

## Additions to the genus *Arnium*<sup>1</sup>

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*Arnium* Nits. in Fuckel is accepted for members of the Sordariaceae typically possessing one-celled, dark brown ascospores provided with gelatinous appendages and one or sometimes two terminal germ pores. An emended description and key are provided. Two new species are described and illustrated: *A. monostichum* from the United States and *A. triepitheca* from Canada and the United States. The following new combinations are proposed: *A. absimile* (*Podospora absimilis* Cain), *A. cirriferum* (*Sordaria cirrifera* Speg.), *A. comatosporum* (*Podospora comatospora* Cain), *A. heterochaetum* (*Pleurage heterochaeta* Griff.), *A. kansense* (*Pleurage kansensis* Griff.), and *A. ontariense* (*Sordaria ontariensis* Cain).

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Le nom *Arnium* Nits. in Fuckel est retenu dans ce travail pour les membres de la famille des Sordariacées qui possèdent normalement des ascospores unicellulaires, brun foncé, pourvues d'appendices gélatineux et d'un, ou parfois deux, pores germinatifs. Une description élargie et une clef sont proposées. Deux espèces nouvelles sont décrites et illustrées: *A. monostichum* des États-Unis et *A. triepitheca* du Canada et des États-Unis. Les combinaisons nouvelles sont présentées: *A. absimile* (*Podospora absimilis* Cain), *A. cirriferum* (*Sordaria cirrifera* Speg.), *A. comatosporum* (*Podospora comatospora* Cain), *A. heterochaetum* (*Pleurage heterochaeta* Griff.), *A. kansense* (*Pleurage kansensis* Griff.) et *A. ontariense* (*Sordaria ontariensis* Cain).

### Introduction

The generic groupings within the Sordariaceae are still quite artificial, especially for *Podospora* Ces. in Rabenh. and *Sordaria* Ces. & DeNot. Lundqvist (1964) has clearly pointed out that before any natural arrangement can evolve, a considerable number of these dissident elements will have to be segregated into other genera. In recent years this has begun to occur (i.e., *Zygo-pleurage* Boedijn 1962, *Fimetariella* Lundq. 1964, and *Apiosordaria* v. Arx & Gams 1967). During a revision of *Podospora*, Mirza and Cain (1969) restricted the genus to species possessing two-celled ascospores provided with a dark upper cell and a lower hyaline one, a single apical germ pore, and gelatinous appendages. The present paper deals with *Arnium* Nits. in Fuckel, a segregate from *Podospora*. This name is used for those species with dark brown, one-celled ascospores, possessing gelatinous appendages as well as a single germ pore at one or both ends, and, in a couple of taxa, developing a transverse septum late in ontogeny.

In his treatment of the Sordariaceae, Lundqvist (1971) adopted a similar concept of *Arnium*. Earlier, Fernier (1954) had proposed *Pleurosordaria* Fernier, unfortunately an invalid

name, for essentially this concept. Although we consider the two genera synonymous, they are not based on the same type as von Arx (1970) has indicated. *Arnium* is based on *Sphaeria lanuginosa* Preuss while *Pleurosordaria* is based on *Sphaeria brassicae* Klotzsch in Smith. These two species are both synonyms of *A. olerum* (Fr.) Lundq. & Krug.

In their treatment of *Sordaria*, von Arx and Müller (1954) listed *Arnium* as well as a number of other quite different genera as synonyms. Some of these belong under *Podospora* although *Camptosphaeria* Fuckel must be placed in the Lasiosphaeriaceae (Lundqvist, personal communication). Neither are the names *Arnium* and *Pleurosordaria* available for *Zopfiella* Winter in Rabenh. nor the synonyms listed by von Arx (1970). Actually none of these taxa are identical with *Zopfiella* (see Malloch and Cain 1971), as indicated by an examination of the types. *Entosordaria* (Sacc.) v. Höhn., which traditionally was placed close to *Anthostomella* Sacc. of the Xylariaceae, was relegated to the Amphisphaeriaceae by Eriksson (1966). *Strattonia* Ciferri (1954) is a doubtful genus since no type specimen is available. It is probably either a synonym of *Triangularia* Boedijn (1934) or an earlier name for *Lacunospora* Cailleux (1968). Although *Trip-terospora* Cain and *Zopfiella* are closely related, they are not synonymous as shown by the characteristics of their ascospores.

