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Nomenclatural notes on some species of *Arthothelium* (Lichenized Ascomycotina)

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Abstract: Nomenclatural changes are presented for eleven species of the genus *Arthothelium*, resulting in four new combinations and five new synonyms. The new combinations are: *Arthothelium subbessale* (Nyl.) comb. nov., *Cyclographina circumscissa* (Vain.) comb. nov., *Minksia angolensis* (Nyl.) comb. nov. and *Thelotrema puniceum* (Müll. Arg.) comb. nov. In addition, a new species is described, *Arthothelium endoaurantiacum*.

Introduction

The genus *Arthothelium* Massal., [*Richerch. Auton. Lichen.* 54, 1852; type species: *Arthonia spectabilis* Flot. = *Arthothelium spectabile* (Flot.) Massal.] is characterized by a crustose, smooth, effuse or verrucose, mostly ecorticate, corticolous, foliicolous or saxicolous thallus; rounded, irregular to more or less lirelline, branched, immarginate ascromata with a rubbed-down appearance; branched, anastomosing and coherent paraphysoids, forming a thick epithecium above; outermost paraphysoids often darkened and forming a pseudoparathecium; 8-spored, subglobose, pyriform, rarely clavate or ellipsoidal, bitunicate, fissitunicate or semi-fissitunicate, thick-walled asci with colourless, muriform, ovate or

ellipsoidal ascospores. Some 150 names are published in the genus (Zahlbruckner 1922-1940; Lamb 1963; Hawksworth 1972; Anonymus 1970-1994) at world level.

Reexamination of type specimens and non-type material of most of the described species has revealed that some do not belong to the genus *Arthothelium*, while others exhibit only minor differences, not worthy of a status as independent species. Many nomenclatural changes have already been proposed by Santesson (1952) and subsequently by Makhija and Patwardhan [1985, 1995 (in press)].

A few more transfers were found necessary and are proposed here. In addition, one new species was discovered, for which a description is presented.

Materials and methods

Specimens have been studied from the herbaria BM, G, H, M, S, TUR and WELT. All specimens were examined with a stereomicroscope and light microscope. Sections of the thallus and ascomata were stained with Lugol's solution. All sections were examined with lactophenol as mounting medium. Chemical data were obtained by standardized TLC method (Culberson 1972) by using standard solvent systems benzene-dioxane-acetic acid (180:45:5, 230 ml) and hexane-diethylether-formic acid (139:80:20, 230 ml).

Taxonomical part

1. *Arthonia cinereoargentea* Kn. apud Shirley, Proc. Roy. Soc. Queensland 7: 212. 1889. Fig. 1, 9, 10

= *Arthothelium cinereoargenteum* (Kn.) Zahlbr., Cat. Lich. Univ. 2: 123. 1922.

Type: Australia, Brisbane, Botanical Gardens, C. Knight 87 - Lectotype (selected here) - WELT (!).

Thallus corticolous, crustose, ash-grey, smooth, glossy, delimited by a black hypothaloidal region at the periphery; ascomata dark blackish brown, lirelline, simple to branched, immersed, up to 0.4 mm across; epithecium dark blackish brown, 10-15 μm thick; hymenium hyaline, 39-55 μm tall, I+ blue; hypothecium hyaline; asci bitunicate, cylindrico-clavate to pyriform, 25-33 x 19.8-33 μm in size; ascospores 8/ascus, hyaline, oblong, fusiform, transversely 3-septate, 12-14 x 6.6 μm in size.

Chemistry: Thallus K-, C-, KC-, P-; no lichen substances present.

Remarks: An examination of the lectotype specimen of *Arthothelium cinereoargenteum* (Kn.) Zahlbr., originally described as *Arthonia cinereoargentea*, showed that it has invariably transver-

sely 3-septate, 4-locular ascospores. Therefore it should be placed back in the genus *Arthonia*, in which it was originally described.

2. *Arthothelium adveniens* (Nyl.) Müll. Arg., Flora 70: 76. 1887.

Type: Nova Caledonia, Lifu, Deplanche s.n. - Lectotype (selected here) H-Nyl. No. 5472 (!).

= *Arthonia adveniens* var. *cinerascens* Nyl., Bull. Soc. Linn. Normand, ser. 2, 2: 102. 1868. syn. nov.

= *Arthothelium adveniens* var. *cinerascens* (Nyl.) Zahlbr., Cat. Lich. Univ. 2: 119. 1922.

