in the old *superficial* state. It appears floury as a whole, but the texture is flaky and initially there are a large number of genuine asci. There is no limbus [marginal flaps]. The colour is constantly white and becomes more snowy with age, never turning black. *To the oak trees of* Europe*, both northern and southern.* (v.v. [vidi vivam*:* I have seen it in a living state]) (Fries 1828).

Fries (1828) cites various elements in this treatment. The exclamation points in "Sclerotium album. *Dec.!*" and "*Chaillet! in litt.* [*in litteris*]" indicate that Fries had personally examined a specimen from Candolle, as well as correspondence by Chaillet (cf. Fries 1823: [621] ["… to the numerous species of *Chaillet*, … add – ! … I have

17. c. *S. alba*, erumpens, prominens, elongata, immarginata, constanter nivea, disco convexo farinaceo.

Sclerotium album. *Dec.! Fl. Franc. et in Mem. Mus. d'Hist. Nat.* 1816. *p.* 411. *Chaillet! in litt.* (Quod alii, v. c. ob auctoritatem *Wallroth*, sub hoc nomine miserunt, est. St. versicolor). Stictis alba. *Fries exs. fasc. IX.*

Et hujus cum *S. versicolori* affinitas perspicua est, tamen species luculenter diversa et insignis, habitu fere Sclerotii, praecipue in statu vetusto *superficiali*. Farinacea apparet tota, tamen contextus adest floccosus et primitus adsunt asci ampli genuini. Limbus nullus adest. Color constanter albus et senescens magis niveus, numquam nigrescens. *Ad ligna quercina* Europae *tam borealis, quam australis.* (v. v.)

Figure 5. Sanctioning treatment of *Stictis alba* Fr. (Fries 1828 2: 27).

used this sign in the sense of DeCandolle"], Stearn 1992: 352). Fries also cites specimens distributed as *Stictis alba* in fascicle nine [no. 335] of his *Scleromyceti Sueciae* (Fries ca. 1825).

We are uncertain about our translation of Fries's comment in parentheses about Karl Friedrich Wilhelm Wallroth and *Stictis versicolor*. It may be that Wallroth sent Fries a specimen of *Stictis versicolor* (= *Propolis farinosa*) that was misidentified as *Sclerotium album*: we examined a specimen labelled "*Sclerotium album* DC." written in what may be Wallroth's script in the Fries fungarium at UPS (F-175307) that is *P. farinosa*. It may also be that somewhere Wallroth used the name *Sclerotium album* to refer to what Fries considered to be *Stictis versicolor* and others followed Wallroth's concept and used the name as he had.

We also cannot account for Fries's (1828) statement that the bodies of *Stictis alba* initially contained a large number of asci. Fries thought *S. alba* was similar to *S. versicolor* (= *Propolis farinosa*), but considered it distinct in that the bodies were initially immersed in the substratum, though not erumpent because they lacked marginal flaps ("limbus"), and produced asci. As the bodies aged they became superficial, and the asci were gradually replaced by crystals until the hymenium was entirely farinaceous with a flaky texture. Fries (1832: 468) summarised his wide concept of the hymenium in species of *Stictis*: "It would take too long … to enumerate all the changes of the disc … for they can be seen with and without asci, deliquescent, powdery, etc." (in Tulasne & Tulasne 1931 [vol. 1]: 226). Although prior to 1832 Fries did not employ a microscope with any regularity because of the poor quality of the optics at the time (in Fries & Fries 1955: 144, 147), Fries's (1828) observations may be trustworthy. In the protologue of *Sclerotium album*, Candolle (1815) described the bodies as fleshy in consistency and somewhat farinaceous on the surface, and Corda (1838) described a specimen of *Stictis alba* issued in the *Scleromyceti Sueciae* as a conidiogenous fungus. Regardless, we did not observe any fungal tissues, reproductive structures, or spores in the specimens that we microscopically examined. We presume that this is the case with the specimens that we were only able to study images of because these appear to have the same crystalline bodies (Fig. 3a–d). We speculate that Fries may have examined specimens of *P. farinosa*, which have asci, in addition to those of *S. alba*, which are entirely crystalline, as he prepared his treatment of *S. alba* (Fries 1828).

Account of the original material that we located. The original material that we located through our studies of the protologue of *Sclerotium album* (Candolle 1815) and the sanctioning treatment of *Stictis alba* (Fries 1828) include a specimen of *Sclerotium album* from Chaillet on *Acer pseudoplatanus* that Candolle had studied in preparation of the protologue, and specimens of *Stictis alba*, number 335, issued in Fries's *Scleromyceti Sueciae* (Fries ca. 1825). These are described as follows.

