# AQUATIC HYPHOMYCETES OF THE DANUBE

(Danubialia Hungarica, XVIII.)

by

DR. J. BÁNHEGYI

Institute of Microbiology of the Eötvös Loránd University, Budapest

Received on December 20th, 1961

Aquatic *Hyphomycetes* are microscopic fungi in leaves decaying in the water. The characteristic spores, as a rule tetraradiate or filiform, are easy to recognize in the waters. They are living for the most part in the decaying leaves of deciduous trees (*Alnus*, *Salix*, *Populus*, *Quercus* etc.), mainly in the vascular system, and have a marked preference for the leaves of alder at an advanced stage of decay when they consist merely of venation.

The aquatic habit of the fungi accounts for the fact that they were found and described for the first time by algologists. The first aquatic hyphomycete has been described by Reinsch (1888) as a variety (var. *inequale*) of *Cerasterias raphidioides* described by himself in 1867. Reinsch, however, did not recognize it as a fungus but took it for an alga. Subsequently the genus *Cerasterias* was united with the genus *Asterothrix* described by Kützing (1845) and the species were considered sometimes as algae sometimes as fungi. In the literature of algae the genus appears even in recent years under the designation *Asterothrix (Cerasterias) raphidioides* (Reinsch) Printz, relying on the evidence of the works of Printz (1914) and Huber–Pestalozzi (1925). The various contradictions were not thrown light upon until Karling (1935) had cleared them, but even this author did not distinguish *Tetracladium setigerum* from the closely related *Tetracladium marshalianum*.

De Wildeman (1893, 1894, 1895) described four further species: *Tetracladium marshalianum*, *Fusarium elongatum* (at present termed *Anguillospora longissima*), *Clavariopsis aquatica* and *Lemonniera aquatica* and definitely recognized these organisms to be fungi.

Kegel (1906) described *Varicosporium elodeae* from a decayed *Elodea* stem, while Grove (1912) *Tridentaria setigera* (=according to its present name *Tetracladium setigerum*).

In the 30 years that followed no substantial progress was made as to the better knowledge of aquatic *Hyphomycetes*. In 1942 appeared the first study of Ingold „Aquatic *Hyphomycetes* of decaying alder leaves" demonstrating that the mycelium of aquatic *Hyphomycetes* lives in leaves decaying in the water and that the conidiophores are growing from there into the water. The spores develop under the water and when fully developed get into the water. He pointed out that the spores can be easily cultivated from leaves put into Petri dishes and covered with water and that they thrive well in simple media (e. g. 2 per cent. malt agar). Most species develop spores only under a water layer. In the study referred to Ingold described 10 new species and reported again the 6 species described by others, from England. He also proved that

*Titaea maxilliformis* described by Rostrup (1894) belongs to the aquatic *Hyphomycetes* and assigned this species into the genus *Tetracladium* under the name *T. maxilliformis*. In subsequent years Ingold (1943a , 1943b, 1943c, 1944, 1945, 1946, 1949, 1952, 1954a, 1954b, 1956, 1958a, 1958b, 1959a, 1959b) discussed the result of his further investigations in several papers. This author alone described 24 new species, more than half of the 40 species known so far. His pioneer work is continued by his co-workers (Ingold–Cox 1957a, 1957b; Ingold–Ellis 1952; Webster 1959a, 1959b, 1959c, 1961; Dixon 1959).

Ranzoni (1953) reported 22 species from California, including 5 new species. Nilsson (1958) described 21 species from Sweden. The aquatic *Hyphomycetes* of Japan were investigated by Tubaki (1957, 1960), Nimura (1960) and Suzaki–Nimura (1960), tracing 19 species including 3 new ones.

Very few data are available on the aquatic *Hyphomycetes* of Central-European countries. One species is known from Hungary. Szemes (1960) reported *Asterothrix raphidioides* (Reinsch) Printz, one of the *Tetracladium* species.

Several species were found in soil. Bessey (1939) isolated *Varicosporium elodeae* from soil, Waid (1954) subsequently from the roots of a beech sapling. Scourfield (1940) found the spores of *Tetracladium setigerum* in broken fragments of forest leaves.

Recently research workers suceeded in breeding the perfect state of 3 aquatic hyphomycete species. Ranzoni (1953) successfully cultivated the perfect state of *Flagellospora penicillioides*, whereas Webster (1959a) that of *Heliscus lugdunensis*. Both proved to be *Nectria* species. Webster (1961) bred the perfect state of *Anguillospora crassa* belonging to *Mollisia*.

## Material and method

Samples were taken for the examinations in 500 and 1000 ml bottles from the Danube at Budapest and farther to the north at Alsógöd, Nógrádverőce, Nagymaros and Zebegény. For the most part foam-scum of the Danube riverside was examined because there the spores used to accumulate. Also leaves

Fig. 1. Foam on decaying leaves, on the pebbly bank of the Danube. Nagymaros, Nov. 13. 1961

decaying in water were examined by placing them in Petri dishes and spilling over a thin sterile water-layer. Within 1 or 2 days the fungi developed from the leaves, mainly from petioles and veins. These two methods proved to be most suitable. Membrane-filters were also made a trial with, this method, however, did not supply good results, since in the huge water-mass of the Danube there are comparatively few spores and a high amount of organic debris.