Type: Nova Caledonia, Lifu, Deplanche s.n. - Lectotype (selected here) H-Nyl. No. 5474 (!).

Thallus corticolous, crustose, white to greyish white, delimited by a black hypothaloidal region at the periphery; ascomata irregularly rounded, solitary or grouped, black, emergent, 0.5 to 1.2(-2) mm across; epithecium brown, 10-13 μm thick; hymenium greenish brown, 26-53 μm tall, I+ red; hypothecium pale brown; asci bitunicate, cylindrico-clavate, 33-40 x 30-33 μm in size; ascospores 8/ascus, hyaline, muriform, oblong, transversely 3- to 5-septate, vertically 1- to 2-septate, with large, undivided terminal cell, 16.5-23 x 10 μm in size.

Chemistry: Thallus K-, P+ yellow; no lichen substances present.

Remarks: The lectotype specimens of *A. adveniens* and its variety *cinerascens* are exactly identical in morphology, anatomy and chemistry (K-, P+ yellow) of the thallus and their ascomata. Hence *A. adveniens* var. *cinerascens* is synonymised with *A. adveniens*.

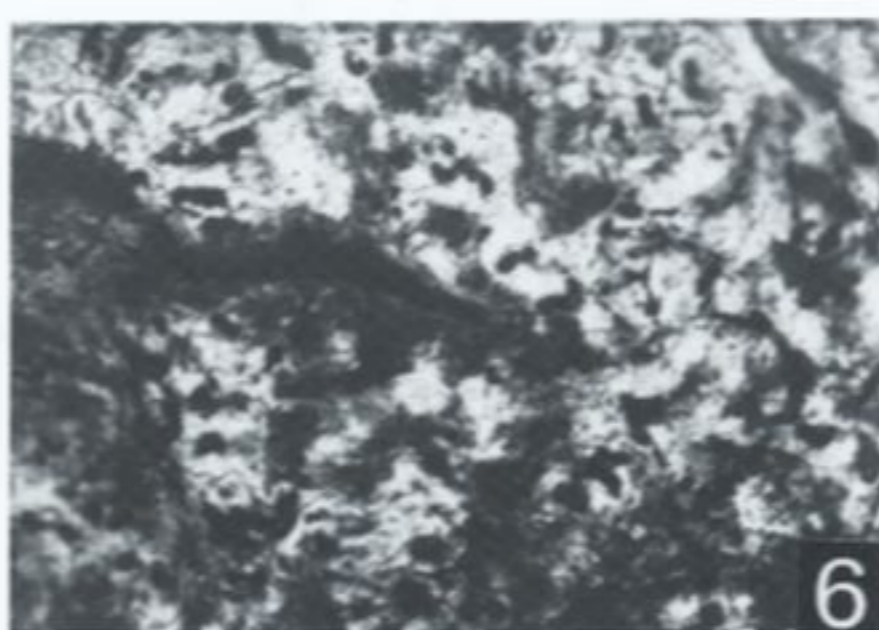
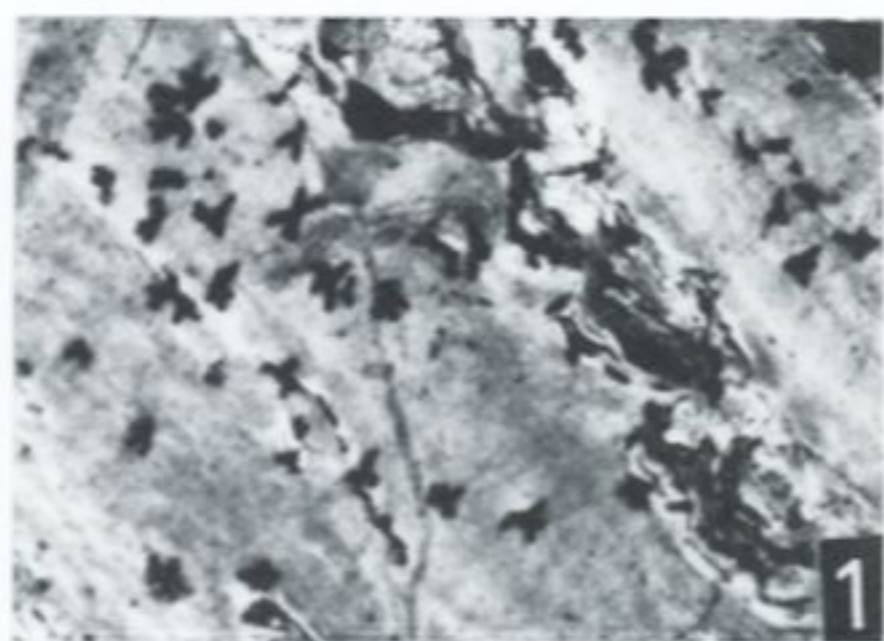
3. *Arthothelium emersum* Müll. Arg., Proc. Roy. Soc. Edinburgh 11: 469. 1882.