Sclerotium album. The morphology of a specimen in the fungarium at G, G 00584953, agrees with the protologue of *Sclerotium album* and several elements associated with the packet labels (Fig 6a) suggest it is original material. First, a printed label associates the specimen with the Candolle family herbarium (Fig. 6b) (Stafleu & Cowan 1976: 438). An English translation of this reads: "Given in 1921 to the City of Geneva by Mme Augustin de Candolle and her children. —Series not having been used for the drafting of either the *Prodromus* or the *Monographiae Phanerogamarum*, gathered in the general collection of the Herbier Delessert from 1924". Second, two portions of undated correspondence from Chaillet to Candolle are affixed to the specimen (Fig. 6c), elements of which appear in the protologue. These are transcribed and translated to English as follows:

> "Sclerotium Aegerita. Hoff.: 2. t. 9. f. 1? Je doute que ce soit cette Plante, mais je ne sais pas où la rapporter et si ce n'est pas celle d'Hoffmann elle s'en rapproche beaucoup. No. 235. Acer Pseudo Plantanus"
>
> *"Sclerotium aegerita.* Hoff.: 2. t. 9. f. 1? I doubt it is this plant, but I don't know where to report it, and if it is not Hoffmann's it is very close to it. No. 235. *Acer pseudoplantanus"*
>
> "Sous un No. 235 je vous ai donné l'année dernière une plante sous le nom de Sclerotium aegerita? Il me paraît que c'est le Sclerotium immersum β Album Tode P. 3. La fig: 4 Pl[anche] 1 qui appartient à la Var: clandestina représente assez bien ma Plante."
>
> "Under a no. 235 last year I gave you a plant under the name of *Sclerotium aegerita?* It seems to me that it is the *Sclerotium immersum β Album* Tode p. 3. The fig. 4 plate 1 which belongs to the var. clandestina represents my plant quite well."

Third, on the reverse side of a small label bearing "*Sclerotium album* DC. 744b" (the species number of *S. album* in Candolle 1815) (Figs. 6a [lower left element], 6d), there is a fragment of notes in Candolle's script (Fig. 6e), portions of which appear to have been directly adapted to the protologue (parts of lines 2–3 and 6 correspond to parts of lines 5 and 7–9 of the protologue [Fig. 4]). Finally, there is an annotation by Joseph Henri Léveillé: "Nullum fructificationis vestigium adest [No trace of fruiting is present]" (Fig. 6f). Léveillé may have examined this specimen in preparation for his treatment of the genus *Sclerotium* (Léveillé 1843). The label pinned in the upper left of Fig. 6a with "Stictis alba. F." written on it was also written by Léveillé.