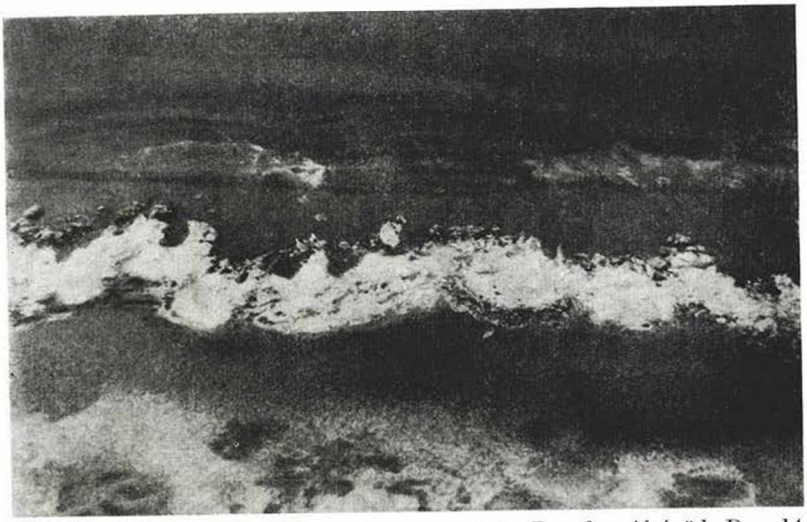

Fig. 2. Slightly frozen foam on the sandy bank of the Danube. Alsógöd, Dec. 14. 1961

Fig. 3. Scum on the bank of the Malompatak-brook. Zebegény, Oct. 8. 1961

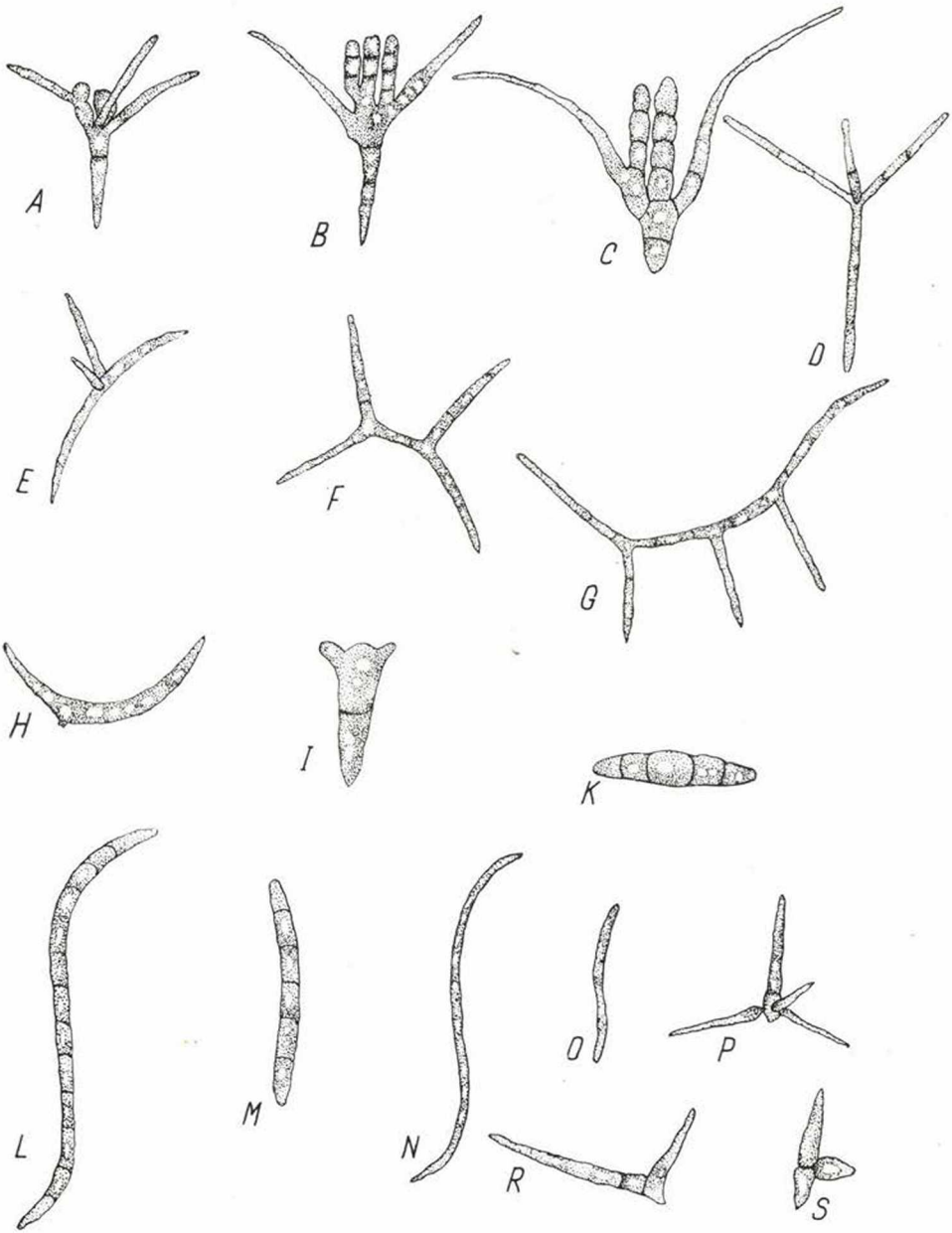


Fig. 4. Conidia of the aquatic Hyphomycetes of the Danube
A: *Tetracladium marshalianum* (430×), – B: *Tetracladium setigerum* (650×), – C: *Tetracladium maxilliformis* (850×), – D: *Lemonniera aquatica* (300×), – E: *Alatospora acuminata* (700×), – F: *Tricladium angulatum* (400×), – G: *Tricladium anomalum* (300×), – H: *Lunulospora curvula* (400×), – I: *Heliscus aquaticus* (600×), – K: *Piricularia submersa* (400×), – L: *Anguillospora longissima* (430×), – M: *Anguillospora pseudolongissima* (400×), – N: *Flagellospora curvula* (200×), – O: *Flagellospora penicillioides* (450×), – P: *Triscelophorus monosporus* (500×), – R and S: unknown species (500× – 600×)