Type: Socotra, Bailey Balfour s.n. - Lectotype

Fig. 1-8. (Scale in mm)

1. *Arthonia cinereoargentea* (Lectotype)
2. *Arthothelium endoaurantiacum* (Holotype)
3. *Arthothelium subbessale* (Lectotype)
4. *Cyclographina circumscissa* (Lectotype)

5. *Helminthocarpon ernstianum* (Lectotype of *Arthothelium ernstianum*)
6. *Minksia angolensis* (Lectotype)
7. *Mycoporum pycnocarpum* (Lectotype of *Arthothelium tumidulum*)
8. *Thelotrema puniceum* (Lectotype)



(selected here) - G (!).

= *Arthothelium consanguineum* Müll. Arg., Flora 71: 207. 1888. syn. nov.

Type: Monte Tafelberg, Capitis Bonae Spei, Wilms 108 (Comm. Dr. Lahm) - Lectotype (selected here) - G (!).

Thallus corticolous, crustose, pale brown, whitish, smooth, delimited by a black hypothaloidal region at the periphery; ascomata black, rounded to deformed, emergent, 0.2-0.5 mm across; epithecium blackish olivaceous-green, 6.6-13 µm thick; hymenium hyaline, 88-100 µm tall, I+ blue; hypothecium hyaline, 29-39 µm tall; asci bitunicate, cylindrico-clavate, 33-40 x 19.3 x 25 µm in size; ascospores 8/ascus, hyaline, muriform, transversely 5-septate, vertically 1 to 2-septate, 13.1-16.5 x 6-7 µm in size.

Chemistry: Thallus K-, C-, KC-, P-; no lichen substances present.

Remarks: The lectotype specimen of *Arthothelium consanguineum* Müll. Arg. is essentially similar to that of *A. emersum* Müll. Arg. in morphology, anatomy and chemistry. Therefore it is treated as a synonym of *A. emersum*

4. *Arthothelium endoaurantiacum* sp. nov. Fig. 2, 11, 12

Type: New Zealand, 25.11.77, C. Knight s.n. - Holotype - WELT (specimen annotated as *Arthonia ampliata* Kn. & Mitt.).

Thallus crustaceus, griseo-albus, distincte et profunde rimulosus, hypothallo nigricante limitatus; ascomata nigra, emergentia, epruinosa, circa 1.0 mm longa et lata; epithecium fuscum vel nigro-fuscum; hymenium aurantiacum; hypothecium aurantiacum; asci cylindrico-clavati, bitunicati; ascosporeae 8:nae, muriformes, ovatae vel oblongatae, 5-7-loculares, 1-4 locellati, 29-36 µm longae et 13-16.5 µm latae.

Thallus corticolous, crustose, greyish white, cracked, areolate, delimited by a black hypothaloidal region at the periphery, epiphloeodal; ascomata black, epruinose, emergent, up to 1.0 mm across; epithecium dark brown to blackish brown,

23-36 µm thick; hymenium dark, bright yellow, 66-100 µm tall; hypothecium concolorous with the hymenium or slightly darker, 30-45 µm tall; asci bitunicate, subglobose; ascospores 8/ascus, hyaline, muriform, transversely 4 to 6-septate, vertically 1 to 3-septate, 29-36 x 13-16.5 µm in size. Chemistry: Thallus K-, C-, KC-, P-; no lichen substance present.

Remarks: The new species *Arthothelium endoaurantiacum* is based

on material collected by C. Knight in New Zealand 25.11.77 and annotated as *Arthonia ampliata* Kn. & Mitt. [= *Arthothelium ampliatum* (Kn. & Mitt.) Zahlbr.]. The specimen differs from *A. ampliatum* and all other known species of *Arthothelium* by the combination of a bright orange-yellow hymenium, a hypothecium covered by a blackish-brown epithecium and the absence of an undivided, large, terminal cell in the ascospores.

