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Concerning Pseudoanguillospora and water-borne Mycocentrospora spp.

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Pseudoanguillospora stricta is redescribed from the type, from ex-type culture and from new isolates. Pseudoanguillospora gracilis, Mycocentrospora clavata, and Mycocentrospora varians are illustrated from the type material. The generic concept of Pseudoanguillospora and Mycocentrospora and delimitation of both genera is discussed. Due to the scarcity of specimens, especially of living cultures available for study, no nomenclatural changes are proposed.

Key words: taxonomy, aquatic hyphomycetes, Pseudoanguillospora, Mycocentrospora.

Marvanová L. (1996): K problematice rodu Pseudoanguillospora a druhů rodu Mycocentrospora izolovaných z vody. – Czech Mycol. 49: 7–20

Pseudoanguillospora stricta je znovu popsána na základě typového materiálu, ex-typové kultury a nových izolátů. Druhy Pseudoanguillospora gracilis, Mycocentrospora clavata a Mycocentrospora varians jsou ilustrovány na základě studia typového materiálu. Je diskutována koncepce rodů Pseudoanguillospora a Mycocentrospora a jejich rozlišení. Vzhledem k nedostatku materiálu u většiny druhů, zejména živých kultur, nejsou zatím navrhovány žádné nomenklatorické změny.

PSEUDOANGUILLOSPORA

The anamorph genus *Pseudoanguillospora* Iqbal (1974) was published to accommodate two species: *Pseudoanguillospora stricta* Iqbal (l.c.) (type species) and *Pseudoanguillospora prolifera* Iqbal l.c. Characteristic morphological features are sympodial conidiogenous cells (similar to those of *Mycocentrospora* Deighton (1972), with unthickened, not rigid scars) and long unbranched conidia lacking the parabasal extension typical of *Mycocentrospora acerina* (Hartig) Deighton (type species). Unfortunately the protologues are rather brief and the drawings do not clearly show the distinguishing characters. Therefore, the species have rarely been recognized by other mycologists.

Cultures isolated in 1983 in the U.K. (CCM F-13283 and CCM F-17883) were compared with the type of *Pseudoanguillospora stricta* (IMI 160109), and a piece of the ex-type culture preserved in FAA (solution of Formaldehyde, Acetic acid and Alcohol), received from S.H. Iqbal in 1974. Some important features of the colony not mentioned in the diagnosis, i.e. the rusty brown colour of the substrate mycelium on 2 % MA and mycelial ropes in the aerial mycelium were found both in the ex-type culture and in the more recent isolates as well. The

conidiogenous structures in the former were rather fragmentary probably due to long-time preservation in FAA, but detached conidia and structures recognizable as conidiogenous cells could be found. This allows to make more precise the concept of this taxon. Moreover, a phialidic synanamorph not mentioned in the protologue was present in the ex-type culture (figs. 1 M, 6 E) and in one of the more recent isolates (fig. 2 J,K).

The microscopical characters of both Iqbal's and CCM material are shown in figs. 1 and 2. There is no doubt, that the conidia are identical. Well differentiated conidiophores as seen in CCM F-17883 (fig. 2 A) have been found in Iqbal's material as well (fig. 1 F). Typical for the CCM isolates are the creeping fertile hyphae present at the water level, with perpendicular conidiogenous cells (figs. 2 L, 6 A), protruding into the air. These have not been seen developed in IMI 160109, but they may be recognized in text-fig. 1 of Iqbal (1974). The caducous conidiogenous cells (arrows) bearing a pair of conidia (fig. 1 G) may be also recognized in CCM F-17883 and in CCM F-13283 (fig. 2 D,H).

In order to make identification of this species easier it is redescribed here.

Pseudoanguillospora stricta Iqbal (1974), Biologia (Lahore 20:11)

(figs. 1, 2, 6)

Colony (MA) whitish grey to dark greyish brown with a rusty brown hue in the reverse after submergence, growing moderately fast, substrate hyphae brown with finely roughened thicker walls, aerial mycelium scanty or abundant in fresh cultures, woolly, often funiculose. Sporulation in damp conditions on agar and after submergence on the water level. Conidiophores apical, simple or sparsely branched, up to 170 × 3.5–5.5 μm or lateral, up to 37 μm. Conidiogenous cells apical, lateral or intercalary, up to 42 × 2.5–4.5 μm, later usually with 2–3 secondary septa, polyblastic, sympodial, sometimes concurrent with conidia (figs. 2 A, 6 B), with up to 3 conidiogenous loci, often caducous, after secession sometimes remaining attached to the conidia, scars 1–3, apical and subapical, broad, flat or convex, unthickened, often centrally papillate, rarely on short denticles. Conidia holoblastic, acrogenous, single or in groups of up to 3 per conidiogenous cell, straight or slightly curved, long-fusoid to narrow-obclavate, (20-)100–210 (-275) × 2.5–5.5 μm, sometimes fragmenting in older cultures, apex subulate, base truncate, parabasal extension (fig. 2 E) exceptional, false branching due to secession of conidiogenous cells bearing pairs of conidia occasional.

