

The genus *Cainia* and a new family, Cainiaceae ¹⁾

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Abstract. The Cainiaceae fam. nov. is described to accommodate *Cainia* v. ARX et MÜLLER, which is segregated from the Amphisphaeriaceae on the basis of the structure of the ascial apical apparatus and the unique ascospore characteristics. Germination studies indicate that reported grooves in the spore wall are germ slits. An emended generic description and key are provided. Revised descriptions and illustrations are provided for *C. graminis* (NIESSL) v. ARX et MÜLLER and *C. desmazieresii* MOREAU et MÜLLER ex KRUG sp. nov. The combinations *Amphisphaeria deutziae* (*Cainia deutziae* E. MÜLLER) and *A. cupula* (ELLIS) SCHRANTZ ex KRUG (*Sphaeria cupula* ELLIS) are proposed for two taxa excluded from *Cainia*. Other genera possessing similar ascospores are briefly discussed.

Zusammenfassung. Auf Grund des ascogenen Apicalapparates und der besonderen Struktur der Ascosporen wird die Gattung *Cainia* v. ARX et MÜLLER von den Amphisphaeriaceae abgetrennt und zu den Cainiaceae fam. nov. gestellt. Keimungsversuche mit Ascosporen zeigten, dass die Vertiefungen der Sporenwand sich spaltförmig öffnen und dem Keimschlauch Durchlass geben. Die Beschreibung der Gattungen und deren Schlüssel ist überarbeitet und erweitert worden. Für *C. graminis* (NIESSL) v. ARX et MÜLLER und *C. desmazieresii* MOREAU et MÜLLER ex KRUG sp. nov. werden revidierte Beschreibungen und Illustrationen gegeben. Weiterhin wird vorgeschlagen, die beiden Kombinationen *C. deutziae* E. MÜLLER und *C. cupula* (ELLIS) E. MÜLLER von der Gattung *Cainia* abzutrennen und zu der Gattung *Amphisphaeria* CÉS. et de NOT. (bzw. *A. deutziae* und *A. cupula*) zu stellen. Gattungen mit ähnlichen Sporen werden kurz besprochen.

Introduction

The genus *Cainia* was erected by von ARX and MÜLLER (1955) for *Delitschia graminis* NIESSL. In describing this taxon, these authors stressed especially the possession of a stroma, an apical apparatus in the ascus as well as the characteristics of the ascospores. These spores were described as having a germ pore at each end and were illustrated with longitudinal ridges. MÜLLER and von ARX (1962) subsequently indicated that such ridges were actually grooves. ERIKSSON (1967), on the basis of Swedish material, found that there were no true germ

¹⁾ Supported by grants from the National Research Council of Canada.

²⁾ The research for this paper was partially performed at the Institut für Spezielle Botanik, Eidg. Technische Hochschule, Zürich, Switzerland and compiled at the University of Toronto.

pores but that a pore was present within the septum. Upon examining the spores in detail, it was observed that the grooves mentioned by both MÜLLER and von ARX (1962) and ERIKSSON (1967) were in fact germ slits and the germ pores merely thickenings in the spore wall.

WARCUP (1951) has cited an earlier homonym, *Cainia verruculosa* (JENSEN) HUGHES ined. This taxon, which is based on *Pleurage verruculosa* JENSEN, is currently accommodated in *Apiosordaria* v. ARX et GAMS of the Sordariaceae. Although differing slightly orthographically, *Cainia* HUGHES must be treated as an invalid homonym as neither diagnosis nor citation was provided. Accordingly, the use of this generic name by von ARX and MÜLLER (1955) for *Delitschia graminis* must be considered legitimate, and the combination *C. verruculosa* rejected as a nomen nudum.

A second species of *Cainia*, based on *Sphaeria incarcerata* DESM., was added to the genus by MÜLLER and von ARX (1955). Subsequently, it became apparent that the collections on which this transfer was based were not con-generic with the type of *S. incarcerata*. MOREAU and MÜLLER (1962), after examining the appropriate types, concluded that *S. incarcerata* was synonymous with *S. spartii* CAST. which is currently placed in *Didymosphaeria* FÜCKEL. Since *S. spartii* CAST. is a later homonym of *S. spartii* NEES (= *Cucurbitaria spartii* (NEES) CES. et de NOT.), the epithet *D. spartii* (CAST.) FABRE must be rejected in favour of *D. incarcerata* (DESM.) SACC. The collections used by MÜLLER and von ARX (1955), in proposing the transfer of *S. incarcerata* to *Cainia*, actually represent an undescribed species of this genus which was named *C. desmazieresii* by MOREAU and MÜLLER. Since no validating description or citation of type was included, this taxon must be treated as a nomen invalidum.

Finally two other species were added to the genus, *Cainia deutziae* MÜLLER (1957) and *C. cupula* MÜLLER (MÜLLER and von ARX, 1962). A close examination of the types of these taxa revealed that the ascospores merely possess longitudinal surface striations but lack true germ slits. Furthermore, the apical apparatus is more simplified than in the type species, consisting only of a ring structure rather than a complicated plug. On account of these considerations, it would appear more appropriate to accommodate these species in *Amphisphaeria* CES. et de NOT.

Descriptions

Cainiaceae KRUG fam. nov.

Stromata convexa aut leviter effusa, clypeata, levia atrobrunnea vel nigra. Perithecia immersa, ampulliformia, ostiolata; peritheci peridium e stratis duobus compositum. Asci unitunicati, cylindranei vel clavati; apparatus apicalis iodo caeruleum colorem accipiens, cylindraneus, annulorum seriem exhibens, quorum inferiores ut laminae videntur. Paraphyses filiformes, septatae,

hyalinae. Ascospores bicellulares, ellipsoideae, atrobrunneae, fissuras germinales longitudinales cristulis leviter similes exhibentes.