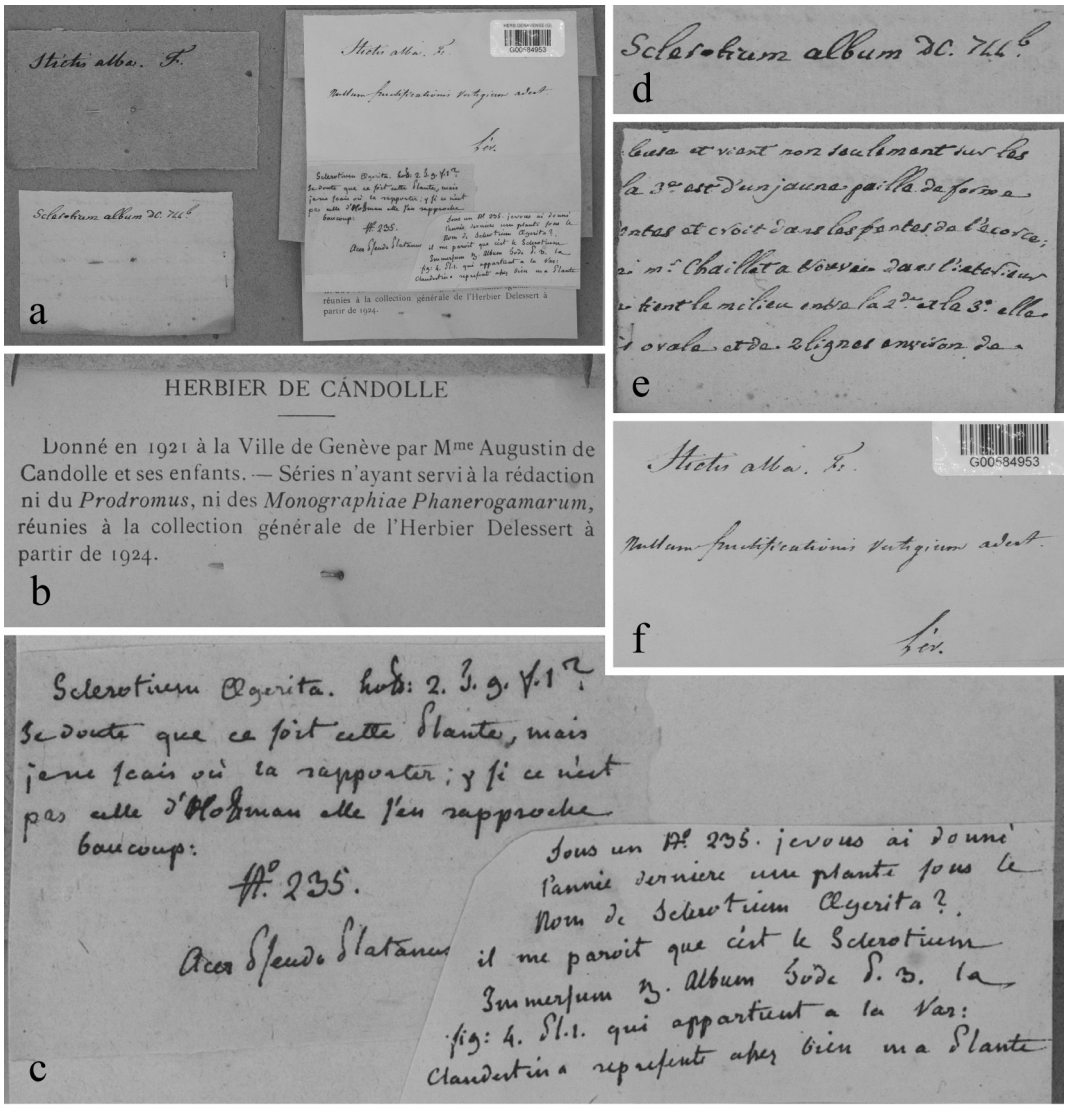


Figure 6. Label information on the lectotype of *Stictis alba*, G 00584953 (*Sclerotium album* DC). **a** Specimen packet and associated elements pinned to herbarium sheet. **b** Detail of printed label shown in a, lower right, giving the provenance of the specimen. **c** Detail of the lower portion of the packet label shown in a, right side, consisting of two portions of undated correspondence from J. F. de Chaillet to A. P. de Candolle, elements of which were incorporated into the protologue. **d** Detail of upper portion of the small label shown in a, lower left. **e** Detail of the reverse side of the small label shown in a, lower left, which is a fragment of notes written by Candolle, from a draft of the protologue because portions of this are copied verbatim in the published protologue. **f** Detail of the upper portion of the packet label shown in a, right side, annotation by J. H. Léveillé: "Nullum fructificationis vestigium adest [No trace of fruiting is present]".

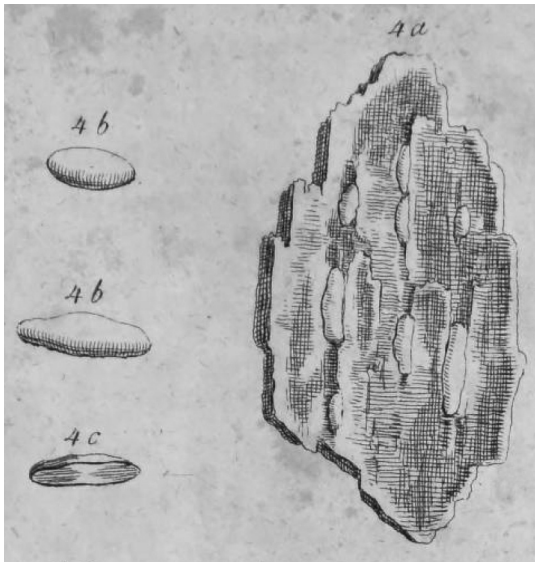


Figure 7. Illustration of *Sclerotium immersum* γ *clandestinum* Tode (Tode 1790: 3, Tab. 1, Fig. 4).

After studying G 00584953, we agree with Chaillet's assessment that this specimen closely resembles Tode's illustration of *Sclerotium immersum* γ *clandestinum* (Fig. 7, from Tode 1790: 3, Tab. 1, Fig. 4). Tode's illustration (Fig. 7, "4a") shows elongate, white bodies in the crevices of the substratum (cf. Fig. 2a–b), and detail drawings of the bodies (Fig. 7, "4b"–"4c") show that they are convex and lack marginal flaps (cf. Fig 2e).

Comparing the notes associated with specimen G 00584953 to the protologue of *Sclerotium album*, we were struck by the possibility that this may be the very specimen that Candolle used to write the description, although we cannot rule out that other material was not also used. We note that Chaillet's collection number, 235, does not appear in the protologue (Candolle 1815).

In the treatment of *Stictis alba*, Fries (1828) indicated that he had personally examined material of *Sclerotium album* from Candolle along with related correspondence by Chaillet. We speculate that the material of *S. album* that Fries studied is specimen G 00584953 because this appears to be a primary, if not the only, specimen that Candolle studied as he wrote the protologue. Furthermore, to our knowledge, it is the only specimen with this provenance that is preserved at G. If this is the case, it is possible that the Chaillet correspondence that Fries referred to is the same as that preserved with this specimen.

Stictis alba. We located several specimens of number 335, *Stictis alba*, issued in Fries's *Scleromyceti Sueciae* (Fries ca. 1825). Because these specimens were cited in the sanctioning treatment (Fries 1828) of this name, they are considered equivalent to original material following Art. F.3.9, Note 2 in May *et al*. (2019). We provide notes on these specimens, as well as some that are not original material, as follows.

Specimen C F-109700 is original material (Fig. 3a). It is from a complete, bound issue of fascicle nine that is part of the first edition of the *Scleromyceti Sueciae* (Fries ca. 1825). The specimen has an original, printed label that was cut out from a single-sided print of the index to this fascicle. Karakehian *et al*. (2024a) provide an overview of Fries's *Scleromyceti Sueciae* with a focus on fascicle nine, along with ample documentation of the copy of this fascicle at C.

A specimen at UPS (sans number) is original material (Fig. 3b). This specimen is in an early draft or "specimen copy" of fascicle nine that Fries gave to Göran Wahlenberg, Swedish botanist at Uppsala University, around 1823. This bound copy was missing the index and ten specimens but is well-documented as authentic by Holm & Nannfeldt (1962), with additional notes in Karakehian *et al*. (2024a).

