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O przyczepianiu się *Tabellaria flocculosa* (Roth) Kütz. do podłoża — Attaching Ability of *Tabellaria flocculosa* (Roth) Kütz. to the Substratum

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The first descriptions of the species *Tabellaria flocculosa* (Roth) Kütz. do not mention its ability of attaching itself to the substratum. Not having on hand the original diagnoses of Roth in 1797 and of Kützing in 1844, I rely upon the descriptions of Agardh (1817, 1824) and Kützing (1845, 1848) and the quotation of Knudson (1952).

In the literature known to me it was Smith (1856) who first gave a drawing of a long colony of this species attached to the filament of some alga, but did not discuss it in the text. Rabenhorst (1863) does not mention initially anything about this ability of the species, but in his next monograph (1864), when describing the whole *Tabellaria* genus, he states that the agglomerations of cells, attached at first, soon liberate themselves. De Toni (1892) gives that statement in words identical to those of Rabenhorst, also as a characteristic mark of the genus.

Later Schröder (1902) publishes a drawing of a *Tabellaria flocculosa* attached to the substratum, and Wesenberg-Lund in 1908 calls attention to this ability of the species (after Fritsch 1935).

In old keys for identification of diatoms or in manuals, Migula (1907), Schönfeldt (1913), Schönichen (1925) and Karsten (1928) consider this attaching ability of the basal cell to algae or any other substratum as a characteristic mark for the whole *Tabellaria* genus. Schönichen however, when describing the species, states that *T. fenestrata* often forms in lakes plankton water-blooms, but that *T. flocculosa* is „festsitzend”, and Karsten encloses drawings of Smith and Schröder representing just the attached *T. flocculosa*. This same drawing of Schröder is also inserted by Oltmanns (1922).

Hustedt (1930, 1930—37) when describing the genus states that the species appear in the littoral and pelagial of stagnant waters and more rarely in flowing ones. Similar remarks are made by him when describing the species, without mentioning however their attaching ability. Also Huber-Pestalozzi (1942) and Proškina-Lavrenko (1951) do not speak about it. Tiffany and Britton (1952) when describing the *Tabellariaceae* family, add a short notice „free-floating or attached”.

Cleve-Euler (1953) in the description of the *Tabellaria* genus mentions what other preceding authors have already stated, that chains of colonies become attached to the substratum with one angle of the cell, become detached occasionally and often cause the appearance of mass vegetation in the plankton. But when describing several forms (*T. flocculosa* (Roth) Kz. a *ventricosa* Grun., *T. fenestrata* (Lyngb.) Kz. and *a lacustris* Meister) she only states „als Aufwuchs” or „im Littoral”, and for the remaining ones generally „im Plankton”.

Lately Knudson (1957), who for a series of years studied the ecological and systematic problems of the *Tabellaria* genus, and especially those of *T. flocculosa* writes that although Smith's and Schröder's drawings indicate the attaching of *T. flocculosa* to the substratum, she herself has never noticed it and therefore is in doubt about the fact. She supposes also that this species „adheres to substrata merely by entanglement in other algae, fungi etc. It is not a motile diatom and cannot therefore actively 'select' its substratum”.

In the year 1957/58, when staying as a visitor at the Windermere Laboratory of the Freshwater Biological Association in England (thanks to a grant of the Polish Academy of Sciences and of the British Council), I cultivated in clone cultures *T. flocculosa* var. *flocculosa* Knud. separated from the periphyton growing upon *Phragmites communis* Trin. collected on the shores of the Windermere Lake. *Tabellaria* was cultivated in several different culture fluids, but mostly on the culture fluid Chu 10 (Chu, 1942), with an addition of mud extract from the lake. The cultures were shaken several times once daily.

Though the major part of the colonies in cultures floated freely in the water, I managed to observe that some of them attached themselves to the bottom or the sides of the flasks. Wishing to observe better this phenomenon, I inserted into the culture small pieces of cotton wool. In a few days the colonies attached themselves abundantly to the cotton wool filaments, what could be conveniently observed with the aid of a microscope. I observed colonies attached by one of the cells on their extremities or one of the central ones (Fig. 1, 2). The cell attached itself by one of its corners with the aid of a big mucilage in the shape of a cone or

hemisphere. Thanks to its yellowish or sometimes brown colouring this mucilage was perfectly visible, in contrast to small and colourless lumps uniting sundry cells (Fig. 3, 4). This observation is in conformity with Smith's drawing. On that of Schröder however one cannot discern any differences between the small lumps of mucilage uniting the cells and the mucilage which served to attach the colony.

