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CONNECTED AND DISCONNECTED CHAINS OF PHIALOCONIDIA AND SAGENOMELLA GEN. NOV. SEGREGATED FROM ACREMONIUM

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Subramanian's concept of true and false chains of phialoconidia is rejected and replaced by a distinction between connected and disconnected chains. In connected conidial chains the primary conidial wall is strongly thickened at both ends and a connective is formed. This criterion allows the distinction between trichocomaceous or eurotiaceous (connected) and sphaeriaceous (disconnected) catenulate phialoconidia. The ultrastructure of conidiogenesis is described. On the basis of this criterion, the species of the *Acremonium diversisporum* series as well as the anamorph of *Sagenoma viride* Stolk & Orr with connected chains are transferred from *Acremonium* to the new genus *Sagenomella* to which four new species are added.

The concept of *Acremonium* Link ex Gray as an admittedly artificial and heterogeneous genus (Gams, *1971*) has received some criticism. The GC-contents of DNA have been found to be discordant even within sections and series (Kedrova *& al., 1973*), but as only a few species have been examined no taxonomic conclusions can be drawn. The inclusion of *Gliomastix* Guéguen in *Acremonium* has repeatedly been criticized because some species of *Gliomastix* with pigmented conidia are conspicuous and easily recognizable, in contrast to the species of *Acremonium* with hyaline conidia. None of the critics, however, could disprove the fact that some species with hyaline conidia (e.g. *A. longisporum* and *A. persicinum*) are most closely related to dark-spored species of this section, thus rendering the generic distinction on the basis of conidial pigmentation impracticable. An analogous case is the distinction between pigmented *Stachybotrys* Corda and hyaline *Hyalostachybotrys* Srinivasan which is now abandoned by most mycologists (Jong & Davis, *1976*).

The present paper is concerned with another aspect of the section *Gliomastix* which was so far unnoticed. This section was characterized by Gams (*1971*) as having chondroid hyphae and (or) pigmented conidia. It is now apparent that the admission of species with pigmented conidia and thin-walled hyphae introduced too much heterogeneity into this section. This conclusions was reached after critical consideration of Subramanian's (*1971*, *1972a*, *1972b*; Subramanian & Pushkaran, *1976*) studies on chain formation in phialidic Hyphomycetes.

Subramanian (*1971*) distinguished between dry–persistent and loose chains and he subsequently (*1972a*) specified these as 'false' and 'true' chains. True chains (as in *Aspergillus niger*) were characterized by the fact that 'the wall around the successive conidia in the chain is a continuum'. True chains were said to occur in *Penicillium corylophilum*, *P. clavi-*

forme, *Aspergillus niger*, *Paecilomyces*, *Memnoniella*, *Phialomyces* and in Subramanian's (*1972a*) new genus *Sagrahamala*. An arbitrary selection from the species treated by Gams (*1971*) in *Acremonium* was transferred to *Sagrahamala* (Subramanian, *1972a*; Subramanian & Pushkaran, *1976*), while other similar species passed unnoticed. The type species, *S. luzulae* (Grove) Subram. (Fig. 7e, f), was taken from section *Gliomastix* together with four other species, including *Sagrahamala murorum* (Corda) Subram., which is considered as a variety of the type species of *Gliomastix* by other mycologists (e.g. Dickinson, *1968*) or completely synonymous with it (Gams, *1971*). Surprisingly, the hyaline counterpart of *Acremonium murorum*, *A. persicinum* (Nicot) W. Gams, was regarded as having false chains and therefore representative of *Acremonium*, while four species of the section *Acremonium* were transferred to *Sagrahamala*. In addition, four species treated by Onions & Barron (*1967*) in the monophialidic *Paecilomyces* and by Gams (*1971*) in the *A. striatisporum* series of sect. *Gliomastix* were transferred to *Sagrahamala*, although the phialidic nature of the conidiogenous cells in *S. striatispora* (Onions & Barron) Subram. has been questioned (Subramanian & Pushkaran, *1976*).

ULTRASTRUCTURE OF THE CONIDIAL CHAINS

According to numerous studies with transmission electron microscopy (TEM), phialoconidia are generally produced endogenously within the phialide tip and the conidial wall is formed *de novo* (Cole & Samson, *1979*). The new wall formation involves the apposition of wall material along a zone which becomes progressively thickened within the phialide tip (thus always 'novotunicogenous' sensu Subramanian, *1972b*). The newly formed conidium is cut off at its base by a septum, along which schizolytic liberation sooner or later takes place (Fig. 1). The ease of separation depends on various modifications of the conidial ends: rounded or truncated shape, exudation of slime, or development of wall thickenings.

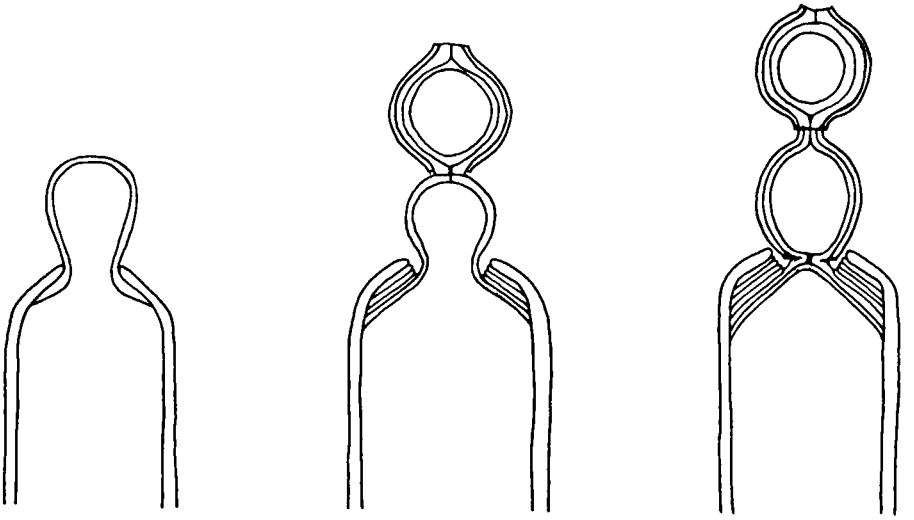

Fig. 1. Schematic representation of the ontogeny of conidial chains on phialides. Note the progressive wall apposition inside the phialide tip.

Contrary to Subramanian (*1971*, *1972a*), many mycologists principally consider basipetal chains of phialoconidia as 'false chains' (if a distinction from 'true chains' is required at all), since each conidium is completely cut off before the next one is formed and the primary conidial wall is not continuous within the chain but incorporates a new layer with each conidium formed, see Fig. 1. In this sense, true chains can only be acropetal with a considerable continuity of wall and cell contents during the development of the whole chain. There may be a thin, electron-dense, continuous, outer layer which encloses all the conidia of a phialidic chain, but this amorphous layer is exuded secondarily and does not represent a proper wall layer.