A specimen at PRM is likely original material (Fig. 3c). Corda (1838: 32) studied a specimen of *Stictis alba*, number 335 and described it as *Hymenula alba* (Fr.) Corda. According to Pilát (1938) there is no specimen of number 335 in the Corda fungarium at PRM. However, we located one specimen, PRM 735152, filed in the general fungarium (Markéta Šandová, pers. comm. 26 May 2023). We examined an image of this specimen and it has a printed label that appears to have been printed on the same type of paper as the label on the specimen at C (cf. Fig. 3a). It is likely that this specimen is from the first edition of the *Scleromyceti Sueciae* (Fries ca. 1825), and not the second (Holm & Nannfeldt 1962, Karakehian *et al*. 2024a), but we are uncertain because the specimen is loose and there are no notes to indicate its history.

A specimen of *Stictis alba* in the Schweinitz fungarium at PH, PH 00083643, is arguably original material (Fig. 3d). Although the specimen lacks any original labels or other notes indicating that it originated from Fries (ca. 1825), there is the notation "Suecia" [Sweden] indicating that the specimen likely came from Fries. Schweinitz

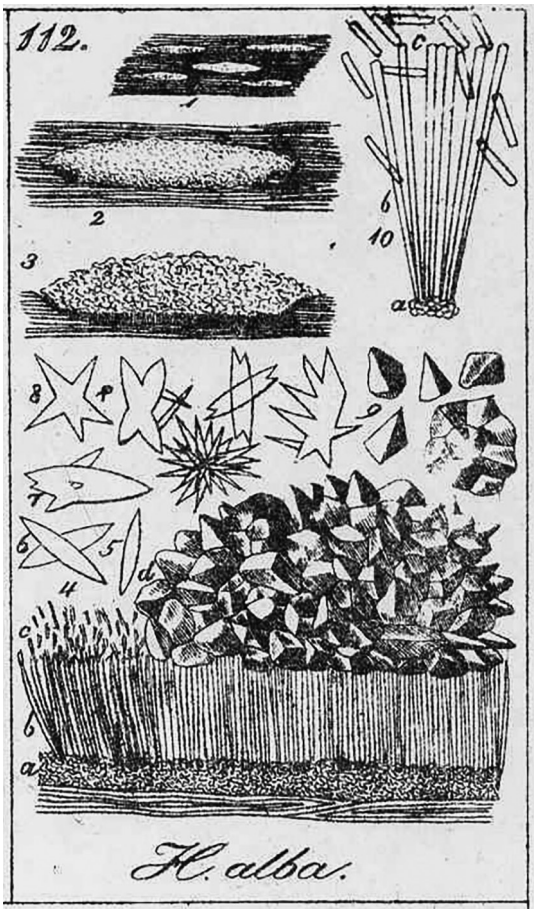


Figure 8. Illustration of *Hymenula alba* (Fr.) Corda (Corda 1838: 32, Tab. 14, fig. 112).

received copies of the *Scleromyceti Sueciae* from Fries, including fascicle nine (Shear 1949, Untereiner 2004), and it is probable that Schweinitz only ever received the first edition (Karakehian *et al*. 2024a). It is well documented that Schweinitz often discarded or re-wrote specimen labels attached to materials that he received from other mycologists (summarised in Karakehian *et al*. 2024a). In addition, later workers in Schweinitz fungarium such as Ezra Michener re-curated many specimens (Shear & Stevens 1917: 337), including this one, by gluing them to a new sheet of paper and copying the labels over (Shear *et al*. 1917). Michener sometimes did not transcribe all the data from the original labels (Shear & Stevens 1917: 338). We do not know if Michener failed to copy the *Scleromyceti Sueciae* species number 335 or if an original label was not with the specimen at the time he remounted the specimen. On face value, the specimen lacks labels or other, concrete information that would connect it to Fries (ca. 1825). However, knowing that Schweinitz received issues of this exsiccata directly from Fries, including fascicle nine, as well as the history of the curation of the Schweinitz fungarium, we consider this specimen to be original material.

Another specimen of *S. alba* that was likely handled by Michener in the same way as the one at PH is in the Michener fungarium at BPI (BPI 1050201). Michener sampled portions of specimens from the Schweinitz fungarium as he conducted his curatorial work (Shear & Stevens 1917: 339). This specimen is from the Schweinitz fungarium, and it is possible that this is a duplicate of the specimen at PH and probably original material, but we did not study images of it.

There are two specimens in the Fries fungarium at UPS, F-543499 and F-117771 (Fig. 3e–f). We do not consider these to be original material because they appear to be from a gathering made later than the specimens issued as *Stictis alba* in fascicle nine of the *Scleromyceti Sueciae* (Fries ca. 1825). These specimens lack printed labels or notation indicating that they were part of this exsiccata and the number 335 written on the packets and labels seems to be a later addition. Moreover, the specimen labels, in Fries's script, give *Propolis alba* but this combination was not published until Fries (1849). In addition to this, Fries wrote the collection locality on the labels as Femsjö in Hägnen (Hägnen Nature Preserve in Hylte, Femsjö parish, Sweden): the collection locality of Femsjö was not noted in the sanctioning treatment of *Stictis alba* (Fries 1828) but it was given in Fries (1849). Finally, a note on the label of specimen UPS F-117771 (Fig. 3e) seems to indicate that Fries thought better specimens were number 335, in the *Scleromyceti Sueciae* (Fries ca. 1825) ("Scl. Suec. 335, ubi meliora specimina").