Stromata dome-shaped or slightly effused, clypeate, smooth, dark brown to black. Perithecia immersed, ampulliform, ostiolate; peridium two-layered. Asci unitunicate, cylindrical to clavate; apical apparatus amyloid, cylindrical, consisting of a series of rings appearing particularly in the lower portion as conspicuous plates. Paraphyses filamentous, septate, hyaline. Ascospores two-celled, ellipsoidal, dark brown, possessing a number of longitudinal germ slits resembling ridges.

Typus familiae: *Cainia* v. ARX et MÜLLER.

Etymology: Derived from the name of the type genus.

This family is erected to accommodate *Cainia* v. ARX et MÜLLER. The essential distinguishing criteria in removing the genus from the Amphisphaeriaceae are the presence of germ slits in the ascospores and the complex structure of the apical apparatus. *Entosordaria* (SACC.) HÖHN. may also be related but for the present it is retained in the Amphisphaeriaceae.

Cainia v. ARX et MÜLLER, Acta Bot. Neerl. 4: 111. 1955.

Stromata saprophytic, scattered or loosely clustered, dome-shaped or sometimes slightly effused, dark brown to black, superficial, clypeate, with each containing one or rarely several perithecia. Perithecia immersed, ampulliform, ostiolate; peridium pseudoparenchymatous, membranaceous or subcoriaceous, two-layered. Asci unitunicate, amyloid, eight-spored, cylindrical, short-stipitate; apical apparatus consisting of a series of rings appearing as conspicuous plates. Paraphyses abundant, filamentous, hyaline. Ascospores equally two-celled, ellipsoidal, dark brown, surrounded by a gelatinous sheath, possessing apical wall thickenings at each end of the spore and a number of longitudinal germ slits appearing as ridges.

Typus generis: *Delitschia graminis* NIESSL.

Etymology: Latinized from the name of the Canadian mycologist, R. F. CAIN.

Key to the Species

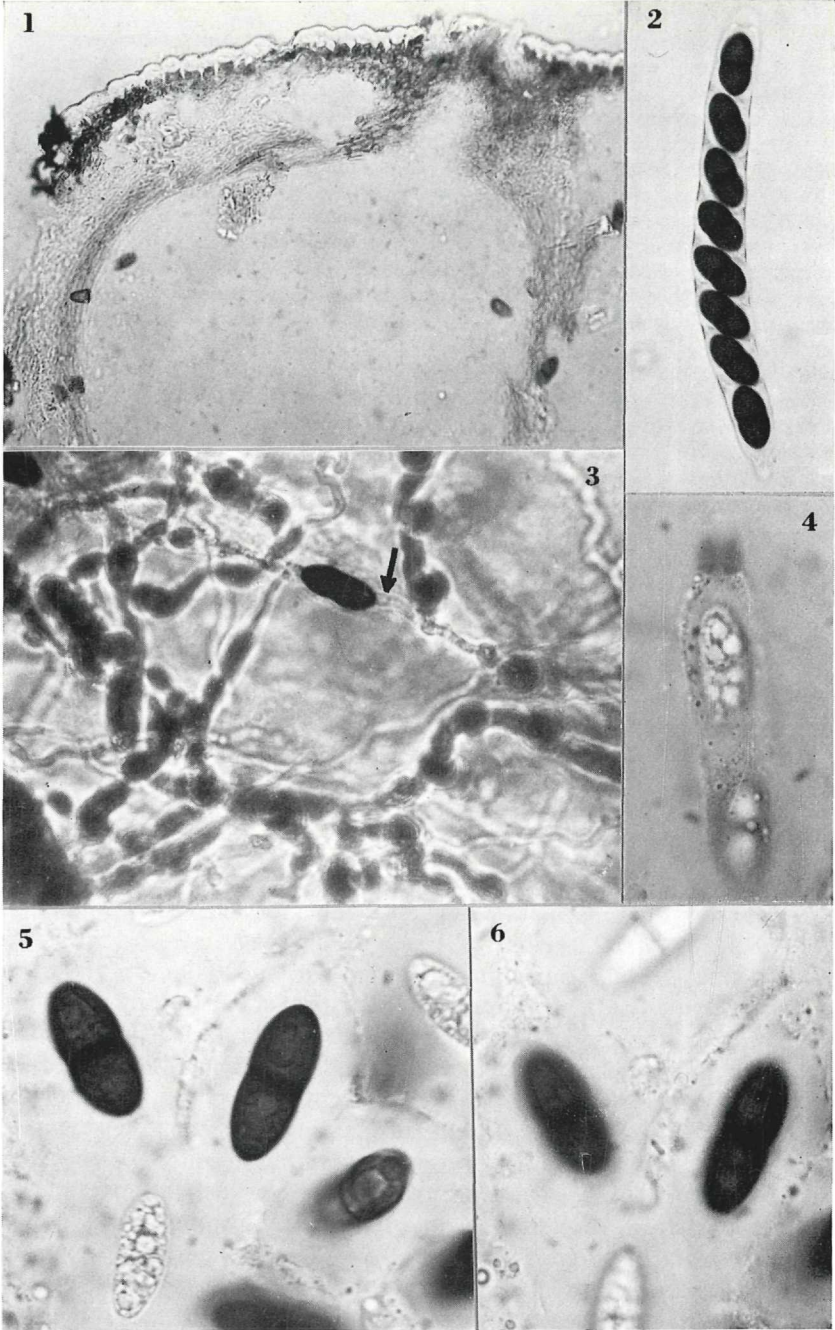
- Stromata discrete, subepidermal; ascospores (20-) 22-26 × 9-11 μ; on Leguminosae 1. *C. desmazieresii*
 Stromata somewhat effused, superficial; ascospores (30-) 34-40 (-41) × (11-) 12-15 μ; on Cyperaceae and Gramineae 2. *C. graminis*

1. *Cainia desmazieresii* MOREAU et MÜLLER ex KRUG sp. nov.