Also the aquatic *Hyphomycetes* of two brooks running into the Danube were examined because on account of the rapid course their water is rich in oxygen and the riverside reach where in the decaying leaves the aquatic *Hyphomycetes* are found is rather extensive as related to the insignificant mass of water. The rapid course and the many branches fallen in the water promote the formation of foam and scum where always many aquatic hyphomycete spores are found.

One of the brooks is a tiny spring-streamlet in the park of the Biological Station of the University in Alsógöd rising from a distance of about 70 m from the Danube and having a total length of about 150 m. Its course leads right through among trees; on its banks alders, maples, poplars and willow-trees are growing. The other brook examined is the Malompatak running into the Danube at Zebegény. This is considerably larger, with a length of about 15 km, of a rapid course, with trees, mainly willow-trees along the banks.

**Enumeration of the species collected**

1. *Tetracladium marshalianum* De Wild.

(Fig. 4. A; fig. 5.)

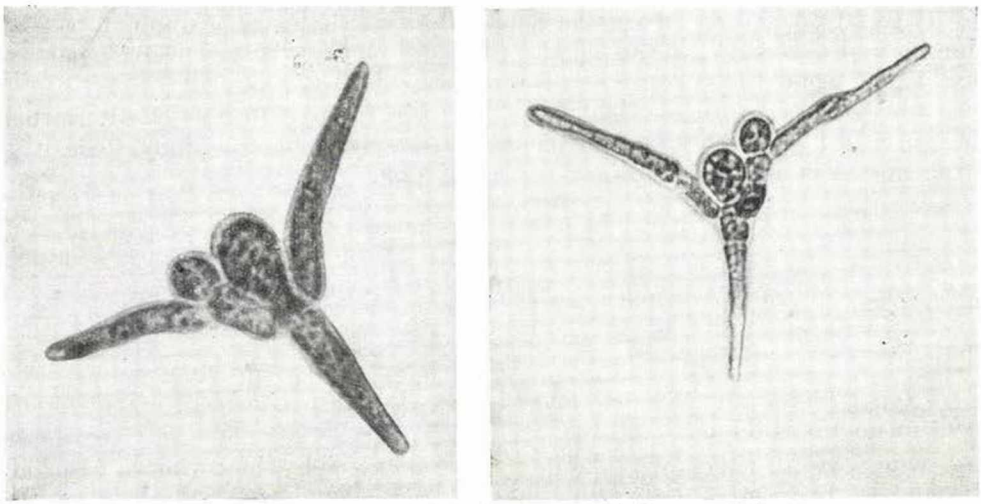

Fig. 5. Aleuriospores of *Tetracladium marshalianum* (750×)

Aleuriophore branched, more rarely simple. The aleuriospore consists of a main axis of 25 to 35 $\mu$ length, tapering, pointed at the base, of 1 to 2 $\mu$ width. Upwards gradually broadening, above with a width of 3 to 6 $\mu$. At the apex a spherical or oval knob is found below which 3 arms depart in different directions. These have a length of 30 to 50 $\mu$, a width of 2 to 4 $\mu$ at the base and are gradually tapering towards the apex. Two arms are uniform, while the third has on its lower part a knob directed upwards, smaller than that on the apex of the main axis.

Nagymaros, in the riverside foam-scum of the Danube, September 10; November 13. 1961. Alsógöd, in the riverside foam-scum of the Danube, December 14. 1961.

The most frequent aquatic hyphomycete of the Danube. A species spread all over the world, that according to data available is the most frequent also in other regions.

### 2. *Tetracladium setigerum* (Grove) Ing.

(Fig. 4. B)

(Syn.: *Cerasterias raphidioides* var. *incrassata* Reinsch 1888. *Tridentaria setigera* Grove 1912. *Asterothrix (Cerasterias) raphidioides* (Reinsch) Printz apud Huber–Pestalozzi 1925).

Aleuriophore simple or branching, length 30 to 100 $\mu$. The aleuriospore consists of a 20 to 26 $\mu$ main axis pointed at its base (width 1 to 2 $\mu$). Upwards gradually widening (4–5 $\mu$) and divided by one or two septa. On its upper part 3 arms originate. These have a length of 35 to 48 $\mu$, a width of 3 to 5 $\mu$ at the base and are gradually tapering towards the apex to reach a width of merely 1 $\mu$. At the apex of the main axis 3 oblong finger-like processes arranged parallel to each other, divided to cells by 2 or 3 septa; their dimensions are 12 to 20×3 to 6 $\mu$. Two of these processes are sitting on a common base at the apex of the main axis while the third originating from the lower part of one of the arms.

Alsógöd, in the scum-foam of the tiny brook, November 28. 1961. Rather rare, occurred with a few specimens only. This species has been, until recently, often mistaken for *Tetracladium marshalianum*.