Our account of original material of *Stictis alba* issued in Fries (ca. 1825) is not exhaustive. Other institutions with holdings of specimens from the *Scleromyceti Sueciae* are given in Stafleu & Cowan (1976: 878) and Pfister (1985). We note that the American mycologist Moses Ashley Curtis succeeded Schweinitz in the study of North American fungi, and he sampled from the Schweinitz fungarium prior to Michener (Shear & Stevens 1917: 339). There are no specimens of *Stictis alba*, number 335 in the Curtis fungarium at FH according to Pfister (1975). We did not inquire at FH about a specimen in this collection, but it may be possible one is present,

and it was not recognised by Pfister as being from the *Scleromyceti Sueciae* (Fries ca. 1825) because of Schweinitz's practice of removing original labels.

Finally, we inquired at PC about Fries's *Scleromyceti Sueciae*, fascicle nine, and specimens of *Stictis alba*, number 335 (Fries ca. 1825). There is no copy of this exsiccata at this institution (Isabelle Bouchart-Dufay, pers. comm. 29 Sept 2023), but Stafleu & Cowan (1976: 878) note there are specimens at this institution, and Holm & Nannfeldt (1962) examined specimens (presumably loose) there. We do not know if they examined a specimen of *S. alba* at PC.

Concluding remarks on the specimens of* Stictis alba *that we located. Fries concluded that the material of *Sclerotium album* from Candolle that he studied and the material that he issued as *Stictis alba* in Fries (ca. 1825) were conspecific. We consider that all the specimens that we located contain the same snow-white, convex, and elongated crystalline bodies.

***Lectotypification of* Stictis alba.** We chose to lectotypify *Stictis alba* with Candolle's specimen, G 00584953, because it is well preserved, ample, and is accompanied by several pieces of documentation that clearly connect it to Candolle and the preparation of the protologue of *Sclerotium album* (Candolle 1815). We suspect that Fries (1828) also examined this specimen. Finally, most of our detailed micromorphological studies were made from G 00584953, and we were able to provide thorough documentation of it in our written description and in Figure 2.

Notes on* Hymenula alba *(Fr.) Corda. Corda (1838) studied a specimen of *Stictis alba*, number 335, issued in Fries (ca. 1825) and transferred this name to *Hymenula* Fr. For ease of reference in the following discussion, our English translation of Corda's treatment is provided here (our editorials and corrections in brackets, figure citations edited for clarity), with his illustration reproduced in Figure 8 (Corda 1838: 32, Tab. 14, Fig. 112).

> *3. H. ALBA: Tab. XIV. Fig. 112. Stictis alba Fries Scleromyc. Suec. no. 335. elongate submerged white; minute cylindrical spores.*
>
> Dwells on the bare decaying wood of the deciduous trees in Sweden, in the company of Prof. Fries.
>
> The species presents a curious excretion of crystals.
>
> The conidiophores (fig. 4[a]) are sunken, small-celled, the conidiogenous cell layer (fig. 4[b]) are formed from the conidiophores (fig. 10[a]) directly inserted cylindrical, stiff, light-colored [conidiogenous cells] (fig. 4[b] 10[b]), which also contain small cylindrical truncated spores (fig. 4[c] 10[c]). Above the fruit layer there is always a vaulted layer of a snow-white granular substance (fig. 3, fig. 4[d]), which, under high magnification, appears as a separation and accumulation of a large number of highly diverse, raphidoid (fig. 5), twinned (fig. 6) or multiple, larger, or smaller, or clustered crystals (fig. 7–9), which are only partially and with difficulty soluble in water.
>
> Fig. 1. Natural size; fig. 2. A fructification, slightly magnified; fig. 3. One section, slightly magnified; fig. 4. A hand-section of the fruit-body greatly enlarged a. conidiophores, b. [conidiogenous cells], c. spores, d. crystal heaps; fig. 5–9. Different shaped crystals greatly enlarged; fig. 10. [conidiogenous cells] b. [conidiophores very much enlarged], c. [with spores].

Corda (1838) described and illustrated a sporodochium immersed in woody substratum with bacilliform conidia. The conidia are produced from a palisade-like layer of conidiogenous cells that arise from a layer of small, isodiametric cells. A thick layer of large, polymorphous crystals is massed on top of the layer of conidiogenous cells in the centre of the sporodochium. We note that there is the possibility that the spores Corda described as conidia could be spermatia.

From the standpoint of fungal biology, we question how the mitospores that Corda depicted, whether they be conidia or spermatia, could form and disperse from under a thick layer of crystalline material. Based on the illustration, it appears that the mitospores are released from the periphery of the sporodochium. It may also be possible that the sporodochia mature and sporulate from the centre outward, followed by a buildup of crystalline material. Because the crystals are insoluble in water, the mitospores could be dispersed by being washed out by rainwater.