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## Descriptions

*Arum* Nits. in Fockel, Jahrbücher Nass. Ver. Nat. 25-26: 326. 1871.

= *Pleurosordaria* Ferner, Rev. Mycol. 19 (Suppl. colonial No. 1): 17. 1954, nomen in-

validum cui descriptio latina deest.

= *Nothopodospora* Mirza, Diss. Abstr. 25(2): 780. 1964; and Mycologia 62: 1006. 1970.

nomen nudum.

Perithecia saprophytic, scattered or clustered,

immersed or superficial, non-stromatic, sub-

globose or pyriform; neck short, black, either

hairy or bare, ostiolate; peridium pseudoparen-

chymatous, membranaceous or rarely coriace-

ous, usually two-layered. Asci unitunicate, non-

amyloid, four- to multi-spored, cylindrical or

clavate, stipitate; apical ring variable, indistinct

or thickened. Paraphyses abundant, filiform,

hyaline. Ascospores one-celled or sometimes

becoming two-celled late in ontogeny, ellipsoidal

or occasionally ovoid-ellipsoidal, in several in-

stances inaequalateral, with gelatinous appen-

dages, possessing one or two germ pores located

at the ends of the spore; gelatinous appendages

usually lash-like, rarely fugaceous.

ETYMOLOGY: Greek, *arion* (αριον), dim. =

sheep, referring to the tomentose appearance of

the perithecium.

TYPE SPECIES: *Sphaeria lanuginosa* Freuss.

## KEY TO THE SPECIES

Several of the taxa included below are not considered in the text. These are treated by Lundqvist (1971) with the exception of *A. ovale*, *A. subtile*, and *A. villosum*, which are being published by Cain and Mirza (1972).

1. Perithecia with agglutinated hairs, other types of hairs may or may not be present..... 2
1. Perithecia without agglutinated hairs, other types of hairs usually but not always present..... 3
2. Perithecia with agglutinated hairs only; asci eight-spored; ascospores uniseriate, with two gelatinous appendages at the upper end and one at the lower end of the spore. 2. *A. triepitheca* 2. Perithecia with agglutinated as well as flexuous hairs; asci 16-spored; ascospores biseriate, with two gelatinous appendages at each end of the spore..... *A. heterochaetium*
3. Hairs on perithecia forming a tomentum; ascospores usually uniseriate but occasionally biseriate in *A. olivum*..... 4
3. Hairs on perithecia present or absent, never forming a tomentum; ascospores biseriate or multi-seriate (except in *A. arizonense* and *A. monostichum*)..... 5
4. Tomentum greyish; peridium coriaceous, breaking up into irregular patches of cells; ascospores 44-55 × 27-32 μ, gelatinous appendages grouped in long fascicles at the ends but scattered and short around the sides of the spore..... *A. comatosporum*
4. Tomentum greyish or sometimes whitish; peridium and the gelatinous appendages not as above; ascospores (40-42-54 × 28-35 μ; usually not fimbiculous..... *A. olivum*
4. Tomentum olivaceous brown; peridium and the gelatinous appendages not as in *A. comatosporum*; ascospores 50-70 × 22-26 μ..... *A. tomentosum*
5. Perithecia with short, straight, hyaline-tipped hairs; peridium coriaceous, of interlocking cells; asci about 512-spored..... *A. ontariense*
6. Perithecia and asci not as above..... 6
6. Perithecia bare; gelatinous appendages lash-like or cirriform..... 16
6. Perithecia with tufted hairs; gelatinous appendages fugaceous (except in *A. arizonense*)..... 7
6. Perithecia with flexuous or stiff hairs; gelatinous appendages lash-like or triangular..... 8
7. Asci four-spored; ascospores slightly flattened on one side, 45-52 × 21-25 μ, gelatinous appendages lash-like..... *A. arizonense*
7. Asci eight-spored; ascospores not flattened, 45-54 × 24-27 μ, gelatinous appendages entirely surrounding the spore..... *A. macrotheca*
7. Asci 256-spored; ascospores not flattened, 18-23 × 10-12 μ, gelatinous appendages not as above, often invisible..... *A. abstinile*
8. Asci 64-spored; ascospores 20-24(-26) × 13-15 μ..... *A. leporinum*
8. Asci eight-spored; ascospores not as above..... 9
9. Perithecia with long, usually flexuous hairs; apical ring usually distinct..... 10
9. Perithecia with short, somewhat flexuous, stiff hairs (usually longer in *A. cervinum*); apical ring frequently indistinct..... 13