Figs. 1-6

= *Cainia desmazieri* et MOREAU MÜLLER, Revue Mycol. 28: 24. 1963, nomen invalidum cui descriptio latina deest.

Stromata dispersa, levia, convexa, interdum leviter effusa, magnitudine media, 500-800 μ diametro magna, nigra, clypeata, 15-20 μ crassa, super-



Figs. 1—6. *Cainia desmazieresii* (Typus). Fig. 1. Longitudinal section through the perithecium and stroma. $\times 195$. Fig. 2. Ascus and ascospores. $\times 385$. Fig. 3. Germinating ascospore with germ tube (arrow) originating from a germ slit. $\times 385$. Fig. 4. Ascus apex stained in aqueous ink blue showing the ring-like apical apparatus. $\times 890$. Fig. 5. Ascospores with gelatinous sheath. $\times 890$. Fig. 6. Ascospores showing the germ slits. $\times 890$.

ficialia, cellulis oblongatis, atrobrunneis, parietibus crassis circumdatis, 8—12 × 3—4 μ magnis, perithecium unicum continentia. Perithecia immersa, ampulliformia, 500—600 × 400—450 μ magna; perithecii collum breve, tholiforme, laeve, nigrum, distinctum, circa 100—125 μ longum, supra stromatis superficiem leviter protrudens; peridium profunde fulvobrunneum, subcoriaceum, 20—24 μ crassum, e stratis duobus compositum. Asci octospori, cylindranei, 150—190 × 19—23 μ magni, in apice obtusi, basin versus in stipitem inconspicuum, 8—10 μ longum satis contracti; apparatus apicalis iodo profunde caeruleum colorem accipiens, distinctior, cylindraneus, 4—6 annulorum distinctorum seriem exhibens, quorum inferiores ut laminae videntur. Paraphyses numerosissimae, filiformes, septatae, hyalinae, guttulate. Ascosporae oblique uniseriales, vagina hyalina gelatinosa circa 12 μ lata postremo circumdatae, bicellulares, aequaliter transverse uniseptatae, ellipsoideae, apicibus late rotundatis aut interdum obtusis, (20—) 22—26 × 9—11 μ magnae, primum hyalinae vel pallide fulvae, maturitate confirmata atrobrunneae et opacae, 8 fissuras germinales longitudinales cristulis leviter similes exhibentes et parietem crassiorem in ambobus apicibus exhibentes. Holotypus: in ramis emortuis Spartii juncei lectus est, in loco Champ de tir, apud Antibes oppidum, in Alpes maritimes dioecesi Gallicae reipublicae, 4 Aprilis 1974, G. et F. CARROLL, ZT.

Etymology: Latinized from the name of the French mycologist, J. B. H. J. DESMAZIÈRES.

Stromata scattered, smooth, dome-shaped, occasionally very slightly effused, medium, 500—800 μ diam., black, clypeate, 15—20 μ thick, superficial, with each containing a single perithecium; stromatic cells oblong, dark brown, thick-walled, 8—12 × 3—4 μ. Perithecia embedded, ampulliform, 500—600 × 400—450 μ; neck short, dome-shaped, smooth, black, distinct, about 100—125 μ long, protruding slightly above the surface of the stroma; ostiole small, indistinct; peridium dark yellow-brown by reflected light, subcoriaceous, 20—25 μ thick, consisting of an outer layer about 4—5 cells thick, of oblong, thick-walled, dark brown cells measuring 6—9 × 2.5—3 μ and an inner layer 3—4 cells thick, of elongated, thin-walled, hyaline cells measuring 12—18 × 1.5—2 μ. Asci eight-spored, cylindrical, 150—190 × 19—23 μ, narrowly rounded at the apices, terminating quite abruptly in an almost negligible stipe measuring 8—10 μ long; apical apparatus I+ (dark blue), relatively distinct, cylindrical, consisting of a series of 4—6 distinct rings appearing particularly in the lower portion as conspicuous plates, 6—9 × 4.5—6 μ. Paraphyses very abundant, filamentous, septate, hyaline, guttulate, mixed with the asci. Ascospores two-celled, obliquely uniseriate, transversely equally uniseptate, surrounded by a hyaline gelatinous sheath reaching a width of about 12 μ, ellipsoidal, broadly or occasionally narrowly rounded towards the ends, (20—) 22—26 × 9—11 μ, ranging from hyaline when young to light yellow-brown, finally dark brown and opaque at maturity, possessing 8 longitudinal germ slits superficially resembling ridges and an apical thickening of the wall at each end of the spore.

Habitat: on dead branches and twigs of *Spartium junceum* and occasionally similar leguminous hosts.