TAXONOMIC IMPLICATIONS

Subramanian includes some discordant elements in his category of true chains: the bulk undoubtedly represent anamorphs of Trichocomaceae (Eurotiaceae), particularly the genera *Penicillium* and *Aspergillus*. No teleomorph connections are known in *Sagrahamala*. *Memnoniella* is very close to *Stachybotrys* which is known to be connected with the sphaeriaceous *Melanopsamma* Niessl (Booth, *1957*; Jong & Davis, *1976*). The distinction between trichocomaceous and hypocreaceous–sphaeriaceous phialidic anamorphs is a problem so far unsolved and, therefore, the above criteria and some additional characters were tested for their suitability in distinguishing trichocomaceous from other, sphaeriaceous, phialidic conidia.

CONNECTED AND DISCONNECTED CHAINS

As is evident from previous studies on *Acremonium* (Gams, *1971*), both true and false conidial chains, as defined by Subramanian, would occur in the sections *Acremonium* and *Gliomastix*. The relative width of the delimiting septum which determines the truncate, rounded, or pointed shape of the conidial ends and often also the persistent character of a chain, is not regarded as an important criterion in classification.

A suitable character, however, is found in the structure of the connectives. Connectives remain when during conidial maturation the contents round off and become surrounded by a secondary wall (Fig. 2c). During this process the primary wall forms a narrowed but more or less thickened structure at either end of the conidium and this is generally termed the connective. Persistent chains of conidia provided with connectives at both ends are characteristic of the Trichocomaceae Fischer sensu Malloch & Cain (*1972*; = Eurotiaceae Clem. & Shear), and are here termed *connected chains* (cf. Fig. 2c). Persistent or caducous chains without connectives or with basal apiculations only (e.g. *Metarrhizium*, Hammill, *1972*), are found in the Hypocreaceae, Sphaeriaceae, Chaetomiaceae, and other pyrenomycetous families, and are termed *disconnected chains*. Examples are listed in Table I. Genera and species with slimy conidial heads are often closely related to the latter group.

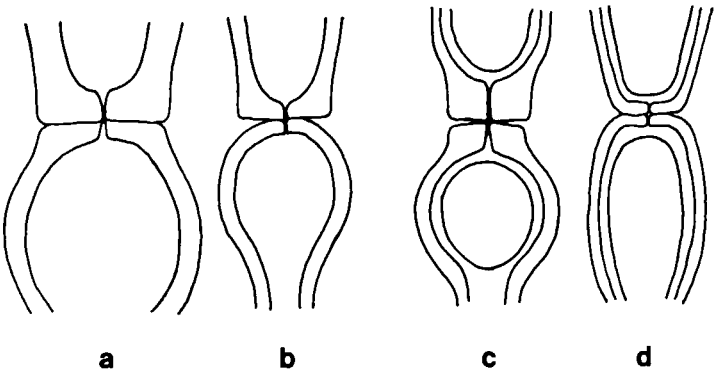

Fig. 2. Schematic representation of the development of caducous (b) and persistent (c, d) phialidic chains. The delimiting septum (a) may round off (b) or remain more or less broadly connected and then either form connectives by further differentiation of the conidial wall (c) or retain a uniform wall thickness throughout (disconnected, d).

From Table I it is evident again that *Acremonium* sensu Gams (*1971*) is a heterogeneous genus. The *A. striatisporum* series is distinguished by its connected chains as well as by its connection with *Sagenoma* Stolk & Orr (*1974*) of the Trichocomaceae. The other cleistocarpous teleomorphs known in *Acremonium*, *Emericellopsis* van Beyma, and *Nigrosabulum* Malloch & Cain, do not affect this conclusion, since they do not belong to the Trichocomaceae.

Since a renewed study of *Acremonium sagenomatis* Stolk & Orr also showed connected conidial chains and the frequent occurrence of reduced, irregularly swollen or sympodially proliferating phialides, like in the *A. striatisporum* series, all these species are regarded as related and removed from *Acremonium*.

Sagenomella W. Gams, *gen. nov.*

Genus Hyphomycetum Acremonii simile. Coloniae lente crescentes, conidiis pulverulentae, albae, griseae, viridulae vel brunneae. Conidiophora plus minusve distincta, erecta, plerumque phialides simplices, raro verticillatas proferunt; phialides aculeatae vel saepe in medio paulo inflatae, saepe irregulariter sympodialiter proliferentes. Conidia continua, hyalina, vel pigmento incrustata et ornamentata, in catenis longis vel brevibus persistentibus connexa, utrinque connectivo terminata.

Species typica: *Sagenomella diversispora* (van Beyma) W. Gams.

A genus of Hyphomycetes close to *Acremonium*. Colonies slow-growing, generally not exceeding 10 mm diam. in 10 days at 20–23°C on MEA, powdery due to the conidial chains, white, grey, greenish or brown. Conidiophores not much differentiated from the vegetative hyphae, erect, usually ending in a simple phialide or rarely bearing several whorls of phialides; phialides aculeate but often centrally swollen, in old cultures often sympodially proliferating. Conidia one-celled, hyaline, or with pigmented incrustations and ornamentations, coherent in long or short persistent chains, with connectives on both ends.

TABLE I

EXEMPLES OF ANAMORPHIC GENERA WITH CATENULATE PHIALOCONIDIA
(TELEOMORPHIC CONNECTIONS IN PARENTHESIS)

Connected chains	Disconnected chains	
Acremonium striatisporum series (*Sagenoma*)	*Acremonium* p. max. p.	*Metarrhizium*
Torulomyces	*Monocillium indicum* (*Niesslia*)	*Mariannaea*
Aspergillus (*Emericella*, *Eurotium*, etc.)	*Memnoniella* (? *Melanopsamma*)	*Catenularia* (*Chaetosphaeria*)
Penicillium (*Eupenicillium*, *Talaromyces*, etc.)	*Riclaretia* (? = *Stachybotryna*)	*Sporoschisma* (*Chaetosphaeria*)
Thysanophora	*Phialophora* (*Lasiosphaeria*)	*Exochalara*
Paecilomyces p.p. (*Talaromyces*, *Thermoascus*, *Aphanoascus* sensu Udagawa, *Hamigera*)	*Fusarium* (*Gibberella*, *Calonectria*)	*Monilochaetes*
	Paecilomyces p.p. (*Byssochlamys*)	*Chalara* (*Ceratocystis*, *Cryptendoxyla*)
	Septofusidium	*Sporendocladia*
Acrophialophora	*Gabarnaudia* (*Sphaeronaemella*)	*Fusichalara*
Phialomyces	*Penicillifer*	*Scopulariopsis* (*Microascus*, *Kernia*)
Phialotubus	(*Chaetomium*)	*Wardomyces* (particularly *Gamsia*)
Polypaecilum (*Dichotomomyces*, *Thermoascus*)	(*Thielavia terrestris*)	(*Microascus*)
Septofusidium herbarum		