The adherence of the colony was very strong, for neither an energetic striking of the cover-glass of the preparation with a needle nor a pression upon it could detach the colony from the substratum. This was also observed by Dr. J. W. G. Lund, in whose laboratory I had then the opportunity to work.

The colonies attached observed in an emulsion of Indian ink proved to be surrounded by a thick layer of completely transparent mucilage (Fig. 6), with a slightly narrowed contour faintly indicating the separate cells. Sometimes the basal cell is only partly surrounded with mucilage though in general this mucilage also connects the colony to the substratum and grows on it, what can be very distinctly seen on stained preparations (Fig. 5). The colonies free-floating in water are also surrounded with the same layer of transparent mucilage (Fig. 7), resembling that which can be seen on the photograph of *T. jenestrata* (Lyngb.) Kz. f. *spirogyra* A. Cl., inserted by Cleve-Euler (1953).

When stained with gentian violet in an alcohol solution the mucilage envelope contracts violently, as a result of the extraction of water. In some places the contracted mucilage adheres nearly completely to the cells, giving a contour similar to that of Schröder's drawing. On it Schröder indicates moreover the differentiation of the mucilagenous envelope into a thin, stronger staining layer adhering to the cells and more faintly stained conglomerations between neighbouring cells. I did not observe pictures of that kind in spite of applying different fundamental stains.

I tried to verify in a similar manner whether *T. flocculosa* var. *asterrionelloides* (Grun. in V. H.) Knud. has the ability of attaching itself. I used here material cultivated by Dr. Lund. I did not observe however any attaching of colonies of this variety either to the sides of the flasks in which they were cultivated, nor to the pieces of cotton wool. This would confirm the euplanktonic character of this variety.

I presume that one could investigate in a similar way which of the remaining species and varieties of *Tabellaria* possess a real ability of attaching themselves. This might perhaps help in a certain measure to explain some ecological and systematic indistinctnesses of which there are still many. But it already seems that the ability of attaching itself

cannot be treated as a common feature of the whole genus, but only as appertaining to some species or their varieties.

On this occasion I shall mention an experiment accidentally accomplished on *T. flocculosa* var. *flocculosa*. In November 1957 I inoculated one 4-celled colony of that alga in a flask (with Chu 10 culture fluid and a layer of mud + Na_2PO_4 on the bottom). This flask was left (on a fluorescent lamp in a temperature of about 8°C) without moving it for several months. After that period, *Tabellaria* produced on the bottom of the flask a macroscopic brown conglomeration (about 4 cm in diameter and 1,5 cm high). When investigated under the microscope it proved to be a single tape-shaped colony, in which the valvae of cells touched each other on the whole surface, as in *Fragillaria* — but under the influence of a greater movement caused, among others, by the striking of a needle against the cover-glass of the preparation, the cells diverged rapidly, forming a zigzag colony characteristic for this species. This indicates that movement of the surrounding water influences the divergency of cells and that the mucilage surrounding them offers no resistance. Movement of the water induced also the breaking up of the colonies. That is why one can usually observe in the periphyton colonies of this species several times longer than in the plankton. This difference appeared also very distinctly in cultures: the more the flasks containing the cultures were shaken, and the more often, the shorter were the colonies.

STRESZCZENIE

Tabellaria flocculosa (Roth) Kütz. jest gatunkiem poroślowym, chociaż występuje również, często w dużych ilościach, w planktonie. Jednak rzadko obserwowano dotąd (Smith 1856, Schröder 1902), w jaki sposób galunek ten przyczepia się do podłoża, a Knudson (1957) przypuszcza, że galunek ten utrzymuje się w peryfitonie jedynie dzięki uwikłaniu się pomiędzy innymi glonami.