10. Ascospores flattened on one side, gelatinous appendages eccentric..... 11  
 10. Ascospores symmetrical, gelatinous appendages not eccentric..... 12
11. Ascospores 28–35 × 16.0–17.5 μ, with two germ pores..... *A. inaequilaterale*  
 11. Ascospores 31–40 × 18–24 μ, with one germ pore..... *A. caballinum*
12. Perithecia villose; ascospores 26–38(–43) × 17–21(–23) μ, ellipsoidal uniseriate, with apical germ pore only..... *A. kansense*  
 12. Perithecia villose, ascospores 34–41 × 18–23 μ, biseriata, with germ pore at each end..... *A. villosum*  
 12. Perithecia not villose, ascospores 24–36 × 17–23 μ, ovoid-ellipsoidal, biseriata, with single apical germ pore, gelatinous appendages eccentric..... *A. ovale*  
 12. Perithecia not villose; ascospores (43–)47–57 × 24–30 μ..... *A. sudermanniae*
13. Ascospores finally becoming two-celled at maturity by the formation of a transverse septum..... 14  
 13. Ascospores remaining permanently one-celled..... 15
14. Apical ring distinct; ascospores 24–31 × 14–18 μ, septum forming equatorially..... *A. imitans*  
 14. Apical ring distinct; ascospores 31–36 × 18–19 μ, septum forming equatorially; not fimicolous..... *A. apiculatum*  
 14. Apical ring lacking; ascospores 21–24 × 12–14 μ, septum forming posteriorly..... *A. septosporum*
15. Perithecial hairs slender, slightly flexuous; ascospores uniseriate, 25–29(–31) × 17–18 μ; gelatinous appendages symmetrical..... 1. *A. monostichum*  
 15. Perithecial hairs slender, slightly flexuous; ascospores biseriata, 33–38 × 17–22 μ; gelatinous appendages symmetrical..... *A. subtile*  
 15. Perithecial hairs straight; ascospores biseriata, 35–52 × 18–25 μ; gelatinous appendages symmetrical..... *A. hirtum*  
 15. Perithecial hairs straight (except in the lower perithecial region where they are flexuous; ascospores biseriata, 35–40(–43) × 17–19(–23) μ; gelatinous appendages eccentric..... *A. cervinum*
16. Apical ring indistinct; gelatinous appendages cirriform..... *A. cirriferum*  
 16. Apical ring distinct; gelatinous appendages lash-like but not cirriform..... *A. mendax*

1. *Arnium monostichum* Krug & Cain sp. nov.