5. *Arthothelium obtusulum* (Nyl.) Müll. Arg., Bull. Herbarium Boissier 2: 84. 1894.

= *Arthonia obtusula* Nyl., Lich. Nov. Zealand, p. 123. 1888.

Type: New Zealand, C. Knight s.n. - Lectotype (selected here) - H-Nyl. No. 5728 (!).

= *Arthothelium polycarpum* Müll. Arg., Bull. Herbarium Boissier 3: 323. 1895. syn. nov.

Type: Australia, Brisbane, Bailey 682 - Lectotype (selected here) - G (!).

Thallus corticolous, crustose, white, greenish white to grey, smooth to verruculose; ascomata blackish-brown, rounded to more or less oblong to orbicular, covered by thallus or naked, emergent, 0.3-0.5 mm across; epithecium dark blackish-brown, 6.6-13 µm thick; hymenium pale brown to hyaline, 33-130 µm tall, I+ blue; hypothecium pale brown; asci bitunicate, pyriform, obovate, 50-66 x 33-40 µm; ascospores 8/ascus, hyaline, muriform, oblong, ovate, mostly 3-septate to 6-septate, with a large, undivided, terminal cell and the rest of the cells divided vertically by 1 to 3 septa, 20-29 x 6-9 µm in size.

Chemistry: Thallus K-, C-, KC-, P-; no lichen substances present.