### 3. *Tetracladium maxilliformis* (Rostr.) Ing.

(Fig. 4. C)

(Syn.: *Titaea maxilliformis* Rostrup 1894. *Maxillospora maxilliformis* (Rostr.) v. Höhnel 1914).

One spore of this rare hyphomycete was detected by the author in Alsógöd, December 14. 1961 in already slightly frozen foam-scum of the Danube riverside. The spore exactly corresponds to the first description of Rostrup (1894) who reported it from a *Trifolium pratense* stem under the name *Titaea maxilliformis*. The genus *Titaea* includes dubious and insufficiently known species. V. Höhnel (1914) placed it into a separate genus under the name *Maxillospora maxilliformis*. Ingold (1942) relying upon literature grouped it into the genus *Tetracladium* at a time when he has not collected it yet. He found it, however, in 1950 in England, in the surface foam-scum of a small ditchwater. In 1952 he gave a detailed description of the species, though he did not succeed to cultivate it and ignored the host.

The spore collected by the present author fully agrees with the detailed description of Ingold (1952). Though it is close to *Tetracladium setigerum* it can be easily separated from the latter on the strength of the following cha-

racters. The lower part of the main axis in *Tetracladium maxilliformis* is short (7 to 10 $\mu$) with an obtuse apex. It has only two arms, which are bent in the form of arches. At the top of the main axis there is an oblong finger-like process consisting of 2 to 4 cells. Another process consisting of 2 to 3 cells originates from the lower part of one of the arms.

### 4. *Triscelophorus monosporus* Ing.

(Fig. 4. P)

The aleuriophore is simple, non-branching, normally short, dimensions: 20 to 100 × 1 to 2 $\mu$. The aleuriospore is apical. It consists of a main axis forming the continuation of the aleuriophore. The lower end of the main axis is somewhat broadening, giving rise at about 4 to 5 $\mu$ from the inferior apex to three uniform, gradually tapering arms of 25 to 30 $\mu$ length. The arms form an angle of 120° with each other and have a diameter of 2,5 to 3 $\mu$ at the base where they are broadest. They originate from the main axis with a very thin (about 1 $\mu$ wide) isthmus. The upper part of the main axis is gradually tapering; its width is under the club-shaped lower end about 3 to 4 $\mu$, its length 30 to 40 $\mu$. At the club-shaped broadening there is a septum, which, however, is sometimes not discernible.

Zebegény, October 8. 1961. Developed in the laboratory from *Alnus* leaves decaying in the Malompatak.

A rather rare species, described by Ingold (1943) from England. Ranzoni (1953) found it rarely in California; more frequent at some places only. Nilson (1958) found it in Sweden once only on *Alnus* leaves. Reported by Tubaki (1957) from Japan. Known from several African countries (Ingold 1956, 1958a; Dixon 1959).

### 5. *Alatospora acuminata* Ing.

(Fig. 4. E; fig. 6.)

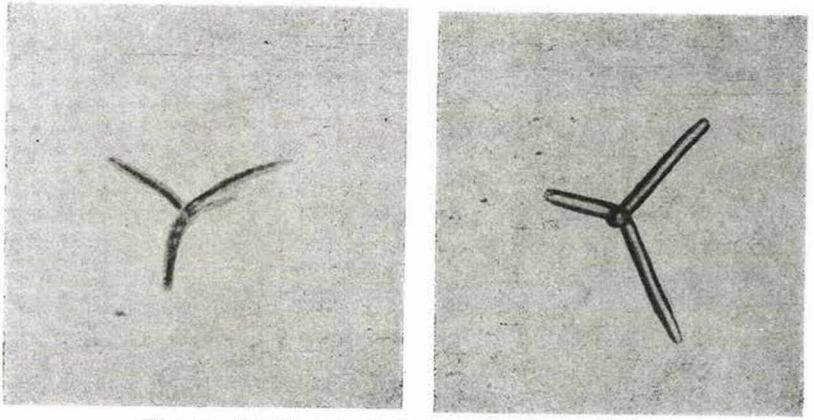

Fig. 6. Conidia of *Alatospora acuminata* (600 ×)

Conidiophore simple or branching, with one or more phialides. Conidia (phialospores) unicellular, consisting of one main axis bent in the form of an arch, which near the middle or somewhat towards the apex gives rise to 2 arms. The main axis has a length of 35 to 60 $\mu$ and a width of 2,8 to 3 $\mu$ in the middle, where it is broadest. The arms have a length of 15 to 30 $\mu$. All four arms are gradually tapering toward the apex.

Nógrádverőce, in the riverside foam-scum of the Danube, November 7. 1961. Nagymaros, in the riverside foam-scum of the Danube, November 13. 1961. Zebegény, in the foam-scum of the Malompatak, October 8. 1961. Alsógöd, in the foam-scum of the tiny streamlet, November 28. 1961.

The form of the spores is suggestive of a flying bird. Widespread in waters, particularly in the foam-scum, but as a rule not en masse. Can be collected mainly in autumn and winter. Described by Ingold (1942) from *Alnus* and *Salix* leaves. Found by Tubaki (1960) in Japan frequently in foam-scum and also in melting snow. Occurs also in Sweden, in foam-scum, in autumn and winter (Nilsson 1958). Collected in California in spring and summer by Ranzoni (1953).