Figs. 1–3

Perithecia dispersa, pilosa, immersa, pyriformia, circa 850–900 × 450–500 μ magna; perithecii collum brevius, conicum, atribrunneum, distinctum, circa 300–350 μ longum, pilis brevibus, flexuosis, hyalinis vel pallide brunneis praeditum, circa 25–40 μ longum; peridium profunde rufibrunneum, membranaceum, e cellulis parvis, angulatis textum. Asci octospori, cylindracei, 225–260 × 20–25 μ magni, summa in parte angustiores et quasi truncati, inferna in parte in stipitem 60–100 μ longum attenuati; annulum apicale indistinctum. Paraphyses numerosissimae, filiformes, septatae, hyalinae. Ascospores unicellulares, oblique uniseriales, appendicem gelatinosam in utroque apice gerentes, ellipsoideae, in apice rotundatae aut interdum minime attenuatae, 25–29(–31) × 17–18 μ magna, primum hyalinae vel olivaceae, maturitate confirmata atribrunneae et opacae, foramen germinale circa 2.5 μ diametro crassum in utroque apice exhibentes; appendices gelatinosae symmetrice dispositae, flagelliformes, circa 50 μ longae et in basi 8–10 μ diametro crassae.

HOLOTYPE: In vaccarum fimo, in loco 12 mi SW a Wheatland remoto, Platte Co., Wyoming, U.S.A., 1 Sept. 1964, Cain, TRTC 43622. In torontoensis universitatis Cryptogamarum herbario.

ETYMOLOGY: Greek, *monos* (μῶνος) = one, and *stichos* (στῖχος) = line, referring to the uniseriate arrangement of the ascospores.

*Perithecia* scattered, roughened by short hairs on the neck, embedded, pyriform, about 850–900 × 450–500 μ; neck relatively short, conical, stout, very dark brown, quite distinct, about 300–350 μ long, with short, flexuous, hyaline to very pale brownish hairs measuring about 25–40 μ long; ostiole small, indistinct; peridium dark red-brown by reflected light, membranaceous, appearing in surface view of small, angular cells. *Asci* eight-spored, cylindrical, 225–260 × 20–25 μ, narrowed and somewhat truncate at the apices, gradually tapering into a very long stipe measuring 60–100 μ; apical ring indistinct. *Paraphyses* very abundant, filiform, septate, hyaline, longer than and mixed with the asci. *Ascospores* one-celled, obliquely uniseriate, with a gelatinous appendage at each end of the spore, ellipsoidal, rounded or occasionally very slightly

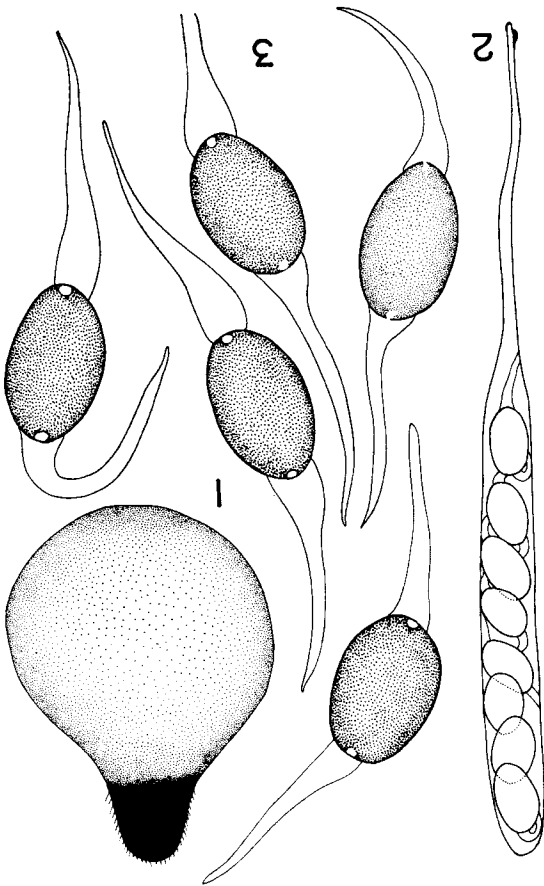
species with flexuous hairs only *A. cervinum* and *A. hirtum* are at all similar to *A. monostichum*. These taxa differ from *A. monostichum* in possessing larger, biserially arranged ascospores. *A. mandax*, a species somewhat resembling *A. monostichum*, can be distinguished by its bare neck in contrast to the short, flexuous hairs of *A. monostichum*, the distinct apical ring, and larger biserially arranged ascospores. A number of other species have a uniseriate spore arrangement but, among other things, can be distinguished from *A. monostichum* by the nature of the perithecial hairs.