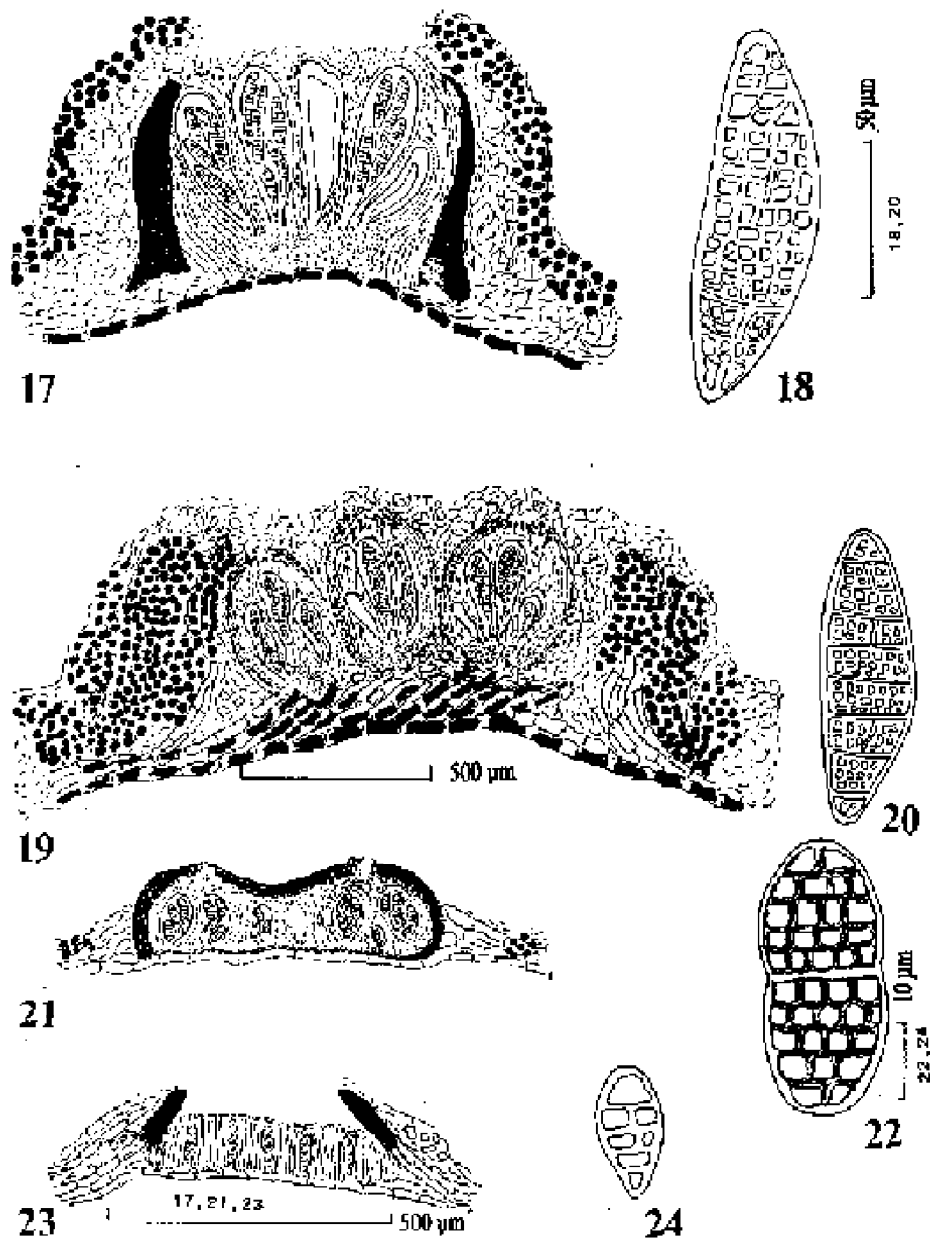


Fig. 9-16. Vertical sections (VS) and ascospores
Arthonia cinereoargentea (Lectotype) 9. VS ascoma, 10. Ascospore
Arthothelium endoaurantiacum (Holotype) 11. VS ascoma, 12. Ascospore
Arthothelium subbessale (Lectotype) 13. VS ascoma, 14. Ascospore
Cyclographina circumscissa (Lectotype) 15. VS ascoma, 16. Ascospore

Remarks: The lectotype specimens of *Arthothelium obtusulum* (Nyl.) Müll. Arg. and *A. polycarpum* Müll. Arg. are exactly identical in their morphology of the thallus, ascomata, ascospores and the chemical contents. *Arthothelium obtusulum* is the correct name due to its nomenclatural priority.

6. *Arthothelium subbessale* (Nyl.) comb. nov. Fig. 3, 13, 14
= *Arthonia subbessalis* Nyl., Sertum Lich. Trop. Labuan et Singapore, p. 23. 1891.
Type: Singapore, 1879, E. Almquist s.n. - Lectotype (selected here) - H-Nyl. No. 5469 (!).

Thallus corticolous, crustose, grey, smooth, effuse, delimited by a black hypothaloidal region at the periphery; ascomata dark blackish brown irregular in shape, immersed, 0.5-0.8 mm across; epithecium dark reddish brown, 16.5-30 µm thick; hymenium 50-66 µm tall, dark reddish brown; hypothecium dark reddish brown; asci bitunicate, clavate to pyriform, 40-50 x 23-33 µm; ascospores 8/ascus, hyaline, muriform, transversely 3- to 6-septate, with uppermost cell larger, undivided and the rest of the cells divided by 1 to 3 vertical septa, 30-35 x 16.5 µm in size.
Chemistry: K-, C-, KC-, P-; no lichen substances present.

Remarks: Nylander identified the specimen collected by Almquist as *Arthonia subbessalis*. The specimen agrees perfectly with the protologue. Since it has muriform ascospores, the species should be placed in *Arthothelium* instead of *Arthonia*.

Arthothelium subbessale can easily be distinguished from *Arthothelium bessale* (Nyl.) Zahlbr. by its deformed, lirelline, branched ascomata and smaller ascospores. *Arthothelium bessale* has rounded, large ascomata, and ascospores measuring 36-44 x 15-16 µm.

7. *Cyclographina circumscissa* (Vain.) comb. nov. Fig. 4, 15, 16
= *Arthonia circumscissa* Vain., Etud. Lich. Brésil 2: 150. 1890.
= *Arthothelium circumscissum* (Vain.) Zahlbr.,

Cat. Lich. Univ. 2: 123. 1922.

Type: Brasil, Sepitiba in civ. Rio de Janeiro, E. A. Vainio 442 - Lectotype (selected here) - TUR-Vainio No. 28520 (!).

Thallus corticolous, crustose, greenish grey, brownish green to whitish green, mostly epiphloeodal, 100-225 µm thick; ascomata lirelline, simple to slightly branched, blackish grey, pruinose, immersed, plane, 1-3.5 mm long and 0.5-1.5 mm broad, the thalline margin concolorous with the thallus; proper exciple blackish brown, not continuous at the base, striate; hymenium hyaline, 66-140 µm tall, I+ blue, covered by a brown, 10-20 µm thick epithecium; hypothecium hyaline, narrow but distinct, 16.5-50 µm thick; asci bitunicate, thick-walled, cylindrico-clavate, 88-140 x 33-50 µm in size; paraphyses branched and anastomosing, non-coherent; ascospores 1-2/ascus, hyaline, muriform, transversely and vertically multiseptate, parenchymatous, ovate or elliptical, 85-140 x 33-48 µm in size, I+ violet-blue.
Chemistry: Thallus K+ yellow to orange, C-, KC-, P+ yellow to orange; stictic acid present.