Synanamorph: microconidial (spermatial), on hyphae. Conidiophores single, apical or lateral, simple or branched, sometimes micronematous, cells often slightly inflated. Conidiogenous cells phialidic, apical or lateral, 5.5–10 × 3.5–4.5 μm, collarette cylindric, 4.5–6.5 × 1–1.5 μm, periclinal thickening more or less distinct. Detached conidia not seen.

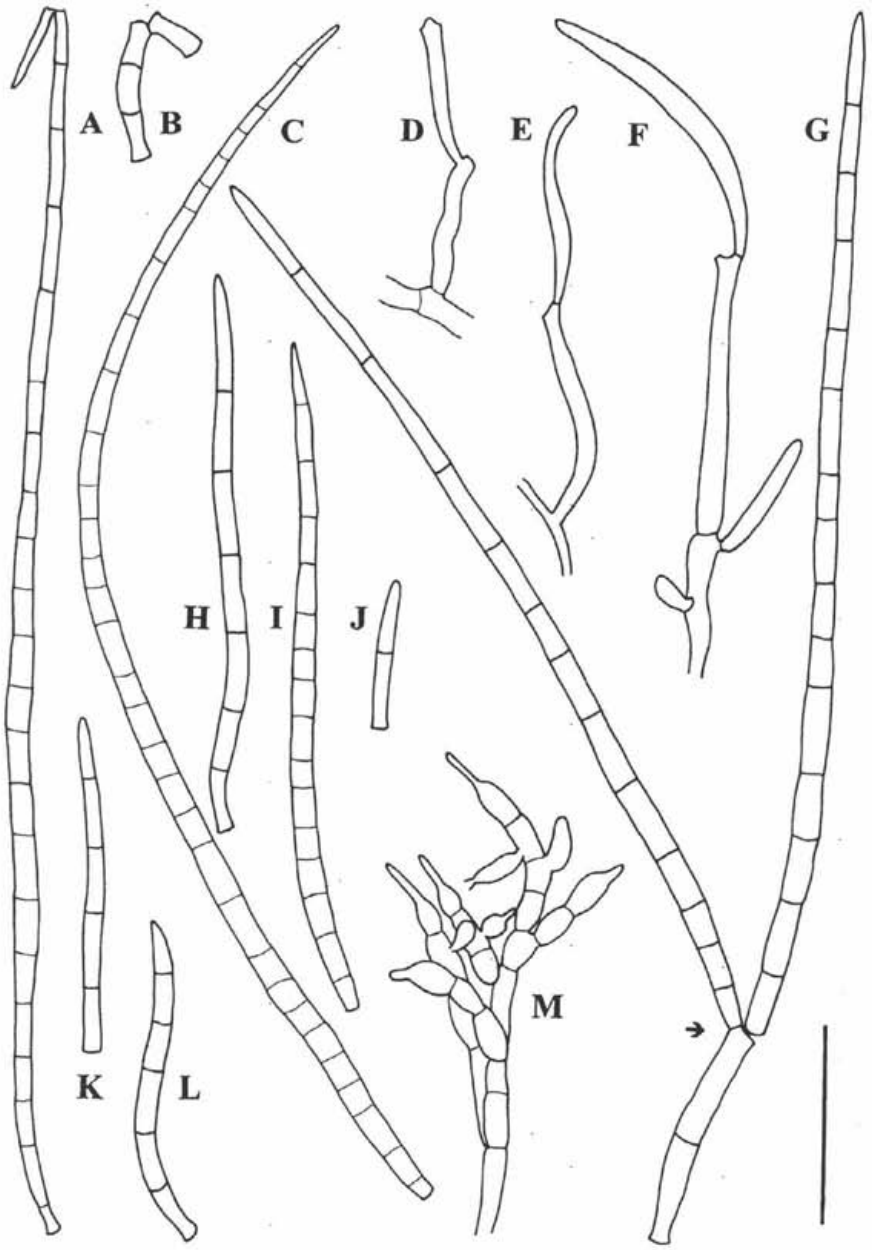

Fig. 1. *Pseudoanguillospora stricta.* A-C, G-L. Conidia and fragmented part-conidia. D. Spent conidiophore. E,F. Developing conidia. M. Microconidial synanamorph. (A,C-G,I,M: from ex-type culture. B,H,J,L: from the type). Scale bar = 30 μm.