2. *Arnim trilepitheca* Krug & Cain sp. nov.

Figs. 4-7

Perithecia dispersa aut laxe aggregata, pilorum breviorum fasciculis parvis obiecta, ex erumpenti ad superficiale positionem pertinentia, ovoida vel pyriformia, 725-950 × 375-500 μ magna; perithecii collum breve, conicum, truncatus, nigrum, distinctissimum, circa 300-375 μ longum; perithecii pili breves, agglutinati, hyalini, parietibus tenuibus, 20-30 μ longi; peridium obscure olivaceibrunneum, membranaceum, e cellulis magnis, irregularioribus, turgidis textum. Asci octospori, cylindracei, 300-360 × 25-30 μ magni, summa in parte leviter angust et truncati, inferna in parte in stipitem circa 100-150 μ longum attenuati; annulum apicale distinctum. Paraphyses numerosae, filiformes, ventricosae, septatae, hyalinae. Ascospores unicellulares, oblique uniseriales, appendices gelatinosas duas in distali apice et appendicem unam in proxima apice gerentes, ellipsoideae, in apice attenuatae, (27-28-37(-40) × (17-18-22(-23) μ magna, firmata atribunnae et opae, foramen germinale circa 2 μ diametro crassum in uno vel utroque apice plerumque exhibentes; appendices gelatinosae terminales, flagelliformes, in spora distali apice excentrice dispositae, 30-40 μ longae et 3-4 μ basis diametro crassae, in spora proxima apice symmetrice dispositae, 40-50 μ longae et 6-8 μ basis diametro crassae.

HOLOTYPE: In vaccarum fimo, Sky Lake, Bruce Peninsula, Bruce Co., Ontario, Canada, 21 July 1932, Cain TRTC 5208. In torontoensis universitatis Cryptogamarum herbario.  
ETYMOLOGY: Greek, *trilepis* (τρεις) = three, and *epitheke* (επιθηκη) = addition, referring to the three gelatinous appendages on the ascospores.



Figs. 1-3. *A. monostichum* (TRTC 43622). Fig. 1. Perithecium, × 35. Fig. 2. Ascus and ascospores, × 350. Fig. 3. Ascospores with gelatinous appendages (apical germ pore shown in two spores), × 700.

narrowed towards the ends, 25-29(-31) × 17-18 μ, ranging from hyaline when young to oliveaceous, finally very dark brown and opaque at maturity with each containing a germ pore at each end of the spore measuring about 2.5 μ diam; gelatinous appendages symmetrically located at the ends, lash-like, measuring about 50 μ long and 8-10 μ diam at the base.

HABITAT: On cow dung.