Remarks: *Cyclographina circumscissa* resembles *C. holstii* (Müll. Arg.) Awas. & M. Joshi. [Holotype: Africa, Usambara, Luttindi-Hochwald, 1894, C. Holst 3400 - G (!)] and *C. pervarians* (Nyl.) Awas. & M. Joshi by the striate proper exciple, but differs by the absence of a blackish brown exciple at the base. Moreover, *C. circumscissa* has a very thick hypothecium.

8. *Helminthocarpon ernstianum* Müll. Arg., Flora 70: 423. 1887. Fig. 5, 17, 18
Type: Venezuela, Caracas, 1878, Dr. Ernst s.n. - Holotype - G (!).

= *Phlyctis ernstianum* Müll. Arg., Flora 63: 285. 1880.

= *Arthothelium ernstianum* (Müll. Arg.) Müll. Arg., Hedwigia 34: 32. 1895. syn. nov.
Type: Venezuela, Caracas, 1878, Dr. Ernst 50 - Lectotype (selected here) - G (!).

Thallus corticolous, crustose, greyish green to yellowish, ± uneven, slightly cracked, delimited by a black hypothaloidal region at the periphery,

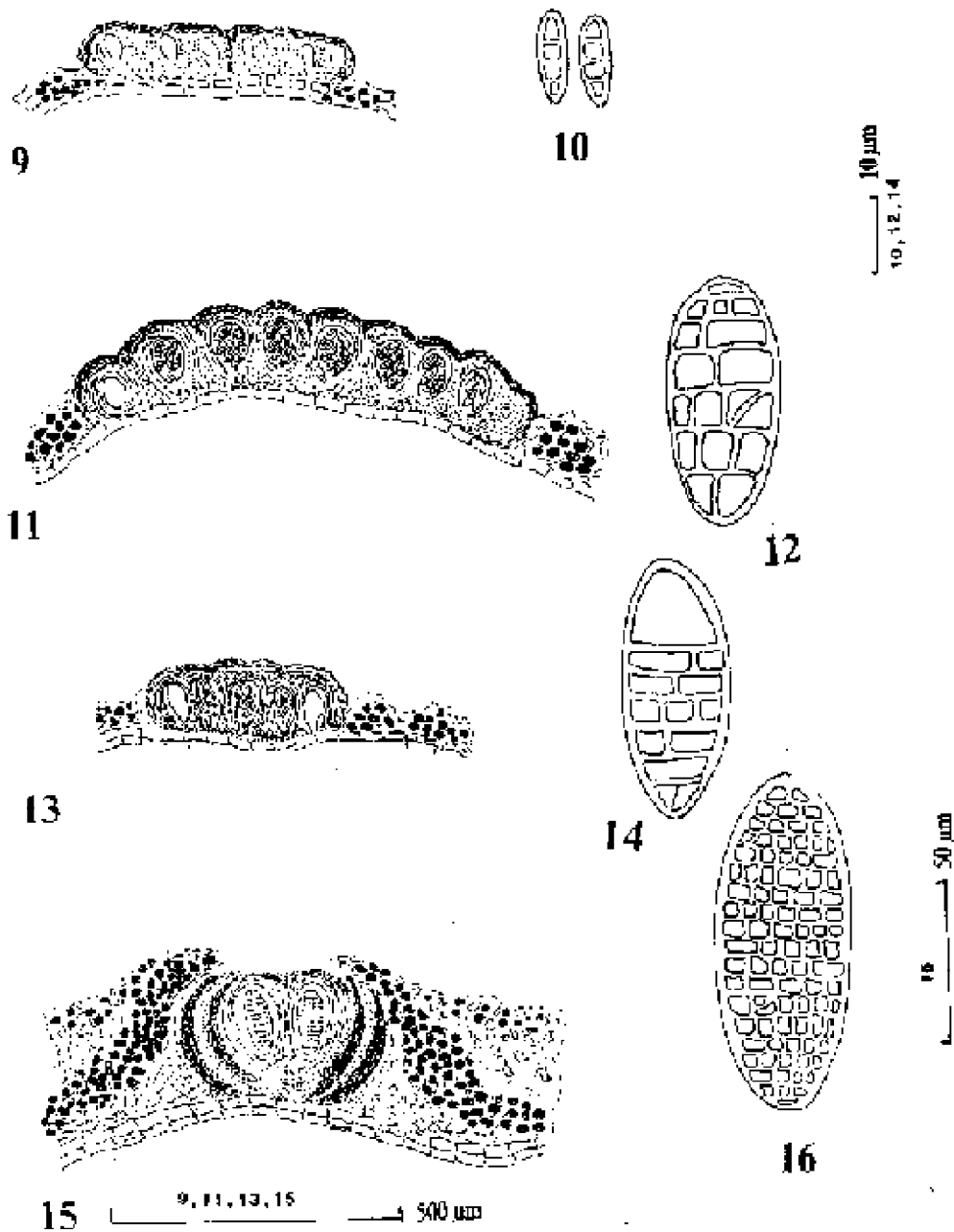


Fig. 17-24. Vertical sections (VS) and ascospores
Helminthocarpon ernstianum (Lectotype of *Arthothelium ernstianum*) 17. VS ascoma, 18. Ascospore
Minksia angolensis (Lectotype) 19. VS ascoma, 20. Ascospore
Mycoporum pycnocarpum (Lectotype of *Arthothelium tumidulum*) 21. VS ascoma, 22. Ascospore
Thelotrema puniceum (Lectotype) 23. VS ascoma, 24. Ascospore

150-225 µm thick; ascomata round or slightly elongated, linear, emergent; a hyaline to blackish brown to black, erect excipuloid region present in both sides of the ascomata and covered by a thick thalline tissue; hymenium hyaline, 325-500 µm tall; hypothecium hyaline, 60-75 µm tall; asci bitunicate, obovoid, thick-walled, 200-250 x 85-99 µm in size; paraphysoids branched and anastomosing, intricate, net-like, soft, spongy; ascospores 8/ascus, hyaline, muriform, 66-115 x 16.5-23 µm in size.

Chemistry: Thallus K-, C-, KC-, P-; unknown lichen substances present.

Remarks: Müller Arg. (1880) described *Phlyctis ernstiana* Müll. Arg. based on material collected by Ernst from Caracas. Later he (1895) transferred the taxon to *Arthothelium*.