Specimens examined ³⁾: FRANCE: Alpes Maritimes: Antibes, *Spartium junceum*, 22 April 1959, MÜLLER (ZT), Champ de tir, *Spartium junceum*, 4 April 1974, CARROLL, TYPE (TRTC), La Salis, *Spartium junceum*, 22 April 1959, MÜLLER (ZT), 17 April 1959 (ZT), Ste. Maymes, *Spartium junceum*, 24 April 1959, MÜLLER (TRTC, ZT), *Calycotome spinosa*, 24 April 1959, MÜLLER (ZT); Fontan, *Spartium junceum*, 26 June 1955, MÜLLER (TRTC, ZT), 28 June 1961, DAOM 91931 (DAOM); Gorges du Loup, *Spartium junceum*, 16 June 1951, MÜLLER (ZT); Gourdon, *Spartium junceum*, 27 June 1957, SCHEINFFLUG (ZT); Gréolières, Le Foulon, *Spartium junceum*, 21 June 1956, MÜLLER (ZT), 29 June 1956, SCHEINFFLUG (TRTC, ZT); Pont du Loup, *Spartium junceum*, 24 June 1956, MÜLLER (ZT). Var: 8 km. SE of le Luc, *Spartium junceum*, 24 May 1972, KRUG 72—124 a (TRTC); Massif de la Ste. Baume, Weg von Plan d'Aups nach St. Zacharie, *Spartium junceum*, 7 June 1959, MÜLLER (ZT). Vaucluse: Malaucène, *Spartium junceum*, 6 April 1962, MÜLLER (ZT), 21 May 1962 (ZT), 28 May 1970 (TRTC); Mt. Ventoux, Südseite, *Spartium junceum*, 18 June 1956, MÜLLER (ZT), Ste. Colombe, *Genista scorpius*, 23 May 1962, SHOEMAKER, DAOM 89971 (DAOM); Orange, *Spartium junceum*, July 1877, FABRE, Sphériacées de Vaucluse, as *Didymosphaeria spartii*, herb. J. H. FABRE, Sérignan; Rochegude, *Spartium junceum*, 27 May 1970, KRUG 530 (TRTC); Ste. Marguerite, *Spartium junceum*, 21 May 1962, SHOEMAKER, DAOM 89953 a (DAOM); Sérignan, L'Harmas, *Spartium junceum*, 6 April 1962, MÜLLER (ZT); Vaison-la-Romaine, *Spartium junceum*, 18 June 1956, MÜLLER (ZT). ITALY: Lombardy: Alpi Giudiciarie (as Judicari), Val dei Conzei, *Genista radiata*, 2 June 1974, GYIMOTHY (TRTC). Tuscany: Pisa, Monti Pisani, Corliano, 200 m. ü. m., *Spartium junceum*, 20 May 1956, O. VERONA, commune di J. Guiliano (ZT).

This species differs from *C. graminis* primarily in possessing smaller ascospores as well as the leguminous host preference. Characteristically *C. desmazieresii* is a saprophyte on the dead or dying twigs. However, there is some evidence that on occasion the fungus may act as a semi-parasite as in the "GYIMOTHY" specimen.

Germination studies were performed using ascospores from the type collection of *C. desmazieresii*. On modified LEONIAN's medium (CAIN and FARROW, 1956) abundant germination occurred within forty-eight hours. It was observed that the germ tubes originated from one to several of the grooves mentioned by MÜLLER and von ARX (1962), thereby confirming that these features were actually germ slits.

MÜLLER and CORBAZ (1956) successfully isolated this organism (as *C. incarcerata*) in pure culture. They report that on malt agar, a white

³⁾ In most instances the specimens cited were labelled as *Cainia incarcerata*.

floccose mycelium with aerial hyphae is produced as in *C. graminis*. After several weeks white pustules producing conidia were observed. This conidial state was referred to *Rhabdospora* MONT. Although a number of attempts were made, I was unable to develop the conidial state in culture, However, if this is a *Rhabdospora* it would be the first report of this conidial state in the Amphisphaeriaceae.

2. *Cainia graminis* (NISSL) v. ARX et MÜLLER, Acta Bot. Neerl. 4: 112. 1955. Figs. 7—13

≡ *Delitschia graminis* NISSL, Verh. Naturf. Ver. Brünn 14: 208. 1875 (p. 48 in distributed separates).

≡ *Massariopsis graminis* (NISSL) REHM, Ann. Mycol. 4: 270. 1906.

≡ *Microthelia delitschii* NISSL in REHM (as *M. delitschia*), Ascomyceten 943. 1888 and Hedwigia 27: 173. 1888, an illegitimate name change for *Delitschia graminis* NISSL.

≡ *Massariella delitschii* (NISSL in REHM) REHM in VESTERGRÉN, Micromycetes rariores selecti 286. 1900 and Bot. Not. 1902: 123. 1902.

Stromata scattered or occasionally loosely clustered, very rarely confluent, smooth, dome-shaped, becoming somewhat effused, medium, 400—1000 μ diam., very dark brown to black, superficial, clypeate, 15—25 μ thick, with each containing one or rarely several perithecia; stromatic cells oblong to elongated, thick-walled, very dark brown, 12—20 \times 5—7.5 μ , frequently rather amorphous in nature. Perithecia embedded, ampulliform, 400—500 \times 300—330 μ ; neck short, dome-shaped, smooth, black, distinct, about 100—150 μ long, protruding above the surface of the stroma; ostiole small, rather indistinct; peridium dark yellowish brown by reflected light, membranaceous, 20—25 μ thick, consisting of an outer layer about 5—6 cells thick, of oblong, thick-walled, dark brown cells measuring 6—8 \times 2.5—3 μ and an inner layer 3—4 cells thick, of elongated, thin-walled, hyaline cells measuring 12—18 \times 1—1.5 μ . Asci eight-spored, cylindrical to slightly clavate, 170—210 \times 27—34 μ , narrowly rounded at the apices, terminating very abruptly in an almost negligible stipe measuring 10—12 μ long; apical apparatus I+ (deep blue), very distinct, cylindrical, consisting of a series of 3—4 distinct rings appearing particularly in the lower portion as conspicuous plates and a deep apical invagination, 11—14 \times 6—8 μ . Paraphyses abundant, filamentous, septate, hyaline, guttulate, mixed with the asci. Ascospores two-celled, obliquely uniseriate, transversely equally uniseptate, surrounded by a hyaline gelatinous sheath reaching a width of about 10 μ , ellipsoidal, narrowly rounded towards the ends, (30—) 34—40 (—41) \times (11—) 12—14 μ , ranging from hyaline when young to pale yellow-brown, finally very dark brown and opaque at maturity, possessing 8 longitudinal germ slits superficially resembling ridges and an apical thickening of the wall at each end of the spore.

Holotypus: in *Avenae parlatorii* culmis lectus est, in Alpibus calcareis, apud Liezen, in Steiermark provincia Austriae, 21 Sextilis 1867, NIESSL, M.