### 6. *Piricularia submersa* Ing.

(Fig. 4. K)

Aleuriophore simple, 30 to 70 $\mu$ long, 2 to 3 $\mu$ wide, producing one aleuriospore on the apex. The aleuriospore is oblong, with the greatest width in the middle, gradually tapering toward the ends. Dimensions 35 to 65 $\times$ 6 to 9 $\mu$. At first unicellular, later on divided into cells by 1 to 3 to 4 (seldom 6) septa.

Nagymaros, in the foam-scum of the Danube riverside, November 13. 1961.

A rare species, easy to recognize, however, by its characteristic spores. Described by Ingold (1944) from decaying *Quercus* leaves from England and North-Ireland. Not known from other countries so far.

### 7. *Lunulospora curvula* Ing.

(Fig. 4. H)

Aleuriophore simple or branching, 70 to 250 $\mu$ long and 2 to 2,5 $\mu$ wide. Aleuriospores develop on a short, thin stalk cell of 3 to 5 $\times$ 1,5 $\mu$. The aleuriospores are crescent-shaped, more rarely sigmoid, 70 to 90 $\mu$ long, unicellular, in the middle 5 to 6 $\mu$ wide, gradually tapering toward the apices, characteristically vacuolated. On the aleuriospore a small hilum at the point of attachment of the stalk cell.

Nagymaros, in the foam-scum of the Danube riverside, September 10. 1961. Zebegény, in the surface foam-scum of the Malompatak streamlet, October 8. 1961.

Rather frequent in the foams and scums during the early autumn, later not found any more by the author.

### 8. *Heliscus aquaticus* Ing.

(Fig. 4. I)

Conidiophore simple or branching, short (30 to 60 $\mu$), with 1 to 4 phialides on the apex. These have a length of 20 to 40 $\mu$. Conidiums developing under the water, with 2 (seldom 3 to 4) cells, 25 to 35×4 to 5 $\mu$, longitudinal, the distal apex broadening, with 3 short, pointed processes. The latter are 3 to 8 $\mu$ long and 3 to 4 $\mu$ wide at the base. The conidia developing above the water are cylindrical to rod shaped, consist of 2 or 3 cells and have no processes. Their dimensions are 25 to 35×4 to 5 $\mu$.

Nagymaros, in te foam-scum of the Danube riverside, September 10. 1961. Zebegény, in the foam-scum of the Malompatak streamlet, October 8. 1961.

A rather rare species. Described from England by Ingold (1942). Collected by Nilsson (1958) in Sweden from several waters. Not frequent in California either, collected by Ranzoni (1953) only once from decaying *Cornus* leaves. In Japan not infrequent in foams and scums (Tubaki 1960).

Very close to *Heliscus lugdunensis* (Sacc. et Therry) isolated by Moreau and Moreau (1949) from water-covered leaves. Webster (1959a) cultivated its perfect state *(Nectria lugdunensis)*. In his opinion *Heliscus aquaticus* and *H. lugdunensis* represent the same species.

### 9. *Tricladium angulatum* Ing.

(Fig. 4. F; fig. 7.)

Aleuriophore simple or sparingly branching. The aleuriospore is hyaline, septate, tetraradiate. It consists of a main axis, which is 60 to 120 $\mu$ long and 4 to 4,5 $\mu$ wide at its broadest part. Gradually tapering towards both apices, divided by 1 to 2 (seldom 3) septa. Two arms take their origin from the main axis, these are 25 to 50 $\mu$ long, below 3 to 4 $\mu$ wide and gradually tapering toward the apex. The distance between the points of origin of the two arms is 10 to 15 $\mu$.

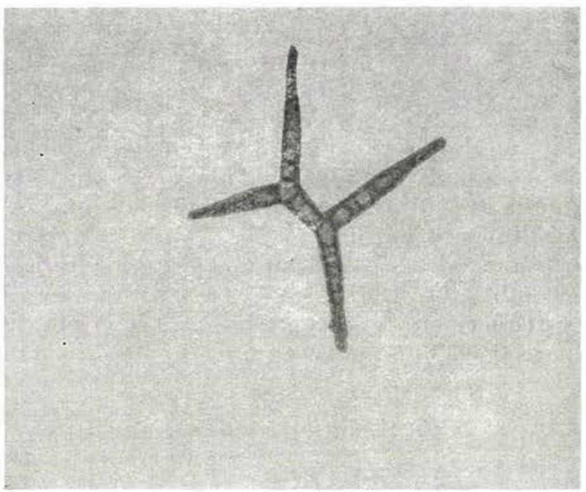

Fig. 7. Aleuriospore of *Tricladium angulatum* (450×)

Nógrádverőce, in the foam-scum of the Danube riverside, November 7. 1961. Nagymaros, in the foam-scum of the Danube riverside, November 13. 1961. Alsógöd, in the foam-scum of the Danube riverside, December 14. 1961.

Zebegény, in the foam-scum of the streamlet Malompatak, October 8. 1961. Alsógöd, in the foam-scum of the tiny brook, November 28. 1961.

One of the most frequent species in the Danube.

### 10. *Tricladium anomalum* Ing.

(Fig. 4. G)

Aleuriophore simple, non-branching, 50—100 $\mu$ long. The aleuriospore consists of a 150 to 220 $\mu$ long and 3 to 5 $\mu$ wide multicellular main axis whose both apices are pointed. From the central part 3 (seldom 2) pointed arms originate. These are 70 to 100 $\mu$ long and below 3 to 5 $\mu$ wide. The points of origin of the arm at the main axis are at a distance of 20 to 30 $\mu$ from each other.