KEY TO THE SPECIES

1a. Conidia (at least partly) distinctly pigmented, ornamented 2
b. Conidia not or faintly pigmented, smooth-walled or slightly ornamented 4
2a. Conidia in short chains (up to 7), covered with irregularly arranged coarse warts . . *S. oligospora*
b. Conidia in long chains, ornamented with longitudinal ribs or rows of warts 3
3a. Conidia variable, onion-shaped to fusiform, always ribbed . . . . . *S. striatispora*
b. Conidia of two distinct kinds, onion-shaped, pigmented and coarsely warted, or smaller, fusiform, hyaline and smooth-walled . . . . . *S. diversispora*
4a. Dark brown chlamydospores formed slingly or in short chains, mostly terminal; conidia ovoid *S. humicola*
b. Chlamydospores absent or paler brown and in chains; conidia mostly fusiform. 5
5a. Colonies greyish green due to the conidia 6
b. Colonies white 7
6a. Young colonies grey-olivaceous; phialides generally solitary; chlamydospores absent, even in old cultures. . . . . *S. griseoviridis*
b. Young colonies glaucous to greyish citrine-green; phialides often in whorls; chlamydospores often abundant in old cultures, pale brown, often in long, intercalary chains . . . . . *S. verticillata*
7a. Osmophilic hyaline sclerotia present; conidia provided with a conical apical refringent connective; odour often suggesting actinomycetes . . . . . *S. sclerotialis*
b. Not osmophilic; sclerotia absent 8
8a. Conidia provided with short truncate connectives at either end, 2.5–3.5 × 1.5–2.2 μm; odour pungent *S. sagenomatis*
b. Conidia with narrow prominent connectives, 3.0–4.5 × 1.2–1.7 μm; odour absent . . . . *S. alba*

Sagenomella striatispora (Onions & Barron) W. Gams, *comb. nov.*—Figs. 3c, d

Paecilomyces striatisporus Onions & Barron *in* Mycol. Pap. **107**: 19. 1967 (basionym). — *Acremonium* striatisporum (Onions & Barron) W. Gams, Cephalosp. Schimmelp. 97. 1971. — *Sagrahamala striatispora* (Onions & Barron) Subram. *in* Curr. Sci. **41**: 49. 1972.

Sagenomella diversispora (van Beyma) W. Gams, *comb. nov.*— Figs. 3a, b

Scopulariopsis diversispora van Beyma *in* Zentbl. Bakt. ParasitKde (Abt. 2) **96**: 430. 1937 (basionym). — *Acremonium diversisporum* (van Beyma) W. Gams, Cephalosp. Schimmelp. 97. 1971.

Paecilomyces variabilis Barron *in* Can. J. Bot. **39**: 1576. 1971. — *Sagrahamala variabilis* (Barron) Subram. & Pushkaran *in* Kavaka **3**: 87. 1976.

Sagenomella humicola (Onions & Barron) W. Gams, *comb. nov.*

Paecilomyces humicola Onions & Barron *in* Mycol. Pap. **107**: 20. 1967 (basionym). — *Acremonium humicola* (Onions & Barron) W. Gams, Cephalosp. Schimmelp. 99. 1971. — *Sagrahamala humicola* (Onions & Barron) Subram. *in* Curr. Sci. **41**: 49. 1972.

Sagenomella griseoviridis (Onions & Barron) W. Gams, *comb. nov.*—Figs. 4a–c

Paecilomyces griseoviridis Onions & Barron *in* Mycol. Pap. **107**: 22. 1967 (basionym). — *Acremonium griseoviride* (Onions & Barron) W. Gams, Cephalosp. Schimmelp. 99. 1971. — *Sagrahamala griseoviridis* (Onions & Barron) Subram. & Pushkaran *in* Kavaka **3**: 89. 1976.

