

**Arthopyrenia** Massal.  
(ARTHOPYRENIACEAE)

After Harris, 1975, 1995, and others

Rev. November 16, 1998

Thallus crustose, thin, ecorticate, uniform, undifferentiated, usually endophloedal, effuse, indicated by discoloration of the substrate, usually whitish or grayish, rarely darker, in a few species consisting of an epiphloedal, dark brown subicular layer of hyphae; lichenized thalli often pinkish when fresh, occasionally delimited.

Asocarps perithecia (perithecium-like pseudothecia?), immersed or adnate, circular to ellipsoid in surface view, [sometimes?] somewhat confluent, globular to hemispherical, opening by a punctiform, erect (rarely eccentric), ostiole; wall (at least the involucrellum) dark brown to blackish, complete or usually dimidiate (lacking below); involucrellum often laterally spreading, clypeate, composed of compacted hyphae and bark cells; true exciple thin, usually colorless; brown hyphae K- or K+ greenish; hymenium without algae; hamathecium usually of branched and anastomosed (but not loosely and regularly reticulate) pseudoparaphyses, which are very thick and regular, conspicuously septate, short-celled,  $\pm$  moniliform and appearing almost parenchyma-like (Arthopyrenia s. str.), or slender and regular, thread-like, not conspicuously septate, with relatively long cells (Ciferriolichen), I- (sometimes interthecal hyphae partly gelatinized, rarely completely so, and then often I+ bluish); downward projecting periphysoids also present; asci ovoid to narrowly ovoid, narrowly ellipsoid, obovoid or  $\pm$  cylindrical, fissitunicate, with two functional wall layers, I-; tip often thickened, with or without an obvious ocular chamber; spores (2-4)8, asymmetric or oval, ellipsoid, oblong, sole-shaped, or fusiform, with blunt ends, with or without terminal protuberances, transversely 1-3(-5-7)-septate, often constricted at septa (at least at the median one), the cells cylindrical; endospore not filling spore lumen in age; walls hyaline, but may become brownish, thickened and ornamented in age; perispore usually evident (in K) inconspicuous or often distinct and well developed.

Pycnidia blackish, wall concolorous with involucrellum of ascomata; conidiogenous cells unbranched, enteroblastic, often percurrently proliferating,  $\pm$  cylindrical, lageniform or  $\pm$  globose; fulcrum endobasidial; pycnospores variously bacilliform, oblong, ovoid or threadlike, 0(-1-3)-septate; some species have two anamorphs, one with 1-septate stylospores. No substances. Very rarely lichenized; photobiont, when present, ? Trentepohlia. On usually smooth bark.

Species on rocks, earth and mosses, with cyanobacterial photobionts, previously included in this genus, are treated under Pyrenocollema. Mycocmicrothelia has a similar morphology and habitat ecology to

Arthopyrenia but has dark-colored and usually ornamented ascospores. Other superficially similar genera on bark, but with different ascomatal, ascus, ascospore, or hamathecium structures, include Acrocordia, Ditremis (Anisomeridium), Leptorhaphis, Porina, Strigula and Tomasellia.

The "Arthopyrenia bifera group" is anomalous within the genus, and may belong under Polymeridium or in a separate genus. It is characterized as follows: spores 2-celled, the wall tending to be slightly thickened forming a partial subdivision of the spore lumen, ultimately these thickenings form additional septa giving rise to 4-celled spores; spore wall usually strongly ornamented; perispore usually quite thick; spores often fewer than 8 per ascus; ostiole often eccentric; microconidia linear. Often with Trentepohlia. Tropical or subtropical.

## I. Spores 4-celled.

**1. Ascospores 28-40(-45) x 9-12(-15)  $\mu$ m, with distinct granular ornamentation and thick gelatinous episore; microconidia 9-12 x 0.5  $\mu$ m.** Florida. .... A. exasperata R. C. Harris

**1. Ascospores less than 25  $\mu$ m long.** ..... 2

**2. Ascocarp immersed, the tip surrounded by a broad, thin shield often confluent with other shields; ostiole often surrounded by a whitish ring;** spores 17-22 x 6-8  $\mu$ m; microconidia linear, 6-9 x 1  $\mu$ m. Ascocarps solitary or in groups of 2-10; hymenium pyriform to hemispherical, 0.1-0.2 mm diam.; wall poorly developed, lacking below; apical shield broad, thin, 0.2-0.3 mm wide; ostiole often depressed. Paraphyses slender, regular and thread-like. Asci mostly narrowly ovate, rarely almost cylindrical, 60-105 x 16-26  $\mu$ m. Spores irregularly arranged to biserial, narrowly ovate to narrowly elliptical, 4-celled; perispore well developed. On bark. Florida. ....  
A. confluens R. C. Harris