Zebegény, in the foam-scum of the Malompatak, October 8. 1961.

Described by Ingold (1943) from England, from the decaying leaves of *Typha latifolia*. Apart from him only Nilsson (1958) collected spores in Sweden in lake-water.

A rare species, easy to distinguish from *Tricladium angulatum* and *Tricladium gracile* for its great spores.

### 11. *Flagellospora curvula* Ing.

(Fig. 4. N)

Conidiophore short, branching, with a great number of phialides. Conidia long, filiform, curved, unicellular, 100 to 150 $\mu$ long, 2 to 2,5 $\mu$ wide in the middle, pointed at the apices.

Nagymaros, in the foam-scum of the Danube riverside, November 13. 1961.

Occurs frequently, often en masse, in well aerated running waters in October-November.

### 12. *Flagellospora penicillioides* Ing.

(Fig. 4. O)

Conidiophore 150 to 300 $\mu$ long and 3 to 4 $\mu$ wide, *Penicillium*-like branched, with many phialides. The latter are 15 to 20 $\mu$ long and 2,5 to 3 $\mu$ wide. Conidia are filiform, curved, 40 to 55 $\mu$ long, 2,5 $\mu$ wide in the middle, pointed, unicellular or divided in the middle into two cells by a septum.

Alsógöd, in the Danube water, filtered through a membrane filter, December 14. 1961.

Described by Ingold (1944) from decaying leaves, from England. Apart from him collected only by Ranzoni (1953) in California.

### 13. *Anguillospora longissima* (Sacc. et Syd.) Ing.

(Fig. 4. L; fig. 8.)

(Syn.: *Fusarium elongatum* De Wildeman 1893; *Fusarium longissimum* Saccardo et Sydow 1899).

Aleuriophore as a rule simple, seldom branching, 50 to 150 $\mu$ long and 2 to 4 $\mu$ wide. Aleuriospore filiform, with serpentine curving, consisting of 8 to 10 cells, 170 to 300 $\mu$ long, 4 to 5 (6) $\mu$ thick in the middle, tapering towards

the apices. Apices 2,5 to 3 $\mu$ thick. The lower apex somewhat more pointed than the upper one.

Nógrádverőce, in the foam-scum of the Danube riverside, November 7. 1961. Zebegény, in the water of the Malompatak streamlet, on decaying *Alnus* leaf, October 8. 1961. Alsógöd, in the foam-scum of the tiny streamlet, November 28. 1961.

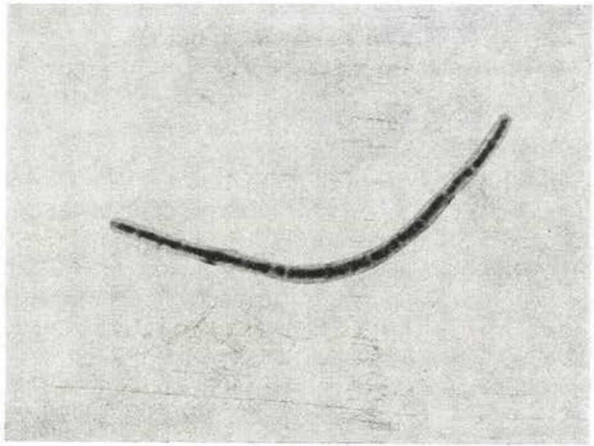

Fig. 8. Aleuriospore of *Anguillospora longissima* (500 ×)

14. *Anguillospora pseudolongissima* Ranzoni

(Fig. 4. M; fig. 9.)

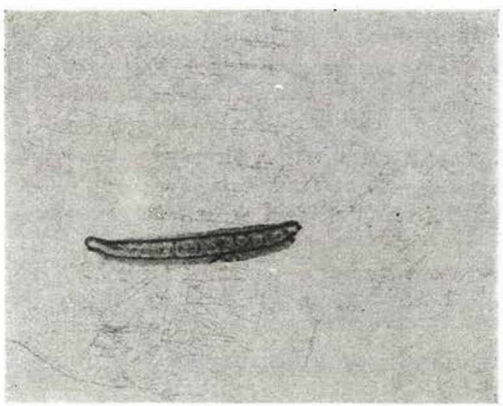

Fig. 9. Aleuriospore of *Anguillospora pseudolongissima* (350 ×)

Conformable with the former species, the aleuriospores, however, are 50 to 100 $\mu$ long only and 4,5 to 6 $\mu$ wide in the middle. Tapering towards the apices; consisting of 5 to 6, seldom 8 cells.

Nagymaros, in the foam-scum of the Danube riverside, November 13. 1961. Alsógöd, in the foam-scum of the tiny brook, November 28. 1961.

Described by Ranzoni (1953) from *Salix* leaves decaying in a streamlet, from California. Has not been found anywhere else.

15. *Lemonniera aquatica* De Wild.

(Fig. 4. D)

Conidiophore penicilloid, branching, 100 to 400 $\mu$ long and 4 to 6 $\mu$ wide, with many ampulliform phialides on the apex. The latter are 20 to 30 $\mu$ long and below at the broadest part 4 to 7 $\mu$ wide. The conidia consist of 4 arms departing from one point. The length of the arms is 50 to 120 $\mu$. One of the arms develops as the continuation of the phialide.

Nógrádverőce, in the foam-scum of the Danube riverside, November 7. 1961.