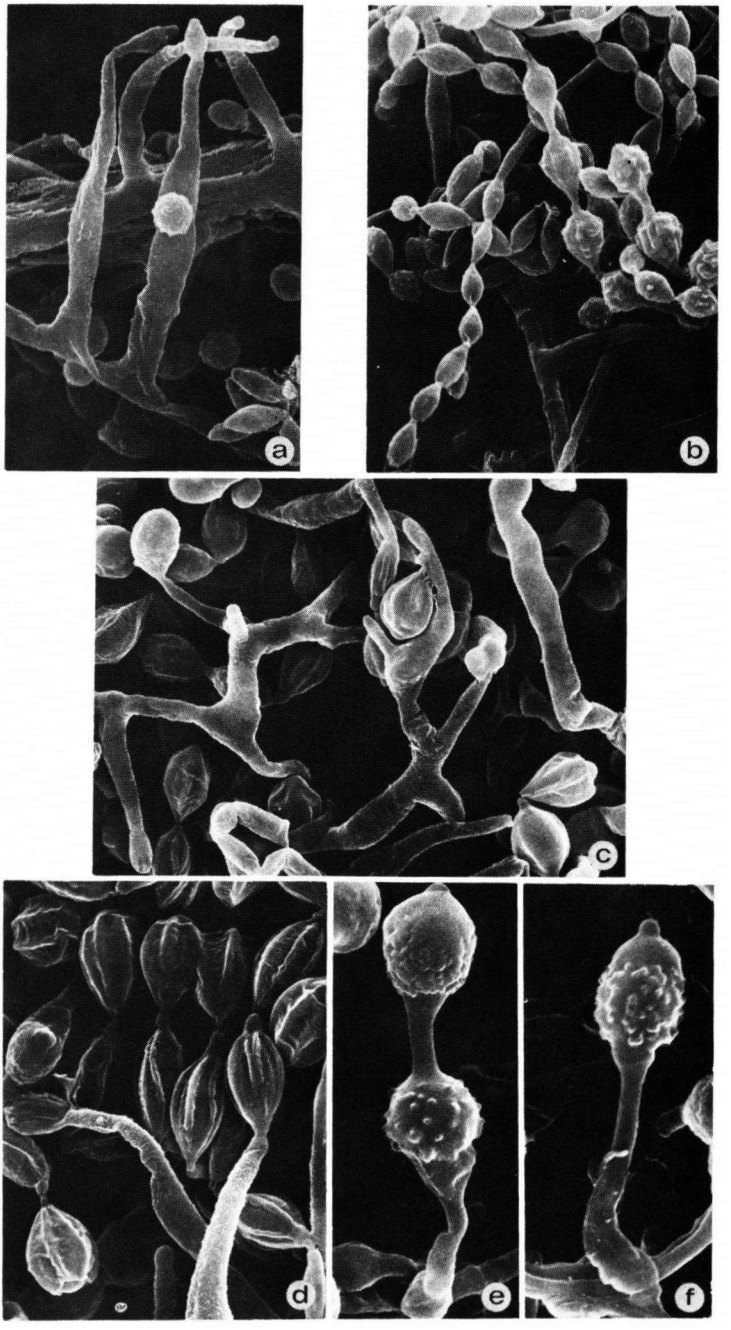

Fig. 3. Scanning electron micrographs of phialides and conidia. — a, b. *Sagenomella diversispora*, CBS 354.36 (Fig. a, ×2880; Fig. b, ×2520). — c, d. *Sagenomella striatispora*, CBS 429.67 (Fig. c, ×2520; Fig. d, ×3600). — e, f. *Sagenomella oligospora*, CBS 615.76, ×2880.

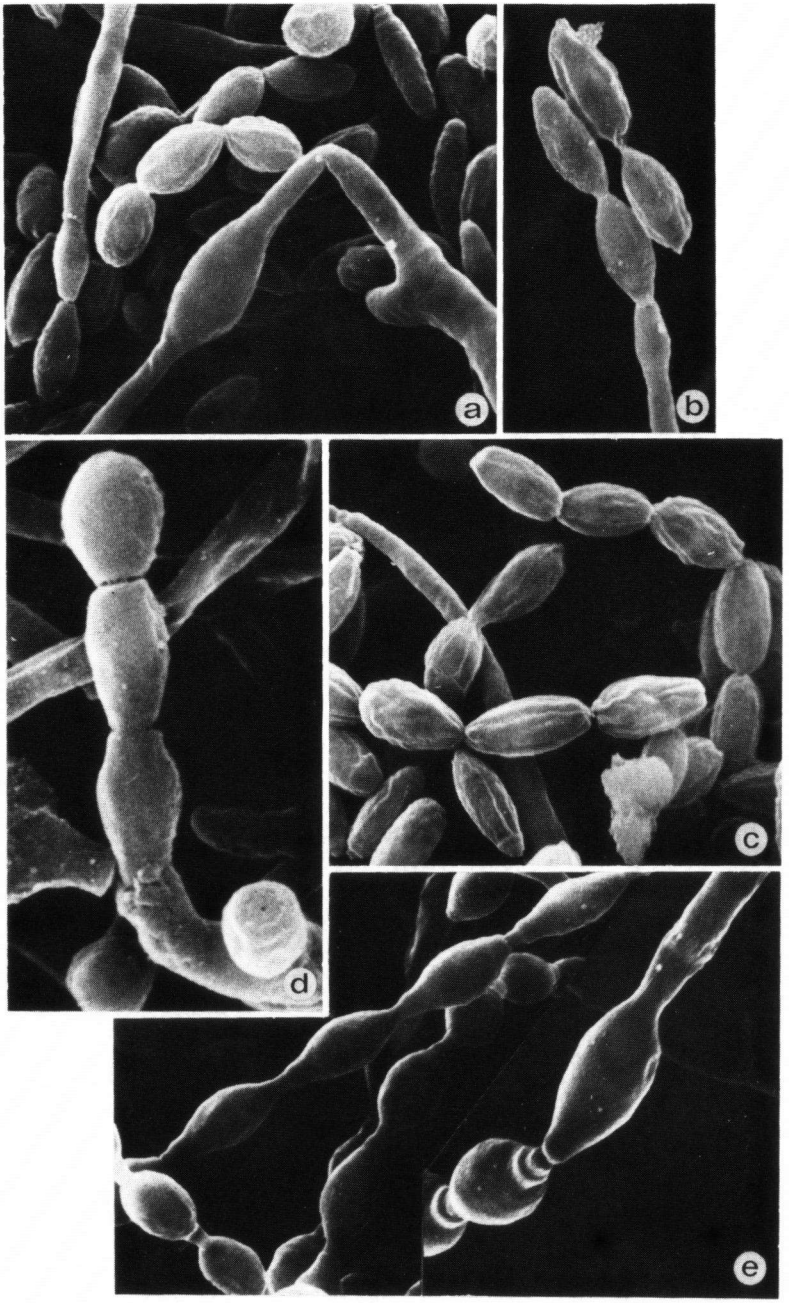

Fig. 4. Scanning electron micrographs of phialides and conidia. — a–c. *Sagenomella griseoviridis*, CBS 426.67 (Fig. a, ×6050; Fig. b, ×6300; Fig. c, ×6050). — d. *Sagenomella sagenomatis*, CBS 114.72, ×8100. — e. *Sagenomella alba*, CBS 167.74, ×6000 (with detail ×8000).

Good growth occurs in the range 18–30°C, with the optimum at 27°C.

ADDITIONAL ISOLATES EXAMINED.— CBS 155.76 and CBS 470.78, isolated from B-horizon of mature *Pinus sylvestris* forest and clear-cut forest, respectively, Jädraås, Prov. Gästrikland, Central Sweden, *B. E. Söderström & E. Bååth*, 1975 and 1977.

Sagenomella sagenomatis (Stolk & Orr) W. Gams, *comb. nov.*—Fig. 4d

Acremonium sagenomatis Stolk & Orr *in* Mycologia **66**: 676. 1974 (basionym).

TELEOMORPH.—*Sagenoma viride* Stolk & Orr, l.c.

Sagenomella oligospora W. Gams & Luiten, *spec. nov.*—Figs. 3e, f, 5

Coloniae in agaro maltoso vel farina avenacea addita post 15 dies 20–25°C ad 36 mm diam., albidae, exigue floccosae, tarde conidiis maturantibus olivascentes. Hyphae vegetativae leves, 1–3 μm latae. Phialides singulae ex hyphis prostratis ascendunt, lageniformes, hyalinae, leves, 7–17 μm longae, e 2–3 μm in ventro ad 1 μm apicem chromophilum versus angustatae, nonnumquam percurrenter proliferentes. Conidia catenis brevibus (1–7) connexa, subglobosa, crassitunicata, connectivis pigmentatis basilari conico prominente et apicali breviore praedita, episporio conspicuo verrucoso vel irregulariter incrustato circumdata, 6.5–8.5 × 4.5–6.0 μm. Chlamydosporae absunt.