Autorce udało się zauważyć przyczepianie się kolonii *T. flocculosa* var. *flocculosa* Knud. hodowanych w jednogatunkowych kulturach (na pożywce Chu 10 z dodatkiem wyciągu z mułu). Kolonie przyczepiały się do dna i ścianek naczynia oraz do włókienek umyślnie włożonych strzępków waty, przy pomocy dużej, żółtawej galaretki (Fig. 1—4) znacznie większej od bezbarwnych grudek galaretki łączącej komórki. Ponadto kolonie otoczone są grubą warstwą galaretki dającej się widzieć w zawieszaniu tuszu (Fig. 6) wzgl. po wybarwieniu. Podczas barwienia fioletem gencjanowym w roztworze alkoholowym następuje gwałtowne kurczenie się galaretowatej otoczki (Fig. 5) na skutek odciągania z niej wody. Nie obserwowano jednak takiego zróżnicowania galaretowatej otoczki, jak to podaje Schröder. Kolonie unoszące się wolno w pożywce posiadają również galaretowatą otoczkę (Fig. 7).

Zatem *T. flocculosa* var. *flocculosa* jest jednak epifitem; kolonie względnie ich części odrywają się od podłoża i mogą się dalej rozwijać w planktonie. Rozpad kolonii na części następuje pod wpływem ruchu wody.

W podobnych warunkach hodowane kolonie *T. flocculosa* var. *asterionelloides* (Grun. in V. H.) Knud. nie przyczepiały się ani do ścianek naczynia, ani do strzępków waty. Wskazuje to na euplanktonowy charakter tej odmiany.

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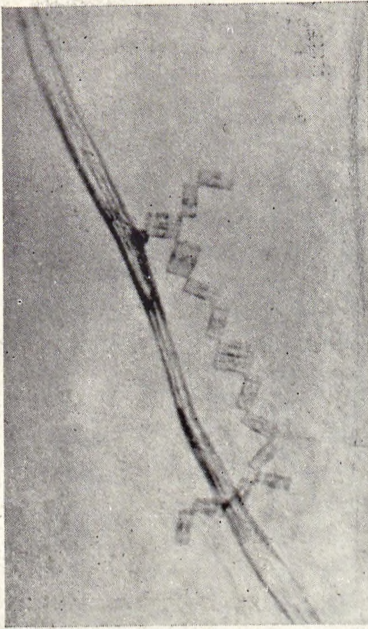


Fig. 1

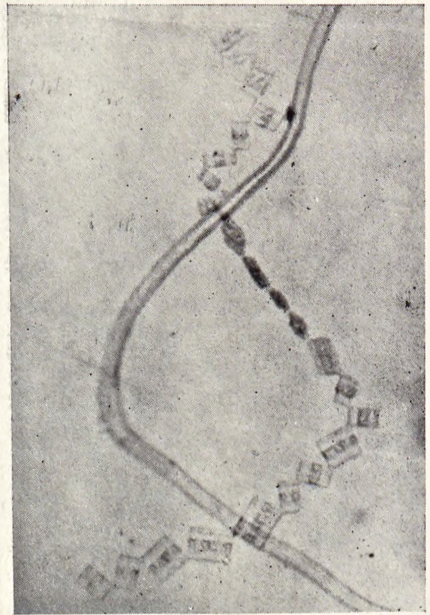
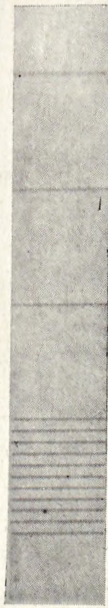