**2. Ascocarp lacking a broad clypeus, not confluent; ostiole not surrounded by a whitish ring; ascospores 17-23 x 6-7.5  $\mu$ m; microconidia 10-13 x 0.5  $\mu$ m.** Asci narrowly ovate to cylindrical (rarely narrowly obovate), 60-90 x 17-20  $\mu$ m; spores 17-23 x 6-7.5  $\mu$ m (excluding the often rather thick perispore). Ascocarps superficial, hemispherical to flattened, (0.2-)0.4-0.5 mm diam.; wall lacking below. Paraphyses slender, regular and thread-like. Spores biserial to irregularly arranged, narrowly ovate, 4-celled. Microconidia linear, 10-13 x 1  $\mu$ m. Listed by Esslinger, but report from N. America (British Columbia) not yet confirmed. Apparently closely related to A. lapponina. .... A. cerasi (Schrader) Massal.

## II. Spores 2-celled, rarely 4-celled in old age.

**1. Spore wall constricted  $\pm$  in the middle of one or both cells or mesospore thickened as if additional septa were forming,** often near apices (ultimately 4-celled in postmature stage) .....2

**1. Spore wall not constricted in the middle of the cells; mesospore not thickened.** .....7

**2. Spore wall with granular ornamentation; mesospore often forming a ring-like thickening cutting off a subchamber.**

**Southern** (North Carolina to Florida and Texas). [*A. bifera* group] .....3

**2. Spore wall not ornamented; no subchamber partially cut off.**

**Northern** (West Virginia and Tennessee to Newfoundland), or western. ....5

**3. Spores 2 per ascus,** 37-48 x 15-16  $\mu$ m; ostiole occasionally eccentric. Thallus poorly developed but *Trentepohlia* usually detectable. Ascocarps mostly immersed, subglobose to hemispherical, 0.2-0.4 mm diam.; wall thinner or lacking below. Ostiole often rather eccentric. Paraphyses slender, regular and thread-like. Asci narrowly elliptical to elliptical, 75-105(-120) x (20-)25-35  $\mu$ m. Spores 2/ascus, narrowly elliptical, 2-celled, with a slightly thickened area of the wall outline a smaller subchamber, ultimately becoming 4-celled; spore wall strongly granular ornamented; perispore well developed; 37-48 x 15-16  $\mu$ m (excluding perispore). Microconidia rod-like to linear, 5-10 x 1  $\mu$ m. On bark. Alabama, Florida, Louisiana.

..... *A. malaccitula* (Nyl.) Zahlbr. (syn. *A. bifera*) ["*A. BIFERA* GROUP"]

**3. Spores 4-8 per ascus.** .....4

**4. Ascospore wall usually without internal thickening, merely constricted; ascospores only very rarely 4-celled when postmature, 18-30 x 6.5-9.5(-12)  $\mu$ m (excluding perispore); microconidia 6-9 x 0.5  $\mu$ m; always? associated with**

***Trentepohlia*.** Florida. Ascocarps semi-immersed, less commonly immersed or superficial, hemispherical, 0.3-0.5 mm diam.; wall usually lacking below. Paraphyses slender, regular and thread-like. Asci narrowly elliptical to elliptical, usually with a distinct ocular chamber; 75-120(-130) x 20-30  $\mu$ m. Spores irregularly arranged to biserial, narrowly elliptical or narrowly ovate, 2-celled; spore wall granular ornamented; perispore well developed. Microconidia linear, 6-9 x 1  $\mu$ m. On bark. Alabama, Florida, Louisiana, North Carolina, Texas; Mexico. ....*A. lyrata* R. C. Harris ["*A. BIFERA* GROUP"]

**4. Ascospore wall with an internal ring-like ridge in both cells which forms a complete septum in postmature spores; ascospores 27-37 x 10-12  $\mu$ m; microconidia 6-8 x 0.5  $\mu$ m.**

Ascocarps immersed; hymenium flattened hemispherical, (0.2-)0.3-0.4 mm diam.; tip of ascocarp surrounded by a broad, thin hyphal ring; wall thin, lacking below. Paraphyses slender, regular and thread-like.