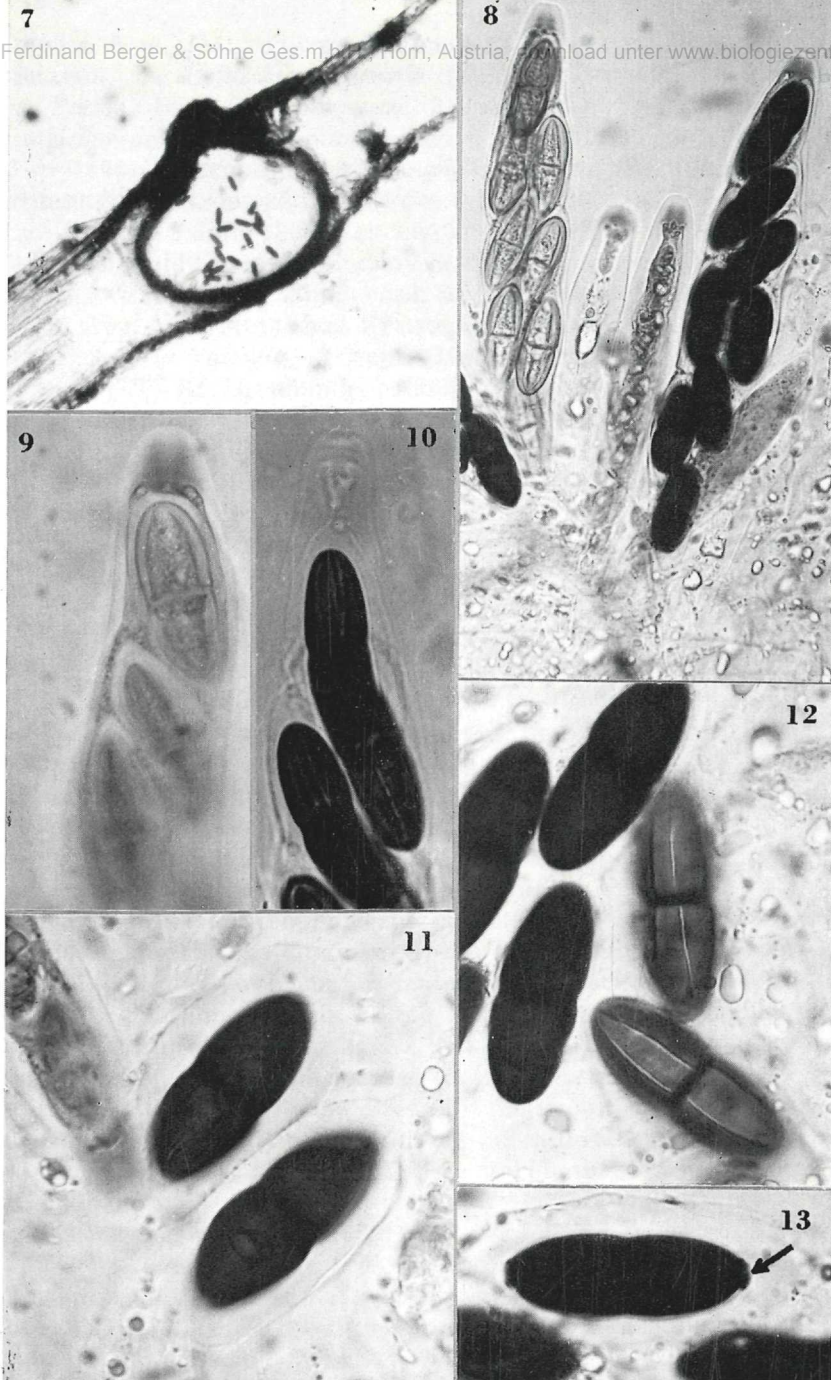
Etymology: Latin, *gramen* = grass, referring to the host plant.

Habitat: on leaves and stems of Cyperaceae and Gramineae.

Specimens examined: AUSTRIA: Niederdonau: Baden, Pfaffstätten, *Sesleria varia* ⁴⁾, June 1940, PETRAK, Mycotheca generalis 622, as *Delitschia graminis* (G, M, TRTC, ZT); Wien, Pfaffstätten, *Sesleria coerulea*, May 1940, PETRAK, Allgem. Mykolog. Tauschverein, Flora Austriae inf., as *Delitschia graminis* (ZT). Salzburg: Lofer, *Sesleria coerulea*, Aug. 1884, NIESSL, as *Delitschia graminis* (M), sine dato (probably Aug. 1884) (M), Aug. 1885, NIESSL, in REHM's Ascomyceten 943, as *Microthelia delitschia* (M. S). Steiermark: 5 km. N of Liezen, Totes Gebirge, Hoch Anger (= Nazogl), 1600 m. ü. m., *Avena parlatorii*, 21 July 1867, NIESSL, as *Delitschia graminis*, TYPE (M). Tirol: Arlberg Pass, St. Anton, Schutthügel des Tunnels, im Grunde eines dünnen Grasbüschels, Sept. 1905, REHM, as *Massariopsis delitschii* (S); N of Brenner, Gries, an einem dünnen Grasbüschel am Kreuzkogel, Aug. 1907, REHM, Ascomyceten 943 b, as *Massariopsis graminis* (M, S); Funtensee, 1700 m. ü. m., *Sesleria coerulea*, July 1908, NIESSL 24, as *Massariopsis graminis* (S); N of Innsbruck, Hefeleskar, am Wege zur Pfeishütte, *Carex firma*, July 1940, PETRAK, ex herb. PETRAK, as *Delitschia graminis* (M), am Wege von der Seilbahnstation zur Pfeishütte auf dem Hefeleskar, *Carex firma*, July 1940, PETRAK, as *Delitschia graminis* (ZT); Kleinziegenfelder Tal ⁵⁾ bei Weisnau (script illegible), *Sesleria coerulea*, March 1908, NIESSL 22a, as *Massariopsis graminis* (S), Nov. 1909, NIESSL 19, as *Massariopsis graminis* (S.) — CANADA: British Columbia: 3 km. N of Golden, 51° 17' N, 116° 59' W. ca. 910 m ü. m., *Oryzopsis asperifolia*, 29 May 1966, SHOEMAKER, DAOM 114065 (DAOM). — FRANCE: Alpes Maritimes: Tende, Nordseite der Rocca Maima, *Sesleria calcaria*, 6. Aug. 1953, MÜLLER et RICHLE (ZT), 24 June 1955, MÜLLER (TRTC, ZT), Rocca Maima, *Sesleria calcaria*, 27 June 1961, MÜLLER, DAOM 92119 (DAOM). Vaucluse: Malaucène, *Sesleria calcaria*, 21 May 1962, MÜLLER (ZT), Vallée de Groseau, *Sesleria coerulea*, 21 May 1962, MÜLLER (ZT), Source de Groseau (as Corceau), *Sesleria calcaria*, 21 May 1962, MÜLLER (M, TRTC, ZT), *Sesleria coerulea*, 21 May 1962, SHOEMAKER, DAOM 89954 (DAOM). Gröden, Sella-Joch (script illegible), dürre Grasblätter, July 1878, REHM, as *Microthelia delitschia* (S); — POLAND: Galicia: Westliche Tatra (West Tatra Mts.): Tatrzanski National Park, Stražyska-Tal,