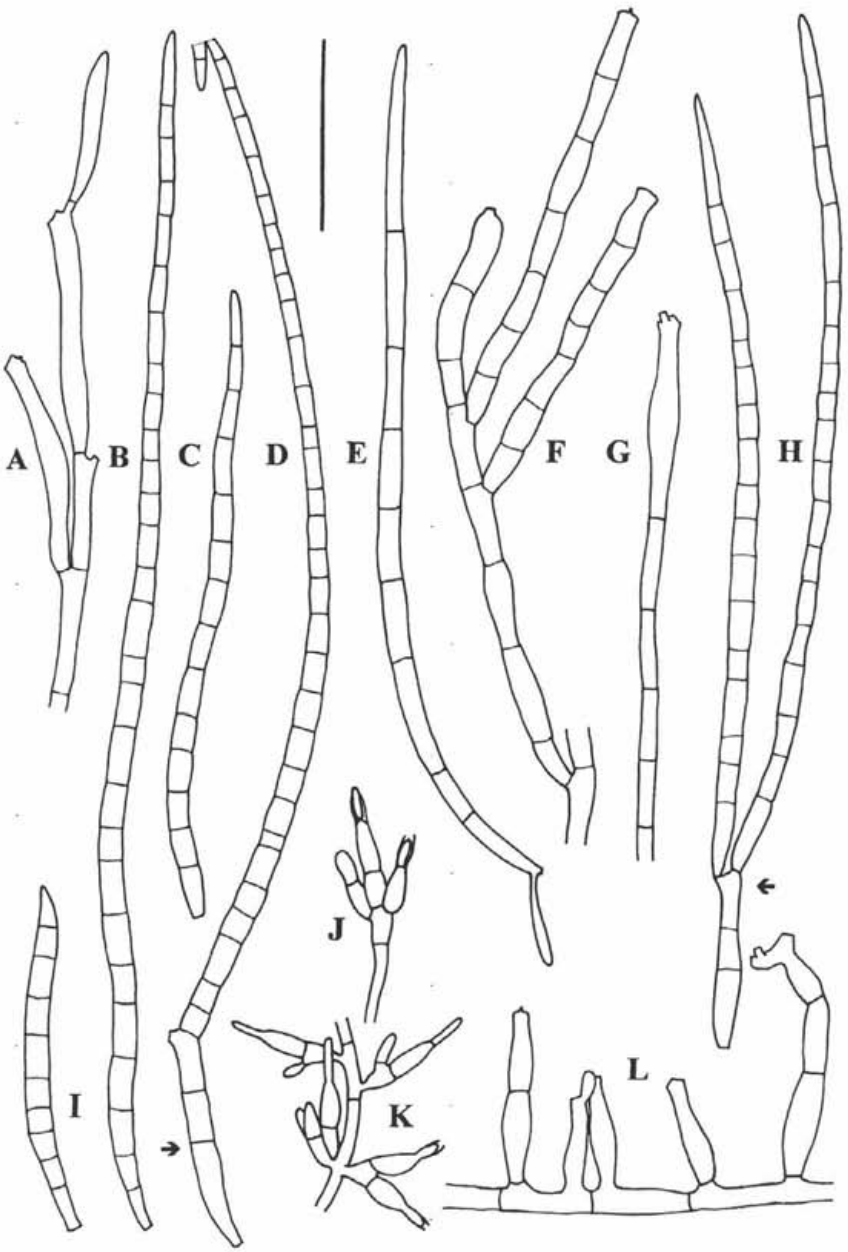

Fig. 2. *Pseudoanguillospora stricta.* A, Conidial development. F, G,L. Spent conidiophores. B-E, H, I. Conidia (H = false branching, arrow indicates a pair of conidia attached to a caducous conidiophore). J.K. Microconidial synanamorph. (A-D,F,G,I-L: from CCM F-17883, E,H: from CCM F-13283).

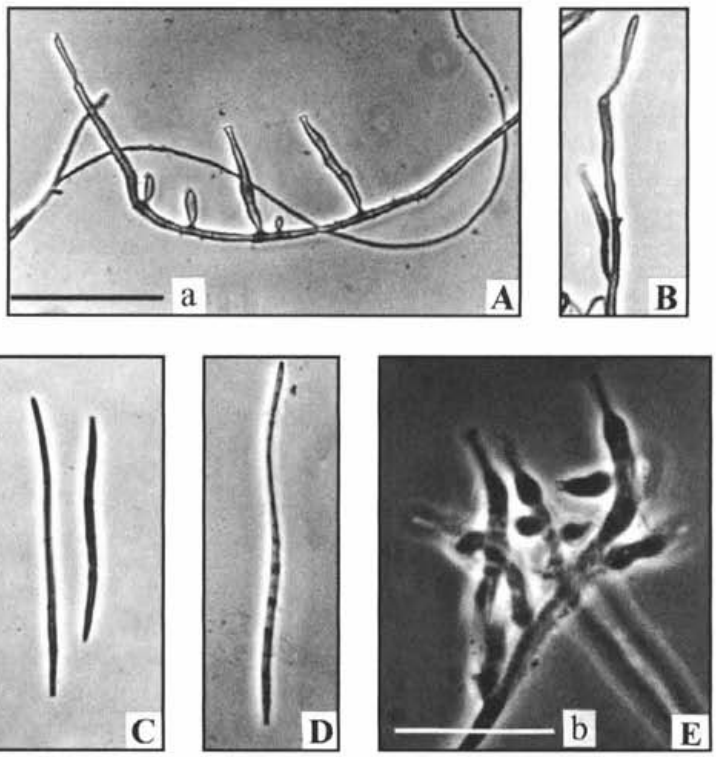

Fig. 6. *Pseudoanguillospora stricta*, A. Spent lateral conidiophores. B. Conidial development. C,D. Detached conidia. E. Microconidial synanamorph. (A-D: from CCM F-17883, E: from ex-type culture). Scale bar a = 50 μm (for A-D), scale bar b = 25 μm (for E).