Asci narrowly obovate, (80-)105-125 x 25-30  $\mu\text{m}$ . Spores 4-8/ascus, irregularly arranged, narrowly elliptical to narrowly ovate, 2-celled; wall strongly granular ornamented; perispore thick, to 2  $\mu\text{m}$ . Microconidia linear, 6-8 x 1  $\mu\text{m}$ . On bark. Florida. .... A. majuscula (Nyl.) Zahlbr. [syn. A. annulata R. C. Harris ined.] ["A. BIFERA GROUP"]

**5. Ascospores 12-15(-18) x 4-5  $\mu\text{m}$ ; spore cells weakly constricted; microconidia 6-8 x 1  $\mu\text{m}$ .** Ascocarps superficial, hemispherical to flattened, 0.3-0.5 mm diam.; wall lacking below. Paraphyses thread-like, regular, to 2  $\mu\text{m}$  wide. Asci narrowly elliptical, 48-60 x 11-13  $\mu\text{m}$ . Spores biseriate to subbiserial, narrowly elliptical, 2-celled, one or both cells constricted near the middle; perispore thin. Microconidia rod-like, 6-8 x 1.5  $\mu\text{m}$ . On smooth bark, possibly always Hamamelis. Tennessee, Massachusetts; most frequent in West Virginia. .... A. degelii R. C. Harris

**5. Spores larger, (13-)15-26 x 4.5-9  $\mu\text{m}$ ; wall rather strongly constricted.** ..... 6

**6. Spores with both ends rounded, upper cell usually somewhat broader and longer, 18-22 x 7-8(-9)  $\mu\text{m}$ ; asci mostly elliptical or obovate (rarely narrowly so), 60-80 x 17-22  $\mu\text{m}$ ; microconidia 10-12 x 0.5  $\mu\text{m}$ .** Ascocarps superficial to semi-immersed, hemispherical to flattened, 0.2-0.3(-0.4) mm diam., wall lacking below. Paraphyses slender, regular and thread-like. Spores irregularly arranged, narrowly ovate to narrowly elliptical, 2-celled, rarely becoming 4-celled; perispore usually well developed. Microconidia linear, 10-12 x 1  $\mu\text{m}$ . On smooth bark. Rare. Newfoundland, California, Oregon, Vermont. .... A. cinereopruinosa (Schaerer) Massal.

**6. Spores with one or both ends pointed, cells approximately equal, (13-)15-20 x 4.5-6.5(-7.5)  $\mu\text{m}$ ; asci mostly narrowly elliptical, narrowly ovate or narrowly obovate, 75-110 x 12-18  $\mu\text{m}$ ; microconidia 10-12(-15) x 0.5  $\mu\text{m}$ .** Ascocarps superficial to slightly immersed, hemispherical, 0.3-0.4(-0.5) mm diam.; wall thinner or lacking below. Paraphyses slender, regular and thread-like. Spores uniseriate to biserial, narrowly elliptical to narrowly ovate with one or both ends pointed, 2-celled, rarely 4-celled in old age, cells approximately equal in size, cells constricted near the middle or rarely two constrictions per cell; perispore well developed. Microconidia linear. On smooth bark. California, British Columbia, Oregon, Washington. .... A. plumbaria (Stizenb.) R. C. Harris

**7. Ascospores ovate, length/width ratio 1.5-2.1; 13-15 x 7-8(-10)  $\mu\text{m}$ ; cells markedly unequal; microconidia 8-10 x 0.5  $\mu\text{m}$ .** Ascocarps immersed; hymenium subglobose, 0.2-0.3 mm diam.; wall extended outward above forming an elongate shield, ca. 0.3-0.5 x 0.7-1.0 mm, thinner or lacking below. Paraphyses slender, regular and thread-like. Asci narrowly elliptical to cylindrical, 75-110 x 14-16  $\mu\text{m}$ . Spores uniseriate to subbiserial, ovate, 2-celled, with the lower cell narrower and shorter; perispore not obvious. Microconidia linear, 8-10 x 1  $\mu\text{m}$ . On bark of "Andromeda"