The following features in the lectotype of *Arthothelium ernstianum* warrant its transfer to the genus *Helminthocarpon*: rounded to lirelline, erumpent, wart-like ascomata; a blackish brown to black, erect excipuloid region present in both sides of the ascomata, covered by a thick thalline tissue; soft, spongy interthecial tissue, composed of loose, intricately net-like, branched and anastomosing paraphysoids; bitunicate, thick-walled asci and hyaline, multicelled, muriform ascospores.

An examination of the holotype specimen of *Helminthocarpon ernstianum* showed that there are no morphological, anatomical and chemical differences whatsoever between the specimens of *Arthothelium ernstianum* and of *Helminthocarpon ernstianum*. Therefore the later described *A. ernstianum* is to be treated as synonymous with *H. ernstianum*.

9. *Minksia angolensis* (Nyl.) comb. nov. Fig. 6, 19, 20

= *Tremotylium angolense* Nyl., Bull. Soc. Linn. Normand, ser. 2, 2: 513. 1868.

= *Arthonia* (*Arthothelium*) *angolense* (Nyl.) Vain., Cat. Welwitsch Afric. Plants 2: 445. 1901.

= *Arthothelium angolense* (Nyl.) Zahlbr., Cat. Lich. Univ. 2: 120. 1922.

Type: Africa, Distr. Loanda, Angola, ad truncas *Euphorbiae candelabri*, 1854, Welwitsch s.n.-Lectotype (selected here) - H-Nyl. No. 22383 (!).

Thallus corticolous, crustose, whitish brown (buff) coloured, verruculose, thick, cracked, epiphloeodal; pseudostromata concolorous with the thallus, slightly elevated, polycarpic; ascomata black, punctate to rounded, immersed, 0.2 to 0.3 mm across; proper exciple thin, hyaline; epithecium brown; hymenium hyaline, convergent, 300-475 µm tall, I+ blue; hypothecium pale yellow to hyaline; asci bitunicate, cylindrico-clavate, 130-240 x 50-63 µm in size; paraphysoids branched and anastomosing, non-coherent; ascospores 4-8/ascus, hyaline, muriform, ellipsoidal, oblong, 65-135 x 16-30 µm in size.

Chemistry: Thallus K-, C-, KC-, P+ yellow to orange; psoromic acid present.