⁴⁾ HESS, LANDOLT and HIRZEL (1967) list both *Sesleria calcaria* (PERS.) OPIZ and *S. varia* (JACQ.) WETST. as synonyms of *S. coerulea* (L.) ARD.

⁵⁾ Although I have been unable to find this locality on any map consulted, I believe that it must be in the Tirol District of Austria.



Figs. 7–12. *Cainia graminis* (Malauécène, Source de Groseau, MÜLLER). Fig. 7. Longitudinal section through the perithecium and stroma. $\times 65$. Fig. 8. Asci and ascospores stained in aqueous ink blue. $\times 375$. Fig. 9. Ascus apex stained in aqueous ink blue. $\times 900$. Fig. 10. Ascus apex in aqueous mount showing the ring-like apical apparatus. $\times 600$. Fig. 11. Ascospores with gelatinous sheath. $\times 900$. Fig. 12. Ascospores showing the germ slits. $\times 900$. Fig. 13. Ascospore illustrating apical thickening (arrow) of the spore wall. $\times 900$.

ca. 1500 m. ü. m., *Festuca tatrae*, 24 June 1935, LANCUCKA, PAWLOWSKI et ŠRODÓN, as *Delitschia graminis* (ZT). — SWEDEN: Gotland: Eriks Parish, Bro, *Poa compressa*, 3 June 1894, VESTERGREN, as *Massariella delitschii*, specimen sterile, DAOM 36916 (DAOM), 14 July 1898, VESTERGREN, as *Massariella delitschii* (S), 3 June 1899, VESTERGREN, *Micromycetes rariores selecti* 286, as *Massariella delitschii* (M. S), 3 June 1899, VESTERGREN, ex herb. S., as *Massariella delitschii*, probably part of *Micromycetes rariores selecti* 286 (M). — SWITZERLAND: Kt. Bern: Simmental, Stieretungel ob Lauenen, *Carex firma*, 21 Aug. 1965, MÜLLER et NÜESCH (ZT). Kt. Glarus: Braunwald, Gumen, *Sesleria calcaria*, 3 Sept. 1962, MÜLLER, BERNHARD et STRICKLER (ZT). Kt. Graubünden: Albulapass, east side, 2200 m. ü. m., *Carex firma*, 23 Aug. 1961, MÜLLER et SHOEMAKER, DAOM 92100 (DAOM, ZT); Bergün, Tuors Davant, *Trisetum distichophyllum*, 13 July 1961, MÜLLER et SHOEMAKER, DAOM 91921 (DAOM); Filisur, Plan grond, Muchetta, *Poa alpina*, 3 Aug. 1949, MÜLLER (ZT); Fürstenalpe, *Sesleria coerulea*, 1906, VOLKART, as *Massariella delitschii* (S); Gotthard Pass, Aug. 1892, REHM, as *Massariella glacialis* nov. spec. (S); National Park, Val Tantermozza bei Hütte, *Agropyron caninum*, 28 Aug. 1968, MÜLLER, OUELLETTE, AEBI et HARR (ZT); Samnaun, Platz, *Sesleria calcaria*, 17 Aug. 1951, MÜLLER (ZT); Sertig, *Carex firma*, 2 Sept. 1971, CAIN, TRTC 47263 (TRTC).

Cainia graminis is readily distinguished from *C. desmazieresii* by the larger size of the ascospores and the more superficial position of the stroma within the host tissue. Furthermore, *C. graminis* appears to be restricted to dead or dying foliage of Cyperaceae and Gramineae, while *C. desmazieresii* has only been found on stems of the more woody members of the Leguminosae in the Mediterranean region.

The material on the holotype collection is composed of two different organisms. The dominant one is sterile and hence unidentifiable while the other, which unfortunately is scanty, clearly agrees with NIESSL's description as well as the current concept of *Delitschia graminis*. In establishing the taxon, NIESSL (1875) commented that from descriptions and illustrations the species resembles *Amphisphaeria culmicola* SACC., from which it differs by the size of the asci and the spores. ERIKSSON (1967) upon studying Saccardo's original material (PAD) found only pycnidia but nothing matching the original diagnosis of *A. culmicola*.