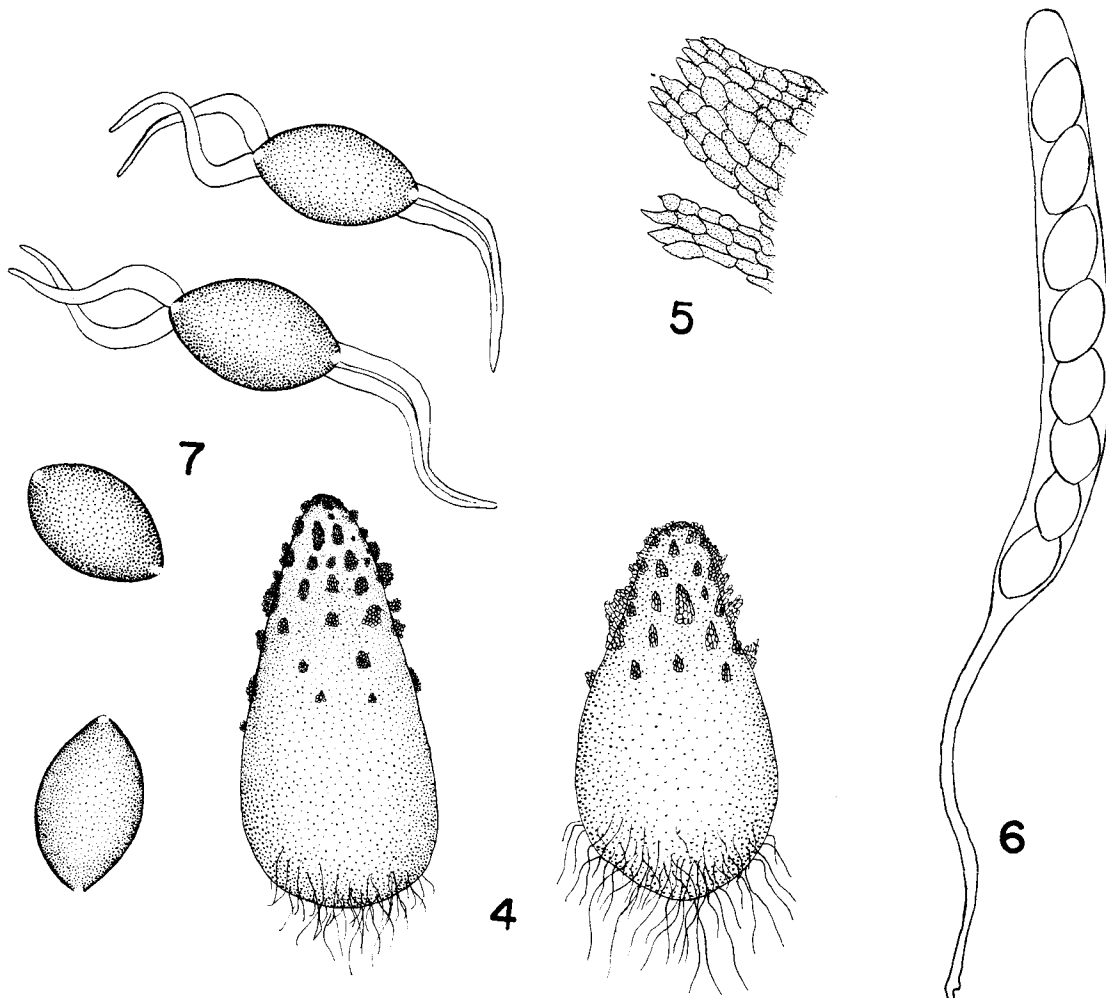
SPECIMEN EXAMINED: UNITED STATES: Wyo- ming: Platte Co., 12 mi SW of Wheatland, 1 Sept. 1964, Cain, TRTC 43622 (TYPE).

The diagnostic features of this organism are the flexuous nature of the hairs on the perithecial neck, size and uniseriate arrangement of the ascospores, as well as the symmetrical position of the gelatinous appendages. Among those

*Perithecia* scattered or loosely clustered, covered with small clusters of hairs, erumpent to superficial, ovoid to pyriform, 725–950 × 375–500 μ; neck short, conical, stout, rather truncate, black, very distinct, about 300–375 μ long; hairs short, agglutinated, hyaline, thin-walled, 20–30 μ long; ostiole small, very distinct; peridium dark olivaceous brown by reflected light, membranaceous, appearing in surface view of large, somewhat irregular, swollen cells. *Asci* eight-spored, cylindrical, 300–360 × 25–30 μ, slightly narrowed and truncate at the apices, gradually tapering into a very long stipe measuring about 100–150 μ; apical ring quite distinct. *Paraphyses* abundant, filiform, ventricose, septate, hyaline,

longer than and mixed with the asci. *Ascospores* one-celled, obliquely uniseriate, with two gelatinous appendages at the upper end and one at the lower end of the spore, ellipsoidal, narrowed towards the ends, (27–)28–37(–40) × (17–)18–22(–23) μ, ranging from hyaline when young to olivaceous, finally dark brown and opaque at maturity, with each usually containing a germ pore at one or both ends of the spore measuring about 2 μ diam; *gelatinous appendages* terminal, lash-like, the upper ones eccentrically located measuring 30–40 μ long and 3–4 μ diam at the base, the lower one symmetrically located measuring 40–50 μ long and 6–8 μ diam at the base.