Typus: CBS 168.74, isolatus e terra agresti prope Naaldwijk in Neerlandia, *B. van der Pol-Luiten*, 1974.

Colonies on 2% MEA or OA reaching 24–36 mm diam. in 15 days at 20–25°C, whitish, thinly floccose, tardily becoming pale olivaceous-grey due to scanty conidia. Vegetative hy-

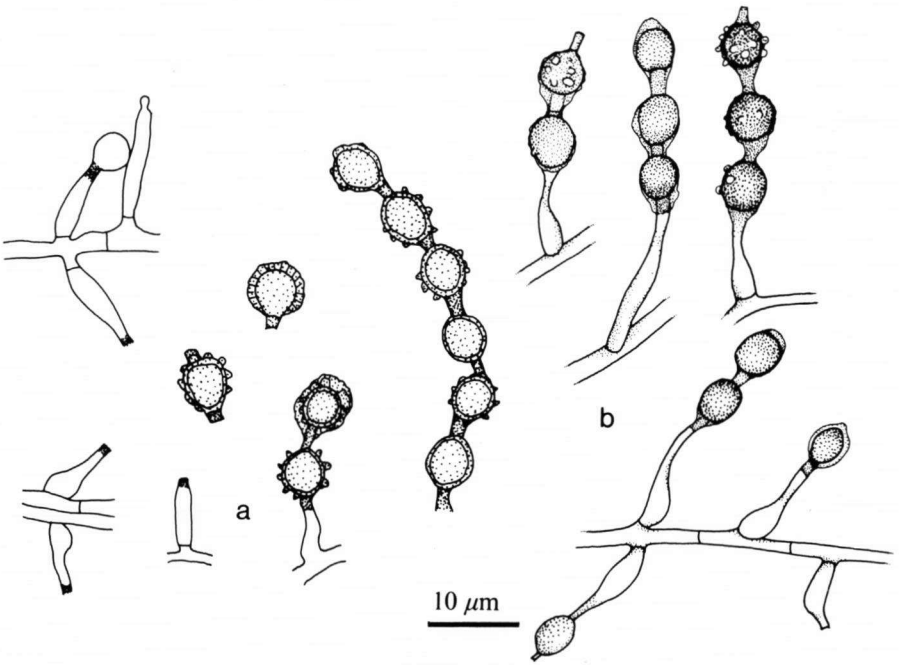

Fig. 5. *Sagenomella oligospora*. — a. CBS 615.76. — b. CBS 168.74.

phae hyaline, smooth-walled, 1–3 μm wide. Phialides arising singly from prostrate hyphae, erect, flask-shaped, hyaline, smooth-walled, 7–17 μm long, tapering from 2–3 μm in the swollen venter to 1.0 μm at the strongly chromophilic tip, only percurrently proliferating. Conidia formed in short chains of 1–5(–7) conidia, subglobose, thick-walled, with a very pronounced basal and a shorter apical pigmented connective, surrounded by a conspicuous brown warted or irregularly spreading incrustation, 6.5–8.5 (including the connectives) × 4.5–6.0 μm (including the ornamentation). Chlamydospores absent.

Good growth occurs in the range 15–33°C with the optimum at 30°C and very little growth occurring at 36°C.

ADDITIONAL ISOLATES EXAMINED.—CBS 404.76, isolated from human nail, comm. O. Fassatiová, Prague, 1976. CBS 615.76, isolated from composted chicken manure, Braunschweig, comm. K. H. Domsch, 1976.

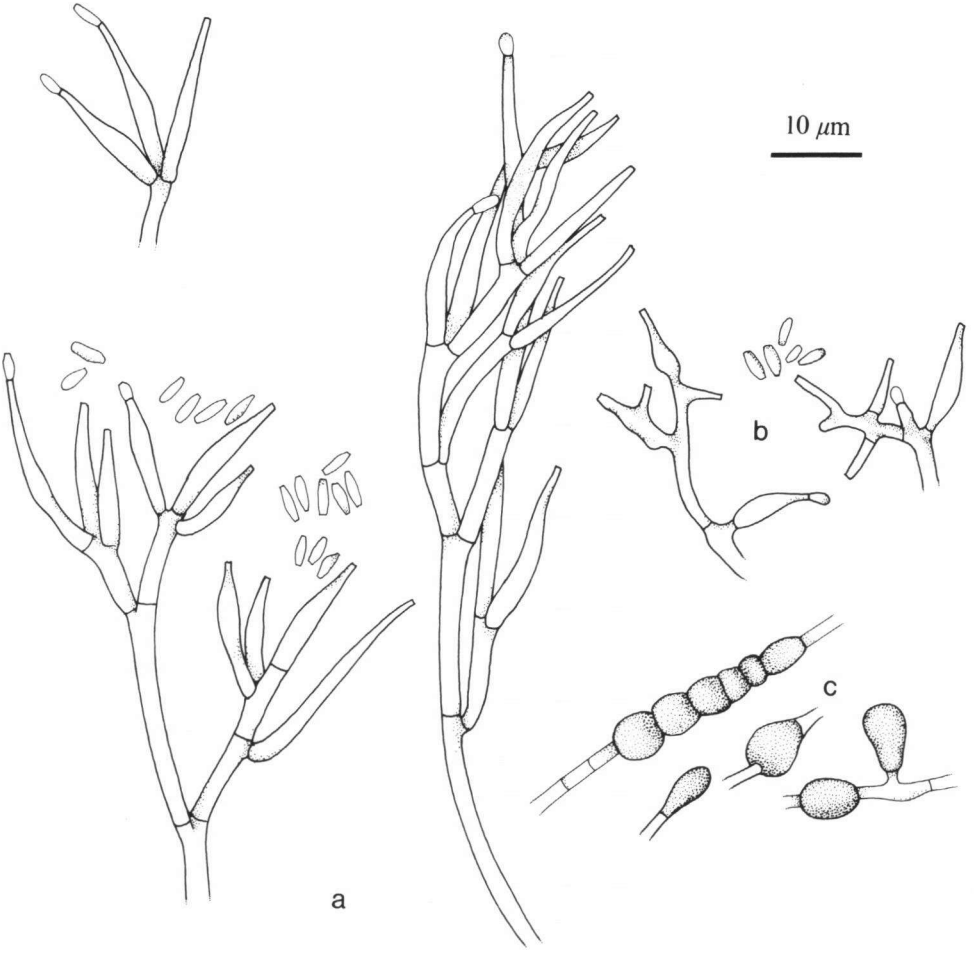

Fig. 6. *Sagenomella verticillata.* — a. Well-developed conidiophores. — b. Proliferating phialides (CBS 414.78). — c. Chlamydospores (CBS 160.76).