The microconidial state in CCM F-17883 differs from that in Iqbal's material by lesser complexity. The conidiophores are reduced to short, mostly lateral cells constricted at the point of attachment to the hypha, whereas there are well differentiated branched structures in Iqbal's specimen.

Small differences in the morphology of spermatial synanamorphs are also known in other taxa, e.g. in *Filosporella versimorpha* Marvanová et al. (1992) or in *Anguillospora crassa* Ingold (unpublished observation). This may indicate that the taxon consists of morphologically slightly different populations or that intraspecific taxa are involved. Owing to the low number of isolates available for study, no definite conclusion can be drawn.

Specimens examined: IMI 160109, type. Ex-type culture in FAA labelled CMI 160109, with synanamorph, isolated from decaying stems of *Juncus effusus* in a moorland stream, Dartmoor, U.K., S.H. Iqbal. CCM F-13283, River Teign at Becka Falls, Devon, U.K., Feb. 1983, L. Marvanová. CCM F-17883, with

synanamorph, Afon Colwyn in Bedgelert Forest, North Wales, U.K., Mar. 1983, L. Marvanová. CCM F-25387, right tributary of the roadside ditch along the Trans Canada Highway, near Ogden Mill Cross, Sackville, New Brunswick, Canada, Apr. 1987, L. Marvanová.

This species was also reported from Pakistan (Iqbal 1977, Iqbal et al. 1979 on leaves, Iqbal et al. 1980a, b, on twigs and conifer needles) and Australia (Thomas et al. 1989, conidia in stream water).

Pseudoanguillospora prolifera Iqbal 1974 has been described in rather vague terms. The protologue includes a drawing (text- fig. 2) which, however, does not contribute to a better understanding of the species. The type or other authentic material (preserved at Punjab University under No. 2964) was not made available. As far as I know, the only report published after its description is by Sinclair et al. (1983, fig. 1 C), but the drawing (conidia only) does not show any diagnostic characters.

Pseudoanguillospora gracilis Sinclair et Morgan-Jones (1979) (fig. 3)

Desribed from South Africa. It has not been reported afterwards, as far as I know. The type material sent to me consisted of two slides and a dried agar culture. One slide was labelled "C4 4/12", the other "aerated culture 12/8/78 RC4". The dried agar culture was brown with a dark grey tinge in the centre, paler at the margin, reverse dark, aerial mycelium hairy.

The slide "C4 4/12" contains detached conidia (fig. 3, A–F) and conidiogenous structures (fig. 3, G–I). The latter are rather scanty. They show apical and lateral origins of conidia, sympodial (fig. 3 I) and pseudopercurrent (fig. 3 G) proliferation. Fig. 3 H may be interpreted either as percurrent proliferation or as a polyblastic conidiogenous cell with three conidiogenous loci: two spent and one bearing an immature conidium. Conidia (macroconidia) show greater variation than given in the protologue: they are 28–141 × 2.2–3 μm.

The slide "aerated culture" contains a fungus with phialidic conidiogenesis, which was not mentioned in the protologue. It occurs on hyphae of similar appearance like these on slide "C4 4/12", but direct connection with macroconidiogenous structures was not observed. Bearing in mind that (1) microconidial and macroconidial states do not always appear in the same part of the colony or at the same time and (2) I have not seen a living culture, but a preparation with a limited amount of dead material, I believe that my inerpretation of it being a synanamorph of *P. gracilis* is legitimate.

Description of the microconidial state: Conidiophores micronematous, single, simple, conidiogenous cells phialidic, apical or lateral, venter 9–14 × 2.5–3.5 μm, collarette cylindrical, up to 8.5 μm deep, periclinal thickening distinct. Microconidia bacilliform, 5–6.5 × c. 1.5 μm, both ends rounded or base truncate.