MÜLLER and von ARX (1962) list both *Phorcys eriophori* FELTG. and *P. lovareana* REHM as additional synonyms. However, the spore size as well as the observation of a gelatinous sheath reported by FELTGEN (1903) would appear to contradict such a disposition. Upon enquiring at Luxembourg (LUX), where FELTGEN's collections are deposited (not BR as indicated in Index Herbariorum Part II), I was informed that the type of *P. eriophori* is no longer present there.

However, WEHMEYER (1961) in discussing *Pleospora opaca* WEGELIN says that the type of *Phorcys eriophori* in the von HÖHNEL herbarium (FH) is the same as *Pleospora opaca*. It should also be mentioned that the two specimens identified by FELTGEN as *Delitschia graminis* are in fact *P. opaca*. Upon examining the type of *Phorcys loveireana* (S), it was observed that this species is also identical with *Pleospora opaca*.

I have examined a specimen determined as *Massariopsis Delitschii* from the REHM herbarium (S). This material was collected by REHM from St. Anton in the Arlberg Pass, Austria. Also deposited in the REHM herbarium is a collection labelled *Massariella glacialis* REHM nov. spec. from the Gotthard Pass, Switzerland. It would appear that these combinations are merely herbarium names and were never actually published but the collections concerned were referred to by REHM (1906) under *Massariopsis graminis*.

Recently SIVANESAN (1975) erected *Amphisphaeria saccharicola*. From the description and illustration this would appear to be very similar to *Cainia graminis*, except for the non-amyloid apical apparatus and the smaller ascospores. Upon examining the type collection, it was observed that the apical apparatus becomes dark blue in MELZER's reagent and the spores are striated, although the striations appear to be more numerous and less distinct than shown in the illustrations.

Excluded Species

Amphisphaeria deutziae (E. MÜLLER) KRUG comb. nov.

≡ *Cainia deutziae* E. MÜLLER, Sydowia 11: 463. 1957.

Amphisphaeria succinea (ROB. in DESM.) KRUG comb. nov.

≡ *Sphaeria succinea* ROB. in DESM., Ann. Sci. Nat. ser. III, 10: 354. 1848 (basionym).

≡ *Charonectria succinea* (ROB. in DESM.) SACC., Syll. Fung. 9: 953. 1891.

≡ *Nectriella succinea* (ROB. in DESM.) WEESE, Ann. Mycol. 12: 130. 1914.

≡ *Paradidymella succinea* (ROB. in DESM.) PETR., Ann. Mycol. 25: 241. 1927.

≡ *Sphaeria cupula* ELLIS, Amer. Nat. p. 317. 1883.

≡ *Didymosphaeria cupula* (ELLIS) SACC., Syll. Fung. 9: 734. 1891.

≡ *Amphisphaeria cupula* (ELLIS) SCHRANTZ, Bull. Soc. Mycol. Fr. 76: 334. 1960, nomen invalidum cui basionym deest.

≡ *Cainia cupula* (ELLIS) E. MÜLLER in MÜLLER et v. ARX, Beitr. Krypt. Fl. Schweiz 11 (2): 706. 1962.

Discussion

Superficially, a number of other genera possess species with ascospores reminescent of those in *Cainia*. These include *Ceriophora* HÖHN., *Entosordaria* (SACC.) HÖHN., *Roussöella* SACC., and *Valsaria* CES. et de NOT. However, detailed examinations of the spores reveal that, except for *Entosordaria*, the spores lack germ slits but rather possess surface striations on the ascospore wall. In *Valsaria* there is a

very characteristic apical apparatus and this genus is a good representative of the Diaporthaceae — a well defined family. *Roussöella* has spores with longitudinal ridges and possesses a very characteristic stroma. ERIKSSON (1966) has indicated that *Chitonospora* BOMM., ROUSS. et SACC. also possesses spores with longitudinal ridges. Whether these are actually true germ slits or wall markings has not been clarified. The illustration and description of *Xylobotryum* PAT., provided by AGNIHOTHRUDU and BARUA (1960), indicate faintly striate spores. In all likelihood these are not true germ slits, although this has not been verified by examination of authentic material. ROSSMAN (1976) has described the spores as lacking both germ pores and germ slits. This along with the presence of a massive, dendroid, carbonaceous stroma and the absence of any defined apical apparatus would seem to exclude this organism from any relationship with *Cainia*.

The most closely related genus would appear to be *Entosordaria*, which ERIKSSON (1966) has shown to be monotypic for *E. perfidiosa* (de NOT.) HÖHN. Here the ascospores, whose unusual features have been discussed in detail by ERIKSSON, possess a number of radiating discontinuous germ slits from the apical end of the dark cell. The apical structure appears to be in the form of a simplified ring. Within the Amphisphaeriaceae there are several types of apical structures, but at present it does not seem possible to correlate all of them with the features of the spores. *Entosordaria* may be related to *Cainia* but for the present it is retained in the Amphisphaeriaceae, although one could argue for its accommodation in the Cainiaceae. Obviously *Anisomyopsis* HINO et KATUMOTO (1964) is more closely related to *Pseudomassaria* JACZ. on the basis of spore morphology, yet the apical apparatus is in the form of a complex plug as in *Cainia*. From such observations, it is quite apparent that a number of divergent evolutionary lines exist within the Amphisphaeriaceae, although considerably more research will be required before a thorough understanding of all the true relationships will emerge.

Currently *Cainia* is accommodated within the Amphisphaeriaceae, although here it is obviously a discordant element with xylarioid affinities. However, the possession of dark, two-celled ascospores; number and arrangement of germ slits; the possible conidial state; and a restricted stroma would seem to exclude the genus from the Xylariaceae, even though there are a few cases in which a reduced stroma is known in this family.