Sagenomella verticillata W. Gams & Söderström, *spec. nov.*—Figs. 6, 7a, b

Coloniae in agaro maltoso post 10 dies 20–30°C 6–10 mm diam., pulverulentae vel minute tomentosae, primum glaucae vel citrino-virides, margine angusta hyalina circumdatae, deinde olivascentes; reversum primum album vel electrinum, deinde chlamydosporis maturantibus brunnescens. Hyphae vegetativae hyalinae, leves, 1.0–2.5 μm latae, in coloniis vetustis nonnumquam brunnescentes. Conidiophora erecta, ab hyphis vegetativis vix diversa, plerumque pluries ramosa et nonnullos verticillos binarum ad quaternarum phialidum proferentia; phialides e ventro plus minusve cylindrico, 7–14 × 2–3 μm, et apice latitudine ad 0.5–1.0 μm diminuto, 5–12 μm longo constant. Alterae phialides breviores, forma variabiles et saepe sympodialiter proliferentes. Conidia longis catenis connexa, fusiformia, utrinque truncata et minute apiculata, hyalina ad subhyalina, levia vel minute incrustata, 3.4–4.0 × 1.5–2.2 μm. Chlamydosporae in coloniis vetustis plerumque copiosae, intercalares vel terminales, vulgo catenulatae, plus minusve elongatae, leves, subhyalinae ad brunneae, 3.0–5.5(–9) μm diam.

Typus: CBS 414.78, isolatus e terra pineti in Suecia.

Colonies on 2% MEA reaching 6–10 mm diam. in 10 days at 20–30°C, powdery due to the conidia, smooth or slightly tufted in the centre, in young cultures glaucous to greyish citrine-yellow with a narrow hyaline margin, later becoming olivaceous-grey; reverse at first white or amber, later becoming tardily brown in the centre. Vegetative hyphae hyaline, smooth-walled, 1.0–2.5 μm wide, in old cultures partly becoming brown. Conidiophores erect, hardly differentiated from the vegetative hyphae at the base, usually repeatedly branched and bearing several whorls of 2–4 phialides. Well developed phialides differentiated into an almost cylindrical or somewhat inflated venter, 7–14 × 2–3 μm, and a tapering neck which is 5–12 μm long and 0.5–1.0 μm wide at the tip; atypical phialides appearing in old cultures, shorter and of irregular shape and often sympodially proliferating. Conidia cohering in long chains, fusiform, with slightly apiculate and truncate ends, hyaline, to slightly pigmented, smooth-walled or very finely encrusted, 3.5–4.0 × 1.5–2.2 μm. Chlamydospores usually abundant in old cultures, intercalary or terminal, often in chains, more or less elongate, smooth- and thick-walled, subhyaline to brown, 3.0–5.5(–9) μm diam.

Good growth occurs in the range 18–33°C with the optimum at 27°C; no growth occurring at 36°C.

ISOLATES EXAMINED.—CBS 450.71, isolated from agricultural soil, Wageningen, *J. H. van Emden*, 1971. CBS 119.72 (71–48), CBS 120.72 (71–52), CBS 145.72 (71–50), all isolated from soil, Francis Park, Vancouver Island, B.C., Canada, *J. Paden*, 1972. CBS 985.73, isolated from vaginal fluor of a patient at Zeist, Netherlands, comm. Dr. Rebholz. CBS 481.74, isolated from B-horizon soil, Lago Indio, Tierra del Fuego, Argentina, *A. Godeas*, Jan. 1973 (527). CBS 160.76, isolated from B-horizon of mature pine forest (*Pinus sylvestris*), 1975; CBS 414.78 (type strain) and CBS 417.78, isolated from A_2-horizon of a clear-cut pine forest, 1977 and 1976; CBS 415.78 A and B, and CBS 416.78, isolated from B-horizon, of clear-cut pine forest, 1977, all collected at Jädraås, Prov. Gästrikland, Central Sweden, *B. E. Söderström & E. Bååth.*

Sagemonella verticillata has for some years been confused with *S. griseoviridis*, until it was realized that the absence of chlamydospores and the constantly solitary phialides in the latter were quite constant features. Moreover, SEM studies confirm their distinction, in that no trace of a longitudinal ornamentation could be found in conidia of *S. verticillata*. The verticillate arrangement of the phialides in this species is similar to that in *Paecilomyces* Bain. (Samson, *1974*), but the more or less basitonous ramification of the hardly differentiated conidiophores distinguishes it from this genus. The biapiculate conidia and the frequent irregular sympodial proliferation show its affinity to other species of *Sagenomella*. The species can thus easily be recognized even if chlamydospores are almost absent as in