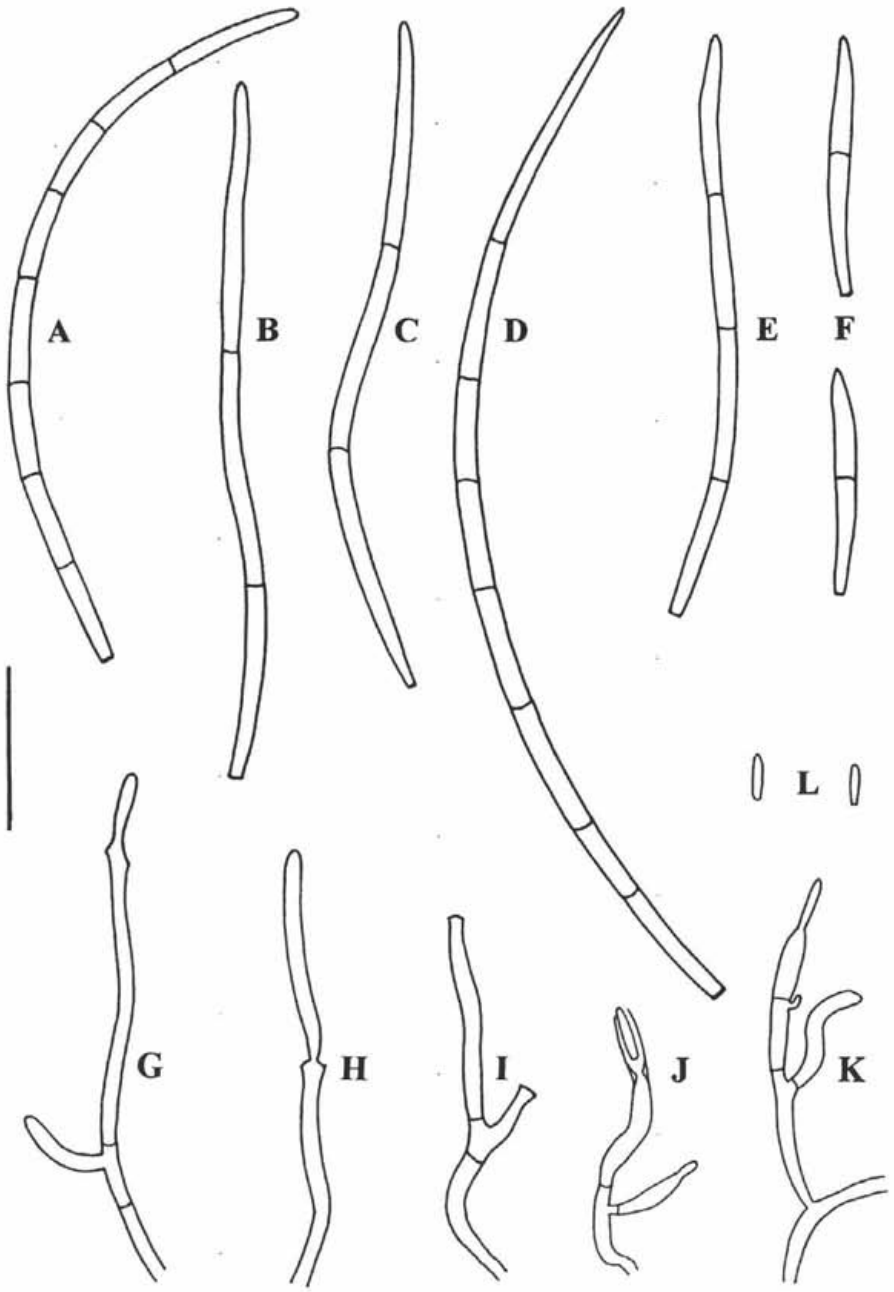

Fig. 3. *Pseudoanguillospora gracilis*, type. A-F. Conidia. G, H. Conidial development. I. Spent conidiophore. J, K. Microconidial (spermatial) synanamorph. L. Spermatia. Scale bar = 20 μm.

Pseudoanguillospora clearly differs from *Anguillospora* Ingold (1942) by the absence of percurrent conidiogenous cells, which are typical of the latter. *Sigmoidea* Crane (1968), a genus with sympodial conidiogenous cells, has typically pale colonies, and a denticulate, mostly distinct conidiiferous rachis on predominantly lateral conidiophores. Conidiogenous cells are not caducous, false branching has not been observed. *Mirandina* Arnaud ex Matsushima (classified as a section of *Dactylaria* Sacc. by de Hoog 1985) is a terrestrial genus similar to *Sigmoidea*, but has rhexolytic conidial secession in some species and macronematous, dark conidiophores with sympodial conidiogenous cells. *Mycocentrospora* also has sympodial conidiogenous cells, but these are neither concurrent with the conidia nor caducous and usually have a number of distinct, rigid scars.

MYCOCENTROSPORA

Braun (1993, 1995) reassessed the genus *Mycocentrospora* (type species *Mycocentrospora acerina*) so, that he suggested to exclude all the "aquatic" (isolated from water) species. He considers all of them improperly classified in *Mycocentrospora*, because "The structure of the conidiophores and conidial scars does not coincide with *M. acerina*. The conidiophores in most of these species are very long, filiform, sometimes branched, without typical zig-zag configuration, and the conidial scars are not thickened and less conspicuous" (Braun 1995). A similar concept of *Mycocentrospora* appeared in the article by Srivastava et al. (1995). In both papers the authors seem to have come to their conclusions without seeing the types of these aquatic *Mycocentrospora* spp. (they are not included in the studied material) and without always being aware of their nomenclatural status (invalid names in several instances).

Braun's redescription of *M. acerina* ignores the fact, that this fungus, known mainly as a biotrophic parasite on *Acer pseudoplatanus* seedlings and many other plants (Braun 1995) and causing rot of parsnip and carrot roots, has saprotrophic populations widespread in lotic waters especially in the temperate climate zone. The capability of water-borne isolates to infect *Acer* seedlings has not been studied, but Iqbal et Webster (1969) proved pathogenicity when inoculating parsnip and carrot roots with a strain isolated from water. The aquatic isolates sporulate freely in standing distilled water and some of them may then form long filamentous conidiophores with remote and unthickened scars usually retaining some rigidity.