Remarks: This species is referred to the genus *Minksia* because the ascomata are embedded in pseudostromata and have a thin but distinct proper exciple.

Minksia angolensis belongs to the section *Euminksia* with 8-spored asci and differs from the other three species of this section, *M. caesiella* Müll. Arg., *M. candida* Müll. Arg. and *M. alba* Makhija & Patwardhan, by its very large ascospores measuring 65-135 x 16.5-30 µm.

10. *Mycoporum pycnocarpum* Nyl., Flora 41: 38. 1858 (as *M. pyrenocarpum*, cf. Harris 1973: 32) Fig. 7, 21, 22

Type: not seen.

= *Arthonia tumidula* Leight., Journ. Linn. Soc. London Bot. 9: 200. 1867.

= *Arthothelium tumidulum* (Leight.) Zahlbr., Cat. Lich. Univ. 2: 137. 1922. syn. nov.

Type: America, River St. Mery's Lake Superior, Sir J. Richardson 158 - Lectotype and isolectotype (selected here) - BM (!).

Thallus corticolous, crustose, greyish green, smooth; ascomata black, minute, aggregated (2-3 in a group), cushion-shaped, resembling a group of small black beads glued together, multichambered, each chamber with its own ostiole; upper layer of the pseudostroma dark blackish brown; hymenium hyaline to brownish, I-negative; asci obovate, much thickened at the top; interthecial tissue made of indistinct, branched and anasto-

mosing hyphae, seemingly parenchymatous; ascospores 8/ascus, brown, muriform, transversely 5- to 9-septate, vertically divided by 1-4 septa, constricted at the middle, 30-37 x 13-15 µm in size. Chemistry: K-, C-, KC-, P-; no lichen substances present.

Remarks: After studying the lectotype and isolecotype specimens of *Arthonia tumidula* Leight. [= *Arthothelium tumidulum* (Leight.) Zahlbr.] at BM it appeared that the specimens are exactly identical with the species *Mycoporum pycnocarpum* Nyl.

11. *Thelotrema puniceum* (Müll. Arg.) comb. nov. Fig. 8, 23, 24

= *Arthothelium puniceum* Müll. Arg., Hedwigia 32: 133. 1893.

Type: Queensland, Brisbane, 1891, Bailey 369 - Lectotype (selected here) - G (!).

Thallus corticolous, crustose, smooth, greenish grey; apothecia orbicular or stellate-angular, grouped, 0.3 to 1 mm broad; exciple black, fused, surrounded by raised margin; epithecium brownish black; hymenium hyaline, 110-130 µm tall; asci unitunicate, cylindrical, 100-115 x 13-16.5 µm in size; paraphyses simple, unbranched; ascospores 8/ascus, hyaline, ovate, oblong, muriform, transversely 3- to 6-septate, vertically 1- to 2-septate, I-negative, 16-30 x 10-16.5 µm in size. Chemistry: K-, C-, KC-, P-; no lichen substances present.

Remarks: The presence of the following combination of features in the lectotype specimen of *Arthothelium puniceum* Müll. Arg. justify its transfer to the genus *Thelotrema* (confirmed by M.E. Hale in a discussion with him in 1986): thallus corticolous, crustose; apothecia orbicular or stellate-angular, grouped together; exciples fused, surrounded by a raised margin; asci unitunicate, cylindrical; paraphyses simple, unbranched; ascospores 8/ascus, hyaline, muriform.

Thelotrema puniceum is easily distinguished by its reddish-purple, orbicular or stellate apothecia, its fused proper exciple and its ovate, oblong, muriform and small ascospores measuring 16-30 x 10-17 µm.

Acknowledgements

We are grateful to the directors/curators of the herbaria BM, G, H, M, S, TUR and WELT who have made the type/authentic specimens available to us.

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EXPLANATION OF FIGURES

Fig. 1-8. (Scale in mm)

1. *Arthonia cinereoargentea* (Lectotype)
2. *Arthothelium endoaurantiacum* (Holotype)
3. *Arthothelium subbessale* (Lectotype)
4. *Cyclographina circumscissa* (Lectotype)

5. *Helminthocarpon ernstianum* (Lectotype of *Arthothelium ernstianum*)
6. *Minksia angolensis* (Lectotype)
7. *Mycoporum pycnocarpum* (Lectotype of *Arthothelium tumidulum*)
8. *Thelotrema puniceum* (Lectotype)