*Aquatic Hyphomycetes not described as yet.*

Fungus spores are often found in waters, in foam-scum. Part of these originate from land-fungi and only accidentally occur in waters. There are, however, spores in the water, whose structure agree with the spores of aquatic *Hyphomycetes* and which are not known from continental habitats. These are spores of aquatic *Hyphomycetes* not described as yet. A great number of such aquatic spores were reported up to now (Ingold 1942, 1956, 1958a, 1959b; Ingold–Ellis 1952; Nilsson 1958; Tubaki 1960). These can be only referred to aquatic *Hyphomycetes* and described as such when they are found on plant parts or cultivated from these in the laboratory. Such spores belonging to unknown species were also collected from the water and foam-scum of the Danube. In the foam-scum of the tiny brook in Alsógöd (November 28. 1961) biradiate asymmetrical spores with pointed apex were found (Fig. 4. R). Their length was 60 to 75 $\mu$, their width at the broadest part 3 to 3,5 $\mu$. Below, where the two arms meet, there is a small pointed process. On the lower part of the longer arm two septa are conspicuous. This spore is somewhat similar to a spore collected by Tubaki (1960) in Japan (Fig. 3. N) on melting snow remnants and considered by this author to be *Ceratosporella* sp.

The other aquatic hyphomycete spore belonging to an unknown species (Fig. 4. S) was found in Alsógöd, in an already slightly frozen Danube riverside foam-scum December 14. 1961. This is a spore consisting of 3 cells, two of which are arranged above each other, the lower one being 8–9 $\mu$, while the upper one 17 to 18 $\mu$ long. The upper cell is tapering at some length, the lower one abruptly pointed. The third cell which is also pointed and has a length of 7 to 8 $\mu$, originates from the side of the lower cell, from its upper part. Very similar to *Tricellula aquatica* described by Webster (1959b) though the latter is considerably smaller.


## Summary

The author succeeded to trace 15 aquatic *Hyphomycetes* in the Danube and in two streamlets running into the river, but particularly in the riverside foam and scum. The most frequent species in the Danube are *Tetracladium marshalianum*, *Alatospora acuminata* and *Tricladium angulatum*.

From the species collected the rarest are *Piricularia submersa* known up to now only from Great Britain and *Anguillospora pseudolongissima*, collected only by Ranzoni in California.

Also two spores belonging to aquatic hyphomycete species not described as yet were found. One of these is very similar to *Tricellula* while the other is a biradiate asymmetrical spore.

## РЕЗЮМЕ

Из воды реки Дуная и прежде всего из побережных пен автором было выделено 15 видов водных Hyphomycetes. Наиболее распространенными в Дунае видами оказались Tetracladium marshalianum, Alatospora acuminata и Tricladium angulatum. Реже всего встречаются виды Piricularia submersa и Anguillospora pseudolongissima. Первый из них известный только из Великобритании, последний же был обнаружен только в Калифорнии.


## REFERENCES


1. Bessey, E. A. 1939: Varicosporium elodeae Kegel, an uncommon soil fungus. Papers Michigan Acad. Sc. Arts & Lett. **35.** 15 – 17.
2. De Wildeman, E. 1893: Notes mycologiques IV. Ann. Soc. Belg. Microsc. **17.** 35 – 68.
3. De Wildeman, E. 1894: Notes mycologiques VIII. Ann. Soc. Belg. Microsc. **18.** 135 – 161.
4. De Wildeman, E. 1895: Notes mycologiques XVI. Ann. Soc. Belg. Microsc. **19.** 191 – 232.
5. De Wildeman, E. 1920: A propos du genre Tetracladium. Compt. Rend. Soc. Biol. Paris, **83.** 192 – 194.
6. Dixon, P. A. 1959: Stream spora in Ghana. Trans. Brit. Mycol. Soc. **42.** 174 – 176.
7. Grove, W. B. 1912: New or noteworthy fungi. J. Bot. London, **50.** 9 – 18.
8. Höhnel, F. von 1914: Fragmente zur Mykologie. XVI. Sitz. K. Akad. Wien. Naturw. **123.** 49 – 146.
9. Huber-Pestalozzi, G. 1925: Zur Morphologie und Entwickelungsgeschichte von Asterothrix (Cerasterias) raphidioides (Reinsch) Printz. Hedwigia **65.** 169 – 178.
10. Ingold, C. T. 1942: Aquatic Hyphomycetes of decaying alder leaves. Trans. Brit. Mycol. Soc. **25.** 339 – 417.
11. Ingold, C. T. 1943a: Further observation on aquatic Hyphomycetes of decaying leaves. Trans. Brit. Mycol. Soc. **26.** 104 – 115.
12. Ingold, C. T. 1943b: Triscelophorus monosporus n. gen., n. sp., an aquatic hyphomycete. Trans. Brit. Mycol. Soc. **26.** 148 – 152.
13. Ingold, C. T. 1943c: On the distribution of aquatic Hyphomycetes saprophytic on submerged decaying leaves. New Phyt. **40.** 139 – 143.
14. Ingold, C. T. 1944: Some new aquatic Hyphomycetes. Trans. Brit. Mycol. Soc. **27.** 35 – 47.
15. Ingold, C. T. 1945: The tetraradiate spores of certain aquatic Hyphomycetes and the propagules in some species Sphacelaria. Proc. Linn. Soc. **157.** 43 – 45.
16. Ingold, C. T. 1946: Dispersal in fungi. An inaugural lecture. London.
17. Ingold, C. T. 1949: Aquatic Hyphomycetes from Switzerland. Trans. Brit. Mycol. Soc. **32.** 341 – 345.
18. Ingold, C. T. 1952: Actinospora megalospora n. sp., an aquatic hyphomycete. Trans. Brit. Mycol. Soc. **35.** 66 – 70.
19. Ingold, C. T. 1954a: Aquatic Hyphomycetes. Rep. Internat. Bot. Congress. Sect. **19.** 62 – 66.
20. Ingold, C. T. 1954b: Fungi and water. Trans. Brit. Mycol. Soc. **37.** 97 – 107.
21. Ingold, C. T. 1956: Stream spora in Nigeria. Trans. Brit. Mycol. Soc. **39.** 108 – 110.
22. Ingold, C. T. 1958a: Aquatic Hyphomycetes from Uganda and Rhodesia. Trans. Brit. Mycol. Soc. **41.** 109 – 114.
23. Ingold, C. T. 1958b: New aquatic Hyphomycetes: Lemonniera brachycladia, Anguillospora crassa and Fluminospora ovalis. Trans. Brit. Mycol. Soc. **41.** 365 – 372.
24. Ingold, C. T. 1959a: Polycladium equiseti gen. nov., sp. nov.: an aquatic hyphomycete on Equisetum fluviatile. Trans. Brit. Mycol. Soc. **42.** 112 – 114.
25. Ingold, C. T. 1959b: Aquatic spora of Omo Forest, Nigeria. Trans. Brit. Mycol. Soc. **42.** 479 – 485.
26. Ingold, C. T. – Cox, V. J. 1957a: Heliscus stellatus sp. nov. an aquatic hyphomycete. Trans. Brit. Mycol. Soc. **40.** 155 – 158.
27. Ingold, C. T. – Cox, V. J. 1957b: On Trichospermum and Campylospora. Trans. Brit. Mycol. Soc. **40.** 317 – 321.
28. Ingold, C. T. – Ellis, E. A. 1952: On some hyphomycete spores, including those of Tetracladium maxilliformis, from Wheatfen. Trans. Brit. Mycol. Soc. **35.** 158 – 161.
29. Karling, J. S. 1935: Tetracladium marshalianum and its relation to Asterothrix, Phycastrum and Cerasterias. Mycologia **27.** 478 – 495.