Nearly all of the "aquatic" species, i.e. *Mycocentrospora angulata, M. aquatica, M. clavata, M. filiformis* and *M. varians*, are poorly described and illustrated and type material is often lacking or unavailable. Authentic living cultures mostly do not exist. Conidia of some of them have been reported from water or from foam, which confirms the existence of such forms, but critical studies of conidiogenesis which would ensure their proper accommodation have not been carried out.

In order to facilitate further studies possibly leading to nomenclatural changes, I present here information on these taxa gained during the type studies of aquatic hyphomycetes.

Mycocentrospora angulata (R.H. Petersen) Iqbal 1974, Biologia (Lahore) 20:3.

= *Centrospora angulata* R.H. Petersen 1962, Mycologia 54:129

= *Anguillospora angulata* (R.H. Petersen) Wolfe (1977) in Parker et Roane: Distributional History of Biota of the Southern Appalachians. IV. Algae and Fungi: 245, nom inval. (Art. 32.2)

= *Mycocentrospora angulata* (R.H. Petersen) Dudka (1983, *ungulata*), Ukr. Bot. Zhur. 40(5):58, nom inval. (Art. 32.2)

= *Anguillospora angulata* (R.H. Petersen) Readhead et White 1985, Can. J. Bot. 63: 1434.

Type: not deposited in NY (fide K.P. Dumont in litt.)

Colony morphology: not described

This is a badly known species. There is a discrepancy in the protologue, namely between the conidial dimensions as presented in the diagnosis *vs.* those in fig. 4. In the text the conidial width is given as 7.5–11 μm, but according to the scale in fig. 4 it equals c. 2.5–5 μm. Type or authentic material, which could help to solve this problem, does probably not exist.

Mycocentrospora aquatica (Iqbal) Iqbal (1974), Biologia (Lahore) 20:3

= *Centrospora aquatica* Iqbal (1971) Trans. Br. Mycol. Soc. 56: 351

Type: not preserved in HME (J. Webster, pers. communication).

Cultures claimed to have been sent to the Centraalbureau voor Schimmelcultures (Baarn, The Netherlands) and to the Commonwealth Mycological Institute (Egham, U.K.) are not cited in the last catalogues of these culture collections (1994 and 1992, respectively).

Iqbal pointed out the similarity of this species to *Centrospora (= Anguillospora) filiformis*. However, according to the protologue *M. aquatica* is probably a member of the genus *Filosporella* Nawawi. Marvanová et al. (1992) drew attention to its similarity to *Filosporella versimorpha* Marvanová et al. (l.c.), but owing to the lack of any type or authentic material of *Mycocentrospora aquatica*, they preferred not to recombine it in *Filosporella*.

Mycocentrospora clavata Iqbal (1974), Biologia (Lahore) 20: 2 (fig. 4)

Type: IMI 160108

The type material sent to me contained two pieces of dried culture and three slides. The culture was dark brown, with abundant aerial mycelium, in one case