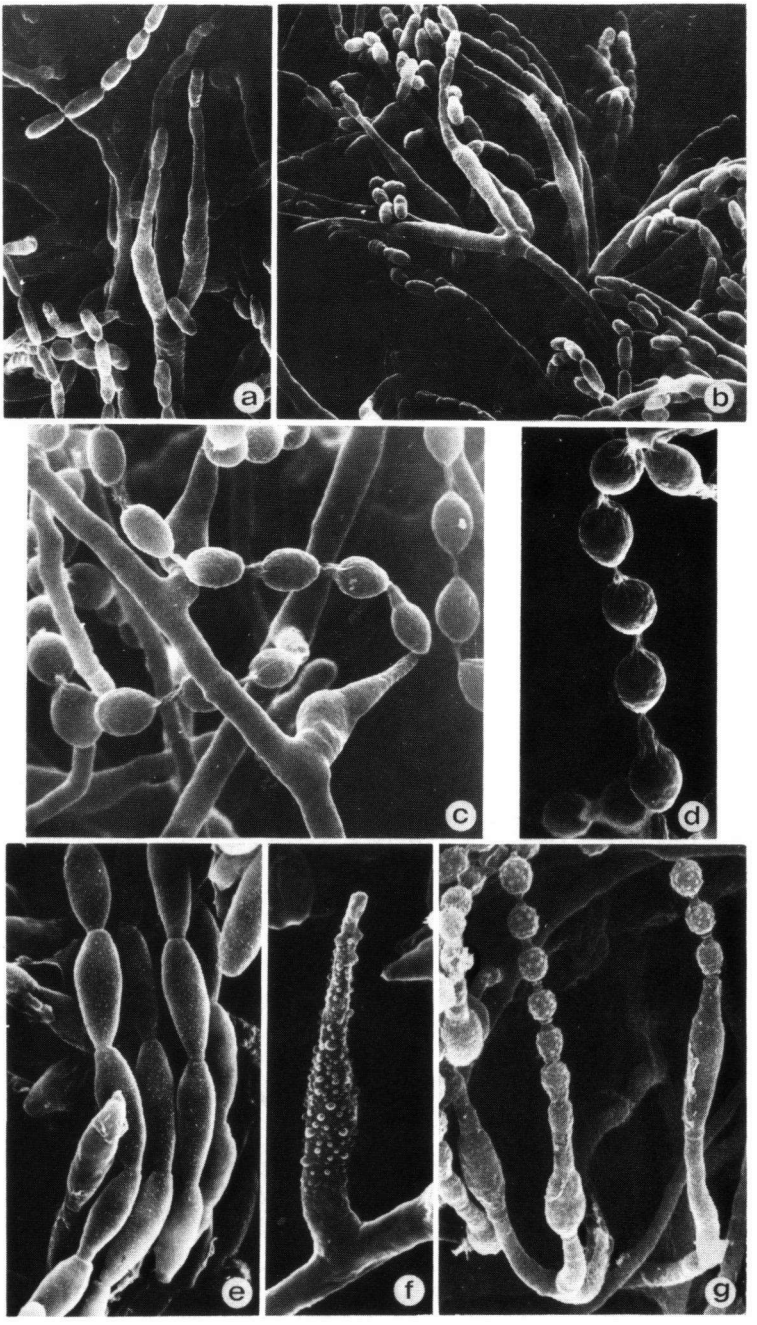

Fig. 7. Scanning electron micrographs of phialides and conidia. — a, b. *Sagenomella verticillata*, CBS 414.78, × 1600. — c, d. *Sagenomella sclerotialis*, CBS 366.77 (Fig. c, × 3000; Fig. d, × 3600). — e, f. *Acremonium luzulae*, CBS 494.67 (Fig. e, conidial chains, × 3000; Fig. f, phialide, × 2400). — g. *Torulomyces lagena*, CBS 185.65, × 3000.

CBS 120.72, CBS 415.78 A and B, and CBS 417.78. It differs from *S. humicola*, which can also form verticillate phialides, by having generally catenulate chlamydospores and fusiform conidia.

Sagenomella sclerotialis W. Gams & Breton, *spec. nov.*—Figs. 7c, d, 8

Coloniae in agaro maltoso 15% saccharosio addito lente crescunt 25°C, sed multo melius 33–36°C, albae, floccosae, deinde sclerotiis granulatae. Hyphae vegetativae leves, (1–)2–3 μm latae, nonnumquam ad 5 μm inflatae. Phialides plerumque simplices ex hyphis repentibus submersis vel aeriis oriundae, 5–15 μm longae, e 1.2–1.8 μm sursum ad 1.0 μm modice angustatae, rectae vel flexuosae; phialides brevissimae saepe septo basilari carent. Conidia longis catenis connexa, ovoidea, basi truncata, apice acuto refringenti praedita, 3.0–4.5 × 1.5–2.0 μm. Chlamydosporae absunt, sclerotia plus minusve globosa, firma, alba, 125–350 μm diam. in coloniis vetustis copiosa.

Typus: CBS 366.77, isolatus e pabulo Lolii, Montoldre in Gallia, ab *A. Breton & P. Zwaenepoel*, 1976.

Colonies on MEA with 15% saccharose reaching 12 mm diam. at 24°C and 25 mm at 33–36°C, white, somewhat lanose, later becoming granular due to sclerotia. Odour suggesting actinomycetes in colonies grown at 27°C or above. Vegetative hyphae smooth-walled, (1–)2–3 μm wide, sometimes inflated to 5 μm. Phialides mostly arising singly from prostrate submerged or aerial solitary or fasciculate hyphae, 5–15 μm long, slightly tapering from 1.2–1.8 μm to 1.0 μm, straight or flexuous; the shortest phialides often not delimited from the subtending hypha by a basal septum. Conidia cohering in long chains, ovoid, with a truncate base; the apical connective transformed into a conspicuous refringent cone which collapses when dry (Figs. 7c, d), 3.0–4.5 × 1.5–2.0 μm. Chlamydospores absent; sclerotia abundant in old cultures, more or less globose, firm and almost smooth-walled but surrounded by some loose hyphae, white, 125–350 μm diam., consisting of isodiametric cells 4–10 μm diam.

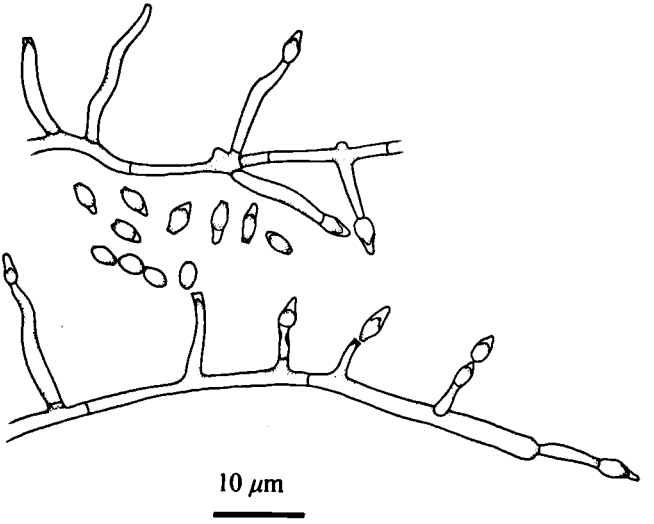

Fig. 8. *Sagenomella sclerotialis*, CBS 366.77.

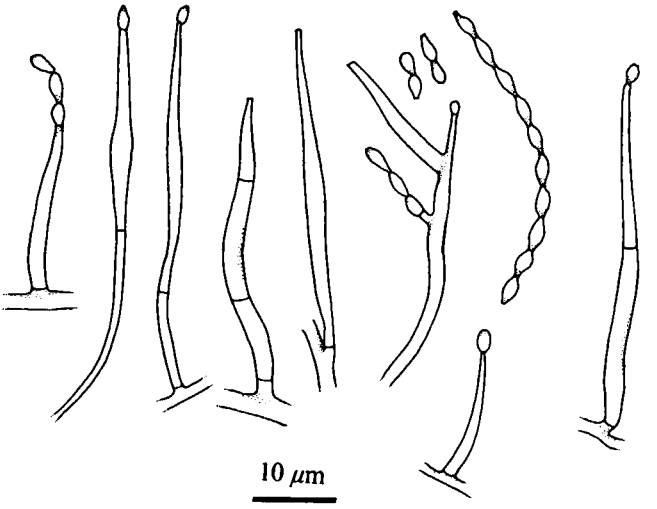

Fig. 9. *Sagenomella alba*, CBS 210.74.