Notes on the origin of the crystalline bodies. If we consider that the crystalline bodies are not sporomata or the senesced remains of them, we are unable to determine how the crystalline bodies originated. They might be a byproduct of fungal activity in the woody substratum, some kind of crystallised plant resin or gum, or the result of wood beetle activity, which might make sense considering the way some of the crystalline bodies appear to extend in tubes below the surface

of the substratum, as we observed in specimen ILLS 00122483. We are uncertain whether the occurrence of fungal hyphae within the crystalline bodies of specimen G 00584953 (Fig. 2g–h) is casual or if they are connected in some way.

Because specimen ILLS 00122483 was recently collected near Femsjö, Sweden, where Fries collected specimens that he issued in the *Scleromyceti Sueciae* (Fries & Fries 1955: 145), we attempted PCR and Sanger sequencing of a sample of the crystalline bodies on this specimen to see if we could amplify any fungal DNA, following the methods outlined in Karakehian *et al*. (2024b). We obtained an ITS sequence (ITS1-5.8S-ITS2) and a mtSSU sequence (GenBank numbers PP830817, and PP833617, respectively). We attempted to obtain an LSU sequence using primers LR0R (Rehner & Samuels 1995) and LR6 (Vilgalys & Hester 1990) but abandoned this after two failed attempts. We subjected these sequences to BLASTn searches (Altschul *et al*. 1990) with the result that these were similar to sequences of *Dactylospora*, *Fusichalara*, *Rhopalophora*, and *Sclerococcum* that are classified in Ascomycota, Eurotiomycetes, Sclerococcomycetidae, Sclerococcales, Sclerococcaceae (Réblová *et al*. 2017, Wijayawardene *et al*. 2022). The ITS sequence was similar to several voucher specimens identified as various *Dactylospora* species with 89–100% query cover (QC)/90–95% percent identity (PI). The ITS2 region of this sequence was 65%QC/99%PI to an environmental sequence (GenBank OR164708) identified as *Dactylospora* sp., which was obtained from a *Quercus robur* stump in Lithuania (Marčiulynas & Menkis 2024). In the tree view function of BLASTn, both the full ITS and ITS2 sequences were estimated as sister to the *Dactylospora* sp. environmental sequence. These clustered in a larger clade that included isolates obtained from the *Dactylospora* voucher specimens. The mtSSU sequence was most similar to an isolate identified as Dothideomycetes sp., GenBank KT263506 (Muggia *et al*. 2016), that was obtained from a lichen thallus, with 75%QC/94%PI. In the tree view function of BLASTn, our mtSSU sequence and KT263506 formed a lineage that was sister to a larger clade consisting of the various genera of Sclerococcaceae listed above. We stress again that we do not know whether the fungi from which we amplified these sequences are not casually associated with the crystalline bodies.

Disposition of Propolis alba. *Propolis alba* is not a species of *Propolis* and is not a heterotypic synonym of *P. farinosa*. Because we found no fungal reproductive structures, tissues, or ascospores in any of the specimens that we examined, we conclude that *Propolis alba* should not be placed in Fungi.

We refrained from placing *Propolis alba* in a different genus. We note that maintaining Corda's disposition of this entity as *Hymenula alba* would require forming a new combination, "*Hymenella alba*". This is because *Hymenula* Fr. (1825: 94) (nom. sanct. in Fries 1828: 37) is a nom. nov. for *Hymenella* Fr. (1822: 233), and although both genus names are sanctioned, *Hymenella* has priority following Art. F.3.5 in May *et al*. (2019).

Author contributions

JMK researched and wrote the manuscript. ANM edited the manuscript. JMK, https://orcid.org/0000-0002-3571-3882; ANM, https://orcid.org/0000-0001-7300-0069.

Acknowledgements

Thank you to Scott Redhead and Shaun Pennycook for their assistance in applying the *ICN*. Thank you also to Christian Lange at C, Markéta Šandová at PRM, and Chelsea Smith at PH for their images and work on the collections and archives, Juan-Carlos Zamora at G, Åsa Kruys at UPS, Lisa Castlebury at BPI, Raundi Quevedo for her help with French translations, and Donald H. Pfister and James Lendemer for helpful advice and reviewing an early draft of this manuscript. Thank you to Michel Hairaud, for collecting and generously sharing the specimen of *Propolis farinosa* that we proposed as a conserved type of this name in Karakehian *et al*. (2023). Jason Karakehian acknowledges the ARCS Foundation Scholar Award (Illinois chapter); Royall T. Moore Mycological Fund, Harvard University; Herbert Holdsworth Ross Memorial Fund, administered by the University of Illinois at Urbana-Champaign, School of Integrative Biology; University of Illinois Urbana-Champaign Graduate College Dissertation Travel Grant.

References

Altschul, S.F., Gish, W., Miller, W., Myers, E.W., Lipman, D.J. (1990). Basic local alignment search tool. *J. Molec. Biol.* **215**, 403–410. https://doi.org/10.1016/S0022-2836(05)80360-2

Bellemère, A. (1967). Contribution a l'étude du dévelopment de l'apothécie chez les discomycètes inoperculés I. *Bull. Trimestriel Soc. Mycol. France* **83**, 393–640 [*Propolis farinosa* (as *Propolis faginea*)].