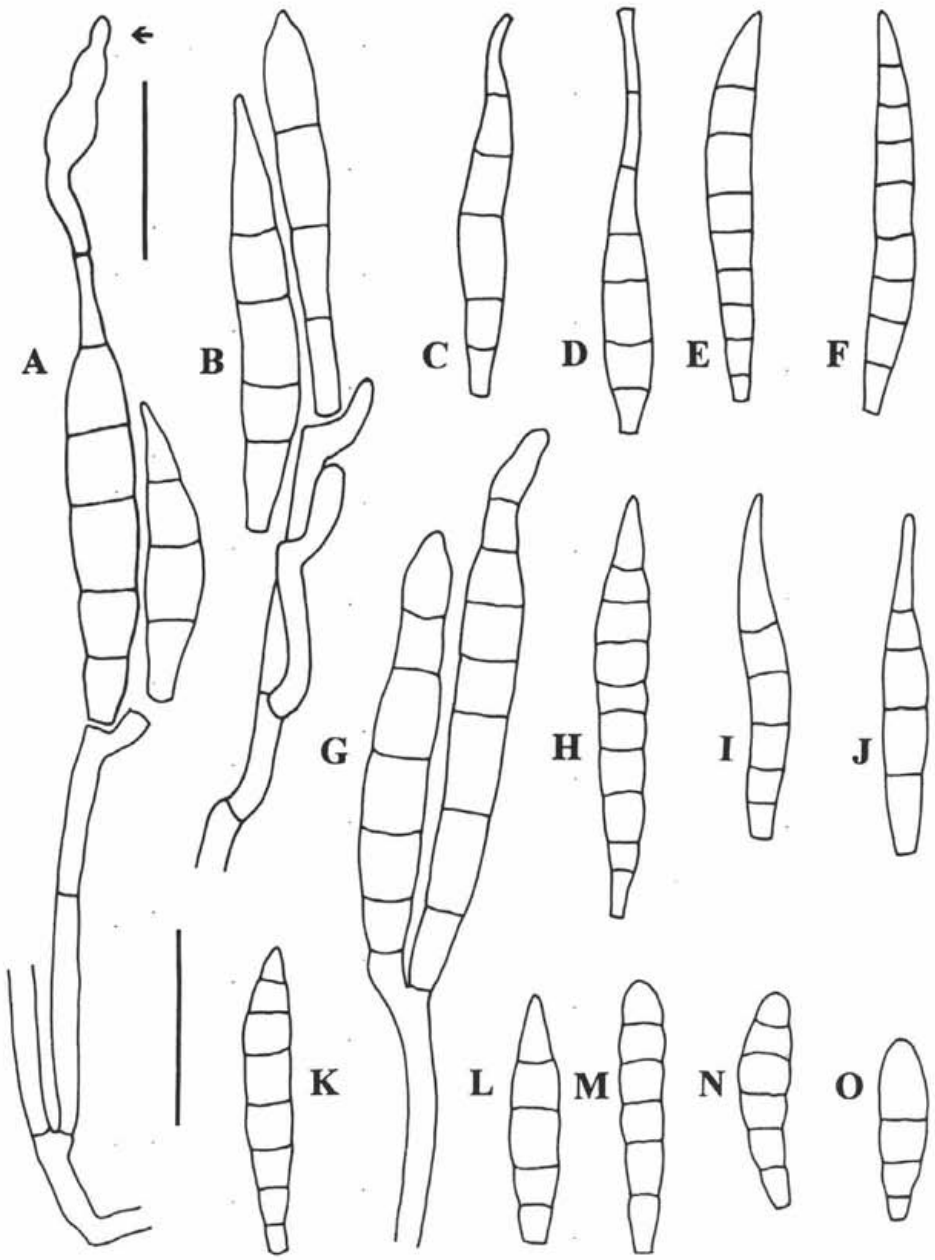

Fig. 4. *Mycocentrospora clavata*, type. A,B. Conidiophores with detached conidia. Note the secondary conidium (?) in A (arrow). G. Developing conidia. C-F, H-J,K,L-0. Conidia. (C,D: conidia with apical scar). Scale bar a = 20 μm (for A,B,G). Scale bar b = 40 μm (for C-F,K,L-O).

with minute blackish sclerotia at the colony margin. The slides contained free conidia and a few conidiophores with developing or just detached conidia. Even though the conidia are similar to those of other species of *Mycocentrospora* and the conidiophores are capable of sympodial elongation, they differ from other members of this genus by bearing closely adpressed branches and conidia occasionally producing a secondary conidium (?) at the apex (fig. 4 A). The detachment scars are few, unthickened, not rigid. The conidia are also similar to *Colispora* Marvanová (1988), but the conidiogenesis there is typically repeatedly percurrent, even though sometimes the newly grown apex is moved to one side of the scar.

Mycocentrospora filiformis (Greathead) Iqbal (1974), Biologia (Lahore) 20: 3 nom. inval. (Art. 37.1)

= *Anguillospora filiformis* Greathead (1961) J. South Afr. Bot. 27: 202 nom. inval. (Art. 37.1)

= *Centrospora filiformis* (Greathead) R.H. Petersen (1962) Mycologia 54: 584 nom. inval. (Art. 37.1)

= *Mycocentrospora filiformis* (Greathead) Dudka (1984) Mikologiya i Fitopatologiya 18: 373 nom. inval. (Art. 37.1, Art. 32.2)

Type: not designated

This species has whitish colonies and percurrently proliferating conidiogenous cells. The excentric basal extension appears typically before secession. Both characters clearly exclude this species from *Mycocentrospora* or *Anguillospora*. A new genus will therefore be established for it in a separate publication.

Mycocentrospora varians Sinclair et Morgan-Jones (1979), Mycotaxon 9: 472 (fig. 5)

Type: AUAM 2284

According to Braun (1995) this species should be the nearest to his concept of *Mycocentrospora* among the aquatic species. Contrary to this, Srivastava *et al.* (1995) point out the absence of multiple sympodial elongations of conidiogenous cells in this species, and are prone to consider *Anguillospora* a better accommodation. However, *Anguillospora* has percurrent conidiogenous cells.

The type material sent to me contained two slides and a piece of dried culture. The culture was brown greyish, hairy, blackish at the margin.

The slide labelled "New plate, aerated culture" contained a mycelial mat without fertile structures. The slide "Old plate spores" showed a few conidiogenous structures and detached conidia. The conidiophores in the type material were discrete, apical, often curved, with relatively long sympodial elongations, rarely branched, or lateral, simple. The conidia were mostly broken or germinating.