Certainly the presence of such features as germ slits in the ascospores as well as the complex structure of the apical apparatus would appear to exclude *Cainia* from the Amphisphaeriaceae. Actually, it was on the basis of such criteria that PARGUEY-LEDUC and CHADEFAUD (1963) suggested that perhaps the genus should be placed in a special family. Obviously, here as well as in other groups, features such as

the apical discharge mechanism and the means of spore germination must be considered of fundamental importance from an evolutionary viewpoint. Accordingly, I am proposing the erection of a separate family to accommodate this genus since I believe that such features are significant enough to be evaluated at the family level.

In making this proposal, I do not wish to initiate unwarranted separations from the Amphisphaeriaceae, for such decisions can only be made after careful study. Nevertheless, there are many counterpart situations within the Phanerogams for the erection of small monotypic families but, as ERIKSSON (1966) has indicated, the Amphisphaeriaceae does provide a temporary disposition for these "pseudo-xylarioid" organisms. As a clearer understanding of relationships develops, certain atypical elements will have to be removed from the Amphisphaeriaceae and, in all likelihood, the family will eventually have to be restricted to *Amphisphaeria* and related elements.

Acknowledgments

I would like to thank the Curators of those Institutions which have permitted the study of collections under their care. These have been abbreviated in accordance with Index Herbariorum (1974). Special thanks are extended to Dr. H. HERTEL (Münich) for his efforts in locating the holotype of *Cainia graminis* and for his information regarding the type locality. In addition, I am especially grateful to Professor A. BALACHOWSKY and Monsieur P. TEOCCHI, Laboratoire d'Entomologie, Muséum National d'Histoire Naturelle, Paris and Sérignan respectively, for enabling me to study FABRE's material.

I am also indebted to Dr. G. BOCQUET (Zürich) and Dr. M. HUBBES (Toronto), who have kindly assisted with the preparation of the Latin diagnoses and the German abstract, respectively. Mr. R. S. JENG (Toronto) has helped with the reproduction of the illustrations for which I extend my thanks. Finally, I would like to express my deep appreciation to Professor E. MÜLLER (Zürich) for many helpful discussions as well as his constant interest in the project.

Literature cited

- ARX, J. A. VON and MÜLLER, E. (1955). Über die Gattungen *Delitschia* AUERSW., *Trichodelitschia* MUNK und *Cainia* nov. gen. Acta Bot. Neerl. 4: 108—115.
- AGNIHOTHRUDU, V. and BARUA, G. C. S. (1960). Notes on fungi from North-East India — VI. *Xylobotryum andinum* PAT. on tea (*Camellia sinensis* (L.) O. KUNTZE). Sydowia 14: 136—137.
- CAIN, R. F. and FARROW, W. M. (1956). Studies of coprophilous Ascomycetes. III. The genus *Triangularia*. Can. J. Bot. 34: 689—697.
- CHADEFAUD, M. (1973). Les Asques et la systématique des Ascomycètes. Bull. Soc. Mycol. Fr. 89: 127—170.
- ERIKSSON, O. (1966). On *Anthostomella* Sacc., *Entosordaria* (SACC.) HÖHN. and some related genera (Pyrenomycetes). Svensk Bot. Tidskr. 60: 315—324.
- (1967). On graminicolous pyrenomycetes from Fennoscandia 3. Amerosporeous and didymosporous species. Arkiv Bot. ser. II, 6: 441—466.
- FELTGEN, J. (1903). Vorstudien zu einer Pilz-Flora des Grossherzogthums Luxemburg I (Nachträge III). 328 pp., Beffort, Luxemburg.

- HESS, H. E., LANDOLT, E. and HIRZEL, R. 1967. Flora der Schweiz und angrenzender Gebiete. I. Pteridophyta bis Caryophyllaceae. 858 pp., Birkhäuser, Basel and Stuttgart.
- HINO, I. and KATUMOTO, K. (1964). *Anisomycopsis*, a new genus of the Pyrenomycetes. J. Jap. Bot. **39**: 321—326.
- HOLMGREN, P. K. and KEUKEN, W. (1974). Index herbariorum. Part I. The herbaria of the world. 6th. ed. Regnum Veg. **92**: 1—397.
- MOREAU, C. and MÜLLER, E. (1963). Sur deux Ascomycètes phaeodidymés du *Spartium junceum* L. Revue Mycol. **28**: 19—26.
- MÜLLER, E. (1957). Pilze aus dem Himalaya I. Sydowia **11**: 454—472.
- and ARX, J. A. VON (1955). Einige Beiträge zur Systematik und Synonymie der Pilze. Phytopath. Zeit. **24**: 353—372.
- (1962). Die Gattungen der didymosporen Pyrenomyceten. Beitr. Krypt. Fl. Schweiz **11** (2): 1—922.
- and CORBAZ, R. (1956). Kulturversuche mit Ascomyceten III. Sydowia **10**: 181—188.
- NISSL, G. VON (1875). Notizen über neue und kritische Pyrenomyceten. Verh. Naturf. Ver. Brünn **14**: 165—217.
- PARGUEY-LEDUC, A. and CHADEFAUD, M. (1963). Les asques du *Cainia incarcerationata* (DESM.) von ARX et MÜLLER et la position systématique du genre *Cainia*. Revue Mycol. **28**: 200—234.
- ROSSMAN, A. Y. (1976). *Xylobotryum andinum*, a tropical pyrenomycete from northern California. Mycotaxon **4**: 179—183.
- SIVANESAN, A. (1975). Redisposition and descriptions of some *Amphisphaeria* species and a note on *Macrovalsaria*. Trans. Br. Mycol. Soc. **65**: 395—402.
- WARCUP, J. H. (1951). The ecology of Soil Fungi. Trans. Br. Mycol. Soc. **34**: 376—399.

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Zeitschrift/Journal: [Sydowia](#)

Jahr/Year: 1977/1978

Band/Volume: [30](#)

Autor(en)/Author(s): Krug J. C.

Artikel/Article: [The genus *Cainia* and a new family, Cainiaceae. 122-133](#)