HABITAT: On cow dung.



FIGS. 4–7. *A. triepitheca* (TRTC 5208). Fig. 4. Two perithecia, × 50. Fig. 5. Agglutinated hairs, × 700. Fig. 6. Ascus with ascospores, × 350. Fig. 7. Four ascospores (gelatinous appendages shown on two only) showing two terminal germ pores, × 700.

≡ *Podospora heterochaeta* (Griff.) Cain, Can. J. Bot. 40: 460, 1962.

≡ *Arnum kansense* (Griff.) Krug & Cain comb. nov. ≡ *Pleurage kansensis* Griff., Mem. Torrey Bot. Club, 11: 83, 1901. (Basionym)

≡ *Sordaria kansensis* (Griff.) Sacc. & D. Sacc., Syll. Fung. 17: 602, 1905.

≡ *Podospora kansensis* (Griff.) Cain, Can. J. Bot. 40: 460, 1962.

*Arnum ontariense* (Cain) Krug & Cain comb. nov.

≡ *Sordaria ontariensis* Cain, Univ. Toronto Stud., Biol. Ser. 38: 31, 1934. (Basionym)

≡ *Podospora ontariensis* (Cain) Cain, Can. J. Bot. 40: 460, 1962.

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The help extended by Dr. C. T. Rogerson (New York) and N. Lundqvist (Uppsala) is especially appreciated. The assistance of Dr. G. Bocquet (Zürich) in correcting the Latin diagnoses as well as preparing the French summary was particularly welcome. We also thank Dr. B. Boivin for his helpful suggestions.

SPECIMENS EXAMINED: CANADA: Ontario: Bruce Co., Bruce Peninsula, Sky Lake, 21 July 1932, Cain TRTC 5208 (TYPE). UNITED STATES: Colorado: Boulder Co., 3 km NW of Lyons, near mouth of St. Vain Creek, W base of Mt. Steam-boat, foothills of Front Range, elev. 1900 m, on cow dung, 30 April 1966, Santesson 18499p (UPS). Nebraska: Deuel Co., Chapel, on cow dung, 16 Aug. 1964, Cain TRTC C1920d.

The agglutinated perithecial hairs, uniseriate arrangement of the ascospores, and the nature of the gelatinous appendages are the essential distinguishing characteristics for this taxon. *A. heterochaeta*, the only closely related species, differs in possessing flexuous hairs in addition to agglutinated ones, 16-spored asci, and two gelatinous appendages at the lower end of the spore as opposed to one in *A. triepitheca*.

For most species of *Arnum*, the number of germ pores in the spore wall usually appears to be a good specific characteristic. However, this does not seem to be true in both *A. oleum* and *A. triepitheca*, since here spores have been observed with both one and two germ pores. In the type collection of *A. triepitheca* the spores generally possess two pores, while in the other collections spores with only one germ pore predominate.

#### New Combinations

*Arnum abstinile* (Cain) Krug & Cain comb. nov. ≡ *Podospora abstinilis* Cain, Can. J. Bot. 40: 449, 1962. (Basionym)

*Arnum cirriferrum* (Speg.) Krug & Cain comb. nov.

≡ *Sordaria cirrifera* Speg., Anal. Mus. Nac. Buenos Aires, 2: 253, 1899. (Basionym)

≡ *Pleurage cirrifera* (Speg.) C. Moreau, Encyclopedie Mycologique, Paris, 25: 255, 1953.

*Arnum comatosporum* (Cain) Krug & Cain comb. nov.

≡ *Podospora comatospora* Cain, Can. J. Bot. 40: 452, 1962. (Basionym)

*Arnum heterochaetum* (Griff.) Krug & Cain comb. nov.

≡ *Pleurage heterochaeta* Griff., Mem. Torrey Bot. Club, 11: 86, 1901. (Basionym)

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