Growth on MEA with 15% saccharose or Czapek's agar with 20% saccharose is better than on 2% MEA, no growth occurring on MEA with 12% NaCl. Growth is scanty at 18–21°C but luxuriant at 30–36°C.

This species was commonly isolated from fodder of Ray-grass and lucerne in the region of Montoldre, 03-France, in 1976 and 1977, on malt and Czapek agars at 24°C.

Sagenomella alba W. Gams & Söderström, *spec. nov.*—Figs. 4e, 9

Coloniae in agaro maltoso post 10 dies 20–23°C 6 mm diam. (30°C non crescunt), pulverulentae, albae. Hyphae vegetativae leves, 1.0–2.5 µm latae. Phialides orthotropicae vel terminales ex hyphis submersis oriuntur, plerumque simplices sed nonnumquam irregulariter sympodialiter proliferentes, aculeatae, saepe inflatae in medio, 12–30 µm longae, 2 µm latae in medio et ad 0.5–1.0 µm sursum angustatae. Conidia longis catenis connexa, hyalina, levia, fusiformia vel connectivis prominentibus limoniformia, 3.0–4.5 × 1.2–1.7 µm. Chlamydosporae et sclerotia absunt.

Typus: CBS 167.74, isolatus e terra piceeti in Suecia, *B. E. Söderström*, 1974.

Colonies on 2% MEA reaching 6 mm diam. in 10 days at 20–23°C (no growth at 30°C), pure white, powdery. Odour absent. Vegetative hyphae hyaline, smooth-walled, 1–2.5 µm wide. Phialides arising orthotropically or terminally from undifferentiated submerged hyphae, usually simple but sometimes irregularly sympodially proliferating, aculeate, often centrally swollen, 12–30 µm long, 2 µm wide at the widest part, and tapering to 0.5–1.0 µm at the tip. Conidia cohering in long chains, hyaline, smooth-walled, fusiform or lemon-shaped due to the prominent connectives, 3.0–4.5 × 1.2–1.7 µm. Chlamydospores and sclerotia absent.

Good growth occurs in the range 15–21°C, none at 27°C or above.

ISOLATES EXAMINED.—CBS 167.74 (type strain) and CBS 210.74, isolated from A_{02}-horizon of planted spruce forest (*Picea abies*), Prov. Skåne, South Sweden, *B. E. Söderström*, 1974.

DISCUSSION

Apart from the somewhat deviating *S. oligospora* and *S. sclerotialis*, *Sagenomella* seems to be a rather homogeneous genus which is distinct from *Acremonium* not only by the connected conidial chains but also by the sympodially proliferating and often centrally swollen phialides. Whilst in *Acremonium* an apiculation of both conidial ends may be indicated in some rare cases, this feature is visible in *Sagenomella* in all but the terminal conidia.

The similar genus *Torulomyces* Delitsch has very conspicuously connected conidial chains but conidiophores which are regularly differentiated into a slender stalk cell and a flask-shaped phialide, thus warranting the generic distinction (Fig. 7g).

The recognition of connected conidial chains in this study is based on both light-microscopic and SEM observations. In *S. sagenomatis* and the other pale species, the former technique gives more conclusive evidence than the latter. Further TEM work will be necessary to verify the assumptions made in this study.

The conidial chains of *Acremonium luzulae* (Figs. 7e, f) and the remaining species of section *Gliomastix* are regarded as disconnected. It might be predicted that a sphaeriaceous teleomorph could be connected with these species. Consequently *Sagrahamala* Subram. is regarded as a synonym of *Acremonium* section *Gliomastix*. Once again it is emphasized, that *Wallrothiella subiculosa* Höhn. (anamorph known as *Gliomastix protea* Sacc.) is not related to species of this section, since the hyphae are pigmented and the conidial pigment is localized in the wall itself and not superficially encrusted as in typical *Gliomastix*. The species hitherto placed in *Paecilomyces* also require further study in the light of these considerations.

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REFERENCES

BOOTH, C. (1957). Studies of Pyrenomycetes: II. *Melanopsamma pomiformis* and its *Stachybotrys* conidia. *In* Mycol. Pap. **68**: 16–27.

COLE, G. T. & SAMSON, R. A. (1979). Patterns of development in conidial fungi. London.

DICKINSON, C. T. (1968). *Gliomastix* Guéguen. *In* Mycol. Pap. **115**: 1–24.

GAMS, W. (1971). *Cephalosporium*-artige Schimmelpilze (Hyphomycetes). Stuttgart.

HAMMILL, T. M. (1972). Electron microscopy of phialoconidiogenesis in *Metarrhizium anisopliae*. *In* Am. J. Bot. **59**: 317–326.

JONG, S. C. & DAVIS, E. E. (1976). Contribution to the knowledge of *Stachybotrys* and *Memnoniella* in culture. *In* Mycotaxon **3**: 409–485.

KEDROVA, O. S., TARASOV, K. L. & ANTONOV, A. S. (1973). (Composition of DNA of some species belonging to *Acremonium* Link ex Fr. genus as correlated with its systematic position.) *In* Mikol. Fitopatol. **7**: 93–95.

MALLOCH, D. & CAIN, R. F. (1972). The Trichocomataceae: Ascomycetes with *Aspergillus*, *Paecilomyces*, and *Penicillium* imperfect states. *In* Can. J. Bot. **50**: 2613–2628.

ONIONS, A. H. S. & BARRON, G. L. (1967). Monophialidic species of *Paecilomyces*. *In* Mycol. Pap. **107**: 1–25.

SAMSON, R. A. (1974). *Paecilomyces* and some allied Hyphomycetes. *In* Stud. Mycol. **6**: 1–119.

STOLK, A. C. & ORR, G. F. (1974). *Sagenoma*, a new genus of Eurotiaceae. *In* Mycologia **66**: 676–680.

SUBRAMANIAN, C. V. (1971). The phialide. *In* B. Kendrick (ed.), Taxonomy of Fungi Imperfecti: 92–119.

—— (1972a). Conidial chains, their nature and significance in the taxonomy of Hyphomycetes. *In* Curr. Sci. **41**: 43–49.

—— (1972b). Conidium ontogeny. *In* Curr. Sci. **41**: 619–624.

SUBRAMANIAN, C. V. & PUSHKARAN, M. (1976). Conidium ontogeny in some monophialidic Hyphomycetes. *In* Kavaka **3**: 77–99 ('1975').