Burdet, H.M. (1979). *Auxilium ad botanicorum graphicem*. Conservatoire et Jardin botaniques de Genève, Geneva [Script samples from various botanists, reprinted in one volume from Burdet, H.M. (1972–1979). Cartulae ad botanicorum graphicem. *Candollea* **27**, 307–340; **28**, 137–170, 407–440; **29**, 207–240; 489–522; **30**, 203–234, 379–410; **31**, 127–158, 319–360; **32**, 165–206, 377–418; **33**, 139–180, 365–408, 409–456; **34**, 167–218]. http://www.ville-ge.ch/musinfo/bd/cjb/auxilium/index.php

Candolle, A.P. de. (1815). *Flore française*, 3rd ed., Tome 5 volume 6. Paris: Desray. https://bibdigital.rjb.csic.es/idurl/1/9881

Chlebická, M. (2014). *Propolis rhodoleuca* (Leotiomycetes, inc. sed.) compared with *P. farinosa*, *P. occulta* sp. nov. and *P. strobilina*. *Nova Hedwigia* **98**, 491–506. https://doi.org/10.1127/0029-5035/2014/0168

Corda, A.K.J. (1838). *Icones fungorum hucusque cognitorum*…, vol. 2. J.G. Calve, Pragae [Prague]. https://bibdigital.rjb.csic.es/idurl/1/11085

Fries, E.M. (1822). *Systema mycologicum*, vol. 2(1). Ex officina Berlingiana: Lundae [Lund]. https://doi.org/10.5962/bhl.title.5378

Fries, E.M. (1823). *Systema mycologicum*, vol. 2(2). Ex officina Berlingiana: Lundae [Lund]. https://doi.org/10.5962/bhl.title.5378

Fries, E.M. (1825). *Systema orbis vegetabilis*, part 1. Typographia Academica, Lundae [Lund]. https://bibdigital.rjb.csic.es/idurl/1/11732

Fries, E.M. (ca. 1825). *Scleromycetes Sueciae* [exsiccata], fascicle nine, decades 31–34, numbers 301–340 [cf. Holm & Nannfeldt (1962), Karakehian *et al*. (2024a)].

Fries, E.M. (1828). *Elenchus fungorum*, vol 2. Sumptibus Ernesti Mauritii: Gryphiswaldiae [Greifswald]. https://bibdigital.rjb.csic.es/idurl/1/12196, https://bibdigital.rjb.csic.es/idurl/1/12197

Fries, E.M. (1832). *Systema mycologicum*, vol. 3(2). Sumtibus Ernesti Mauritii: Gryphiswaldae [Greifswald]. https://doi.org/10.5962/bhl.title.5378

Fries, E.M. (1849). *Summa vegetabilium Scandinaviae*, sect. post. A. Bonnier: Holmiae [Stockholm] & Lipsiae [Leipzig]. https://doi.org/10.5962/bhl.title.47008

Fries, T., Fries, R. (1955). Elias Fries' autobiography, "Historiola studii mei mycologici." *Friesia* **5**, 135–160.

Hoffmann, G.F. (1796). *Deutschland Flora. Zweiter Theil "…fur das Jahr 1795. Cryptogamie."* Johann Jacob Palm, Erlangen. https://doi.org/10.5962/bhl.title.126793

Holm, L. & Nannfeldt, J.A. (1962). Fries's "Scleromyceti Sueciae" A study on its editorial history with an annotated checklist. *Friesia* **7**, 10–59.

Karakehian, J.M., Miller, A.N., Pennycook, S.R. (2023). (2983) Proposal to conserve the name *Stictis farinosa* (*Propolis farinosa*) (*Fungi*, *Ascomycota*, *Marthamycetales*) with a conserved type. *Taxon* **72**, 1115–1116. https://doi.org/10.1002/tax.13060

Karakehian, J.K., Pfister, D.H., Miller, A.N. (2024a). Elias Magnus Fries's fungus exsiccati *Scleromyceti Sueciae*: New light on the obscure "fascicle nine". *Taxon* **73**. https://doi.org/10.1002/tax.13168

Karakehian, J.M., Quijada, L., Miller, A.N., Krieglsteiner, L., Baral, H.O. (2024b). *Ramomarthamyces octomerus* sp. nov. and insights into the evolution and diversification of *Ramomarthamyces* (Ascomycota, Leotiomycetes). *Journal of Fungi* **10**, 301. https://doi.org/10.3390/jof10050301.

Léveillé, J.H. (1843). Mémoire sur le genre Sclerotium. *Ann. Sci. Nat., Bot.* **20**, 218–248. https://www.biodiversitylibrary.org/item/129773

May, T.W., Redhead, S.A., Bensch, K., Hawksworth, D.L., Lendemer, J., Lombard, L. and Turland, N.J. (2019). Chapter F of the International Code of Nomenclature for algae, fungi, and plants as approved by the 11th International Mycological Congress, San Juan, Puerto Rico, July 2018. *IMA fungus* **10**, 21. https://doi.org/10.1186/s43008-019-0019-1

Marčiulynas, A., Menkis, A. (2024). Long-term dynamics of fungal communities inhabiting decaying stumps of *Quercus robur*. *Microbial Ecology* **87**, 27. https://doi.org/10.1007/s00248-023-02334-3

McNeill, J. (2014). Holotype specimens and type citations: General issues. *Taxon* **63**, 1112–1113. http://dx.doi.org/10.12705/635.7

Minter, D. (2003). *Propolis* and *Marthamyces* gen. nov. (Rhytismatales). *Mycotaxon* **87**, 43–52.