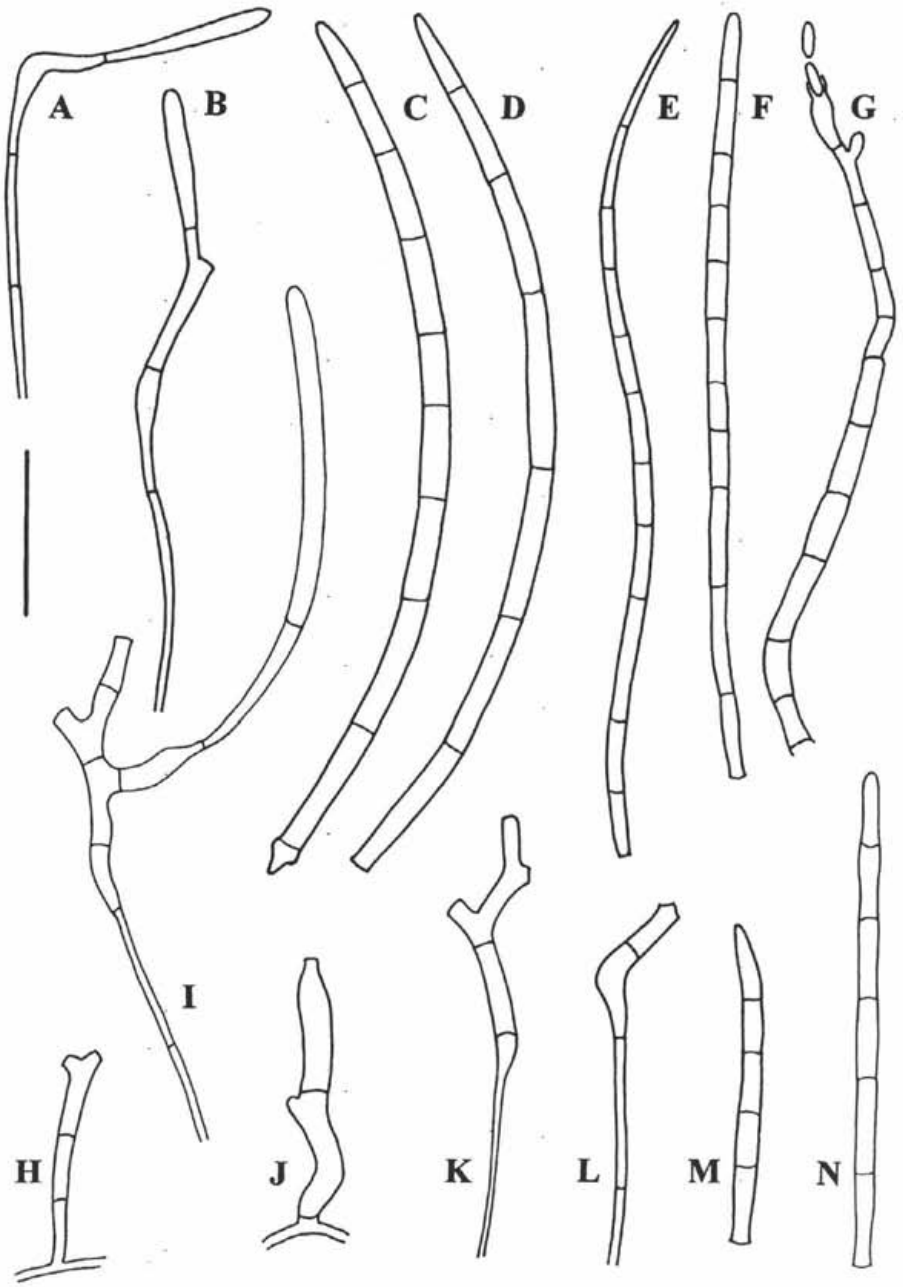

Fig. 5. *Mycocentrospora varians*, type. A,B,I. Conidial development. C-F,M,N. Conidia. G. Microconidial (spermatial) synanamorph on one conidial end. H,J-L. Spent conidiophores. Scale bar = 20 μm.

Some conidia bore a phialidic microconidial state either on the basal extension or at the apex (fig. 5 G). In my opinion this fungus possesses some similarity to *Pseudoanguillospora gracilis,* and its accommodation in this genus may be more approppriate. Nevertheless, without more material, preferably living cultures, any redisposition is precarious.

SURVEY OF GENERIC CHARACTERS OF THE RELEVANT TAXA

Pseudoanguillospora: aquatic, saprotrophic, caducous conidiogenous cells, few, often indistinct sympodial elongations of conidiogenous cells, false branching of conidia, basal extension exceptional, excentric.

Mycocentrospora: terrestrial and aquatic, bio- or saprotrophic, distinct, multiple sympodial elongations of the conidiogenous cells, no false branching of conidia, basal extension in some species well developed, appearing before secession.

Anguillospora: aquatic, saprotrophic, percurrent elongations of conidiogenous cells, no false branching of conidia, basal extension typically after secession, percurrent.

Sigmoidea: aquatic, saprotrophic, multiple sympodial elongation of the conidiogenous cells, no false branching of conidia, basal extension exceptional, excentric.

Dactylaria: terrestrial, saprotrophic, distinct, multiple sympodial elongations of the conidiogenous cells, no false branching of conidia, basal extension lacking.

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Sincere thanks are expressed to the IMI Herbarium for providing the type material of *Pseudoanguillospora stricta* and *Mycocentrospora clavata*, to Prof. S.H. Iqbal for sending the ex-type culture of *Pseudoanguillospora stricta* and to Prof. Morgan-Jones for poroviding the type material of *Pseudoanguillospora gracilis* and *Mycocentrospora varians.*

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