30. Kegel, W. 1906: Varicosporium Elodeae, ein Wasserpilz mit auffallender Konidienbildung. Ber. Deutsch. Bot. Ges. **24.** 213 – 216.
31. Kützing, F. T. 1845: Tabulae Phycologicae oder Abbildungen der Tange. Nordhausen.
32. Nilsson, S. 1958: On some Swedish freshwater Hyphomycetes. Svensk Bot. Tidskr. **52.** 291 – 318.
33. Nimura, H. 1960: Some aquatic Hyphomycetes in the stream of Chichibu-Tama National Park. Bull. Chichibu Mus. Nat. Hist. **10.** 77 – 80.
34. Printz, H. 1914: Kristianialraktens Protococcoideen. Skr. Vidensk. Math.-Nat. **6.** 1 – 123.
35. Ranzoni, F. V. 1953: The aquatic Hyphomycetes of California. Farlowia **4.** 353 – 398.
36. Reinsch, P. F. 1888: Familiae Polyedriearum Monographia. Notarisia **3.** 493 – 516.
37. Rostrup, E. 1894: Mykologiske Meddelelser IV. Bot. Tidsskr. **19.** 36 – 47.
38. Scourfield, D. J. 1940: The microscopic life of the "leaf carpet" of woods and forests. Essex Nat. **26.** 231 – 246.
39. Suzuki, S. – Nimura, H. 1960: The microbiological studies of the lakes of Volcano Bandai. II. Ecological study on aquatic Hyphomycetes. Bot. Mag. Tokyo **73.** 360 – 364.
40. Szemes, G. 1960: Aufzählung der Kryptogamen aus der Donau in Ungarn. Annales Univ. Sc. Budapest. Sectio Biologica **3.** 377 – 400.
41. Tubaki, K. 1957: Studies on the Japanese Hyphomycetes. (III) Aquatic group. Bull. Nat. Sci. Mus. Tokyo **3.** 249 – 268.
42. Tubaki, K. 1960: On the Japanese aquatic Hyphomycetes. Scum and foam group, referring to the preliminary survey of the snow group. Nagaoa **7.** 15 – 28.
43. Waid, J. S. 1954: Occurrence of aquatic Hyphomycetes upon the root surfaces of beech grown in woodland soils. Trans. Brit. Mycol. Soc. **37.** 420 – 421.
44. Webster, J. 1959a: Nectria lugdunensis sp. nov., the perfect state of Heliscus lugdunensis. Trans. Brit. Mycol. Soc. **42.** 322 – 327.
45. Webster, J. 1959b: Tricellula aquatica sp. nov., an aquatic hyphomycete. Trans. Brit. Mycol. Soc. **42.** 416 – 420.
46. Webster, J. 1959c: Experiments with spores of aquatic Hyphomycetes. I. Sedimentation and impaction on smooth surfaces. Ann. Bot. **23.** 595 – 611.
47. Webster, J. 1961: The Mollisia perfect state of Anguillospora crassa. Trans. Brit. Mycol. Soc. **44.** 559 – 564.