(probably = Lyonia). Florida. .... A. oblongens R. C. Harris

**7. Ascospores narrowly ovate or narrowly elliptical, length/width ratio 2.5 or greater. .... 8**

**8. Ascospores mostly more than 20 x 7  $\mu$ m. .... 9**

**8. Ascospores mostly less than 23 x 7.5  $\mu$ m. .... 10**

**9. Ascocarp superficial, hemispherical to flattened, no hyphal ring present; spores 20-30 x 7-9.5(-11)  $\mu$ m; microconidia rod-like, 4-5 x 1  $\mu$ m. on a wide variety of smooth, thin barks.** Ascocarps 0.4-0.6 mm diam.; wall lacking below. Paraphyses slender, regular and thread-like. Asci mostly narrowly obovate, rarely almost cylindrical; ocular chamber mostly not evident; (85-)100-125 x 17-22  $\mu$ m. Spores biseriate, subbiserial or almost uniseriate, occasionally only 4/ascus, narrowly ovate, 2-celled, the lower cell occasionally slightly constricted in the middle; perispore well developed. Florida, Alabama, Kentucky, Louisiana, South Carolina, Tennessee, Texas, New Jersey. .... A. ("Cifferioliichen") cinchonae (Ach.) Müll. Arg.

**9. Ascocarp immersed, tip surrounded by a broad, thin hyphal ring (clypeus); spores 20-28(-32) x 6-8(9.5)  $\mu$ m; microconidia linear, 7-8 x 1  $\mu$ m. On Taxodium.** Hymenium pyriform, 0.2-0.3 mm diam.; ascocarp wall poorly developed, lacking below. Paraphyses slender and regular; asci cylindrical, 100-130 x 14-20  $\mu$ m. Spores subbiserial, often almost uniseriate, narrowly ovate to narrowly elliptical. Florida, Texas. .... A. taxodii R. C. Harris

**10. Spores 12-17 x 4-5.5  $\mu$ m.** Ascocarps hemispherical to subglobose, superficial to semi-immersed, 0.25-0.5 mm diam.; wall thinner or lacking below. Paraphyses slender, regular and thread-like. Asci slender, narrowly elliptical to cylindrical; ocular chamber usually distinct, (50-)60-90 x (9-)12-14  $\mu$ m. Spores subbiserial, narrowly ovate, 2-celled; perispore thin. On bark. Florida, Louisiana. .... A. minor R. C. Harris

**10. Spores 15-23 x 5-7.5  $\mu$ m. .... 11**

**11. Ascomata usually complanate with a broad clypeus, often fusing with others; ascospores 17-23 x 5-7  $\mu$ m; microconidia arcuate, 20-27 x 0.5  $\mu$ m. Subtropical.** Ascocarp wall usually extended outward forming a broad shield to 1 mm diam. Ascocarps semi-immersed to superficial, flattened to hemispherical; hymenium mostly pyriform to subglobose, ca. 0.2 mm diam.; wall lacking below. Paraphyses slender, regular and thread-like. Asci narrowly elliptical, 55-100 x 12-17(-20)  $\mu$ m. Spores subbiserial to biserial, narrowly ovate, 2-celled, rarely 4-celled; perispore thin. Microconidia filiform, usually curved, 20-27 x 1  $\mu$ m. On bark. Florida and the West Indies. .... A. planorbis (Ach.) Müll. Arg.

**11. Ascomata hemispherical to subglobose, with weak basal fringe; ascospores 15-22 x 5.5-7.5  $\mu$ m; microconidia 7-10 x 0.5  $\mu$ m.**

**Northern.** Ascocarps superficial, hemispherical to flattened, 0.3-0.6 mm diam.; wall lacking below. Paraphyses slender, regular and thread-like. Asci narrowly elliptical, 75-90(-110) x 15-23  $\mu$ m. Spores biserial to subbiserial,

narrowly ovate, 2-celled; perispore well developed. Microconidia linear, 7-10 x 1  $\mu$ m. On smooth bark. Massachusetts, New Hampshire, Newfoundland. ....A. ("Cifferiolichen") analepta (Ach.) A. Massal.