Minter, D.W. (2019 [16 Jan.]) [2018]. *Propolis farinosa*. I. M. I. Descript. Fungi Bact. no. 218: Sheet 2176. https://doi.org/10.1079/DFB/20183388372

Muggia, L., Fleischhacker, A., Kopun, T., Grube, M. (2016). Extremotolerant fungi from alpine rock lichens and their phylogenetic relationships. *Fungal Diversity* **76**, 119–142. https://doi.org/10.1007/s13225-015-0343-8

Pfister, D.H. (1975). Comments on the Scleromyceti Sueciae in the Farlow Herbarium. *Mycotaxon* **3**, 185–192.

Pfister, D.H. (1985). A bibliographic account of exsiccatae containing fungi. *Mycotaxon* **23**: 1–139. [See also: Pfister, D.H. (1986). A corrected authors index for *A bibliographic account of exsiccatae containing fungi*. *Mycotaxon* **25**, 141–145].

Pilát, A. (1938). Seznam druhů hub, popsaných A.C.J. Cordou s udáním originálních exemplářů, které jsou uloženy v herbáři Národního Musea v Praze [List of species of fungi, described by A.C.J. Corda with the indication of the original specimens, which are stored in the herbarium of the National Museum in Prague]. *Sborn. Nár. Mus. Praze, Řada B, Přír. Vědy*. **1B**, 139–170.

Réblová, M., Untereiner, W.A., Štěpánek, V., Gams, W. (2017). Disentangling *Phialophora* section *Catenulatae*: disposition of taxa with pigmented conidiophores and recognition of a new subclass, Sclerococcomycetidae (Eurotiomycetes). *Mycol. Progress* **16**, 27–46. https://doi.org/10.1007/s11557-016-1248-y

Rehner, S.A., Samuels, G.J. (1995). Molecular systematics of the Hypocreales: A teleomorph gene phylogeny and the status of their anamorphs. *Can. J. Bot.*, **73** (Suppl. 1), S816–S823.

Shear, C.L. (1949). Schweinitz–Fries letters. *Mycologia* **41**, 456–461. https://doi.org/10.2307/3755239

Shear, C.L., Stevens, N.E. (1917). Studies of the Schweinitz collections of fungi–II: Distribution and previous studies of authentic specimens. *Mycologia* **9**, 333–344. https://doi.org/10.2307/3753107

Shear, C. L., Stevens, N.E., Tiller, R.J. (1917). *Endothia parasitica* and related species. *Bull. U.S.D.A.* **no. 380**, 1-82, pl. 1–23.

Sherwood, M.A. (1977). The ostropalean fungi. *Mycotaxon* **5**, 1-277.

Stafleu, F.A. & Cowan, R.S. (1976). Taxonomic literature: A selective guide to botanical publications and collections with dates, commentaries and types, 2nd ed., vol. 1, A – G. Scheltema & Holkema: Utrecht: Bohn. https://doi.org/10.5962/bhl.title.48631

Stearn, W.T. (1992). *Botanical Latin*. 4th ed. Timber Press, Portland.

Tode, H.J. (1790). *Fungi mecklenburgenses selecti. Fasciculus i. Nova fungorum genera complectens.* Joh. Friedr. Guil. Lemke, Lüneburg. https://doi.org/10.5962/bhl.title.148599

Tulasne, L.R., Tulasne, C. (1931). Selecta fungorum carpologia of the brothers L. R. and C. Tulasne translated into English by W. B. Grove (3 volumes). A.H.R. Buller and C.L. Shear (eds.). Oxford, The Clarendon Press.

Turland, N.J., Wiersema, J.H., Barrie, F.R., Greuter, W., Hawksworth, D.L., Herendeen, P.S., Knapp, S., Kusber, W.-H., Li, D.-Z., Marhold, K., May, T.W., McNeill, J., Monro, A.M., Prado, J., Price, M.J. & Smith, G.F. (eds.). (2018). *International Code of Nomenclature for algae, fungi, and plants (Shenzhen Code) adopted by the Nineteenth International Botanical Congress Shenzhen, China, July 2017.* Regnum Vegetabile 159. Koeltz Botanical Books, Glashütten. https://doi.org/10.12705/Code.2018

Untereiner, W.A. (2004). Lewis David von Schweinitz's copy of the Scleromyceti Sueciae. *Sydowia* **56**, 98–122.

Vilgalys, R., Hester, M. (1990). Rapid genetic identification and mapping of enzymatically amplified ribosomal DNA from several *Cryptococcus* species. *J. Bacteriol.* **172**, 4238–4246. https://doi.org/10.1128/jb.172.8.4238-4246.1990

Wijayawardene, N.N., Hyde, K.D., Dai, D.Q., Sánchez-García, M., Goto, B.T., Magurno, F. (2022). Outline of Fungi and fungus-like taxa – 2021. *Mycosphere* **13**, 53–453. https://doi.org/10.5943/mycosphere/13/1/2l.