## ADD?

**Paraphyses completely or almost completely gelatinized;** spores (12-)15-22 x 4.5-6  $\mu\text{m}$ ; asci ovate to narrowly ovate, 30-50 x 15-20  $\mu\text{m}$ . Ascocarps superficial, hemispherical to flattened, 0.15-0.25(-0.3) mm diam.; wall lacking below. Hymenial gelatin occasionally 1+ pale violet. Spores irregularly arranged, narrowly ovate, mostly with rather blunt ends, 2-celled; perispore thin. Microconidia short, narrowly elliptical, 2-3 x 1  $\mu\text{m}$ . On smooth bark. Alabama, Louisiana, Massachusetts. .... A. salicis Massal. (Taxonomic position uncertain according to Harris 1995)

### A. kentrospora (Branth) Branth

Thallus not visible. Ascocarp small, 0.3-0.4 mm broad, exciple dark, spores hyaline, 3-septate, the tips with a small mucro, fusiform, with a gelatinous sheath, 22-26 x 5-6  $\mu\text{m}$ . Greenland. Not mentioned by Harris (1995)

Lichenicolous. .... A. texensis (Cooke) Hawksw. (Not seen by Harris; position uncertain)

## Detailed Descriptions

### **A. degelii**

Forming brown, rarely tan, blotches on smooth bark, often Hamamelis. Ascomata superficial, hemispherical to complanate, 0.3-0.5 mm diam., clypeate, not melanized below. Asci narrowly elliptical, 48-60 x 11-13  $\mu$ m, with 8 biseriate to subbiseriate spores. Ascospores narrowly elliptical, 2-celled, one or both cells constricted near the middle (spore outline sinuose), 12-15(-18) x 4-5  $\mu$ m, with a thin sheath. Microconidia rod-shaped, 6-8 x 1  $\mu$ m. Tennessee.

### **A. exasperata**

Forming whitish patches on bark. Ascomata hemispherical to subglobose, mostly immersed, 0.4-0.6 mm diam., with slightly spreading clypeus or not, little or not melanized below. Asci cylindrical, 140-160 x 20-28  $\mu$ m, with 8 biseriate to nearly uniseriate spores. Ascospores narrowly elliptical to narrowly ovate, 4-celled, 28-40(-45) x 9-12(-15)  $\mu$ m, distinctly granular ornamented, with a thick gelatinous sheath. Microconidia 9-12 x 0.5  $\mu$ m. Florida.

### **A. oblongens**

Forming a whitish blotch on bark of ericaceous shrubs. Ascomata  $\pm$  subglobose, immersed, 0.2-0.3 mm diam., with a broad, elongate clypeus, 0.3-0.5 x 0.7-1.0 mm, little or not melanized below. Asci narrowly elliptical to cylindrical, 75-110 x 14-16  $\mu$ m, with 8 biseriate to subbiseriate spores. Ascospores ovate, 2-celled, 13-15(-17) x 7-8.5(-10)  $\mu$ m, smooth; cells markedly unequal, the lower narrower and shorter. Microconidia rod-shaped, 8-12 x 0.5-1  $\mu$ m. Florida.

### **A. plumbaria**

[Description of Pyrenula herrei Fink]:

Thallus well developed, epilithic; spores 14-19 x 4.5-5.5  $\mu$ m. Thallus brown to dark brown, gelatinous when wet. Photobiont apparently Trentepohlia. Ascocarps very numerous, semi-immersed, subglobose, 0.2-0.3 mm diam.; wall lacking below. Paraphyses thread-like but rather irregular and short celled, to 2.5-3  $\mu$ m wide. Asci narrowly ovate to cylindrical; wall strongly thickened at apex; 65-85 x 12-15(-20)  $\mu$ m. Spores irregularly arranged, narrowly ovate, 2-celled; perispore not obvious. Microconidia rod-like, 4-5 x 1  $\mu$ m. On maritime rock (sandstone). California.

### **A. taxodii**

Forming a whitish blotch on bark of Taxodium. Ascomata subglobose, immersed, 0.2-0.3 mm diam. with a broad clypeus; wall poorly melanized. Asci cylindrical, 100-130 x 14-20  $\mu$ m, with 8 nearly uniseriate to subbiseriate spores. Ascospores narrowly ovate to narrowly elliptical, 20-28(-32) x 6-8(9.5)  $\mu$ m, smooth. Microconidia 7-8 x 0.5  $\mu$ m. Florida.

## **Excluded**

A. rappii Zahlbr. = Melaspilea s. l.

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