Fig. 2

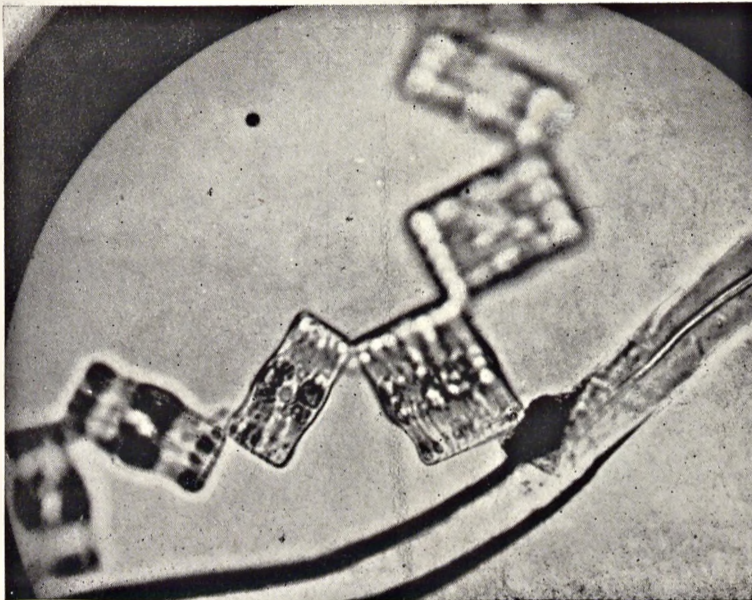


Fig. 3



Fig. 1 — 3. *Tabellaria flocculosa* var. *flocculosa* colonies attached to the cotton wool filaments. On fig. 3 enlarged fragment of the colony on fig. 2.

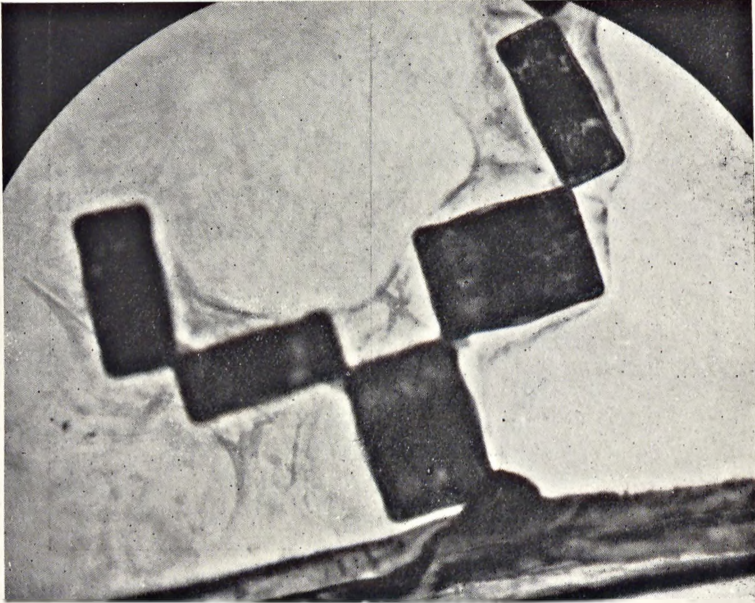
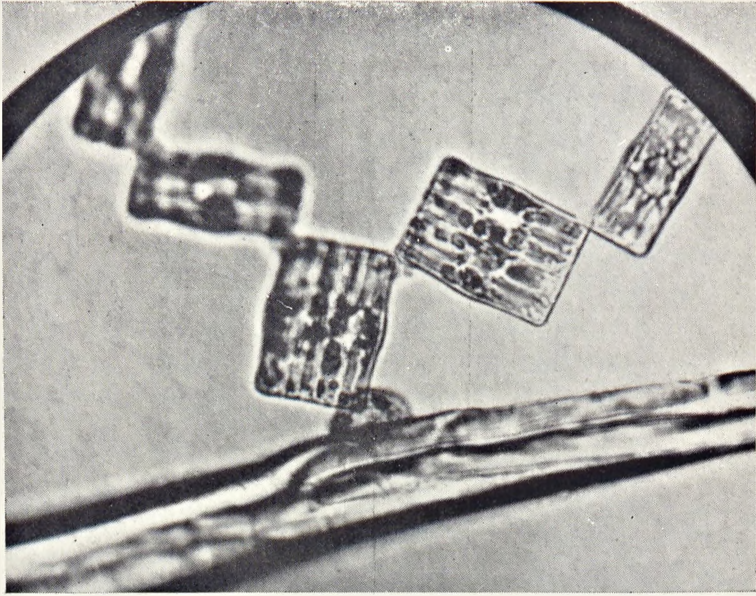


Fig. 4. Enlarged fragment of the colony on fig. 1.
Fig. 5. The same fragment stained with gentian violet.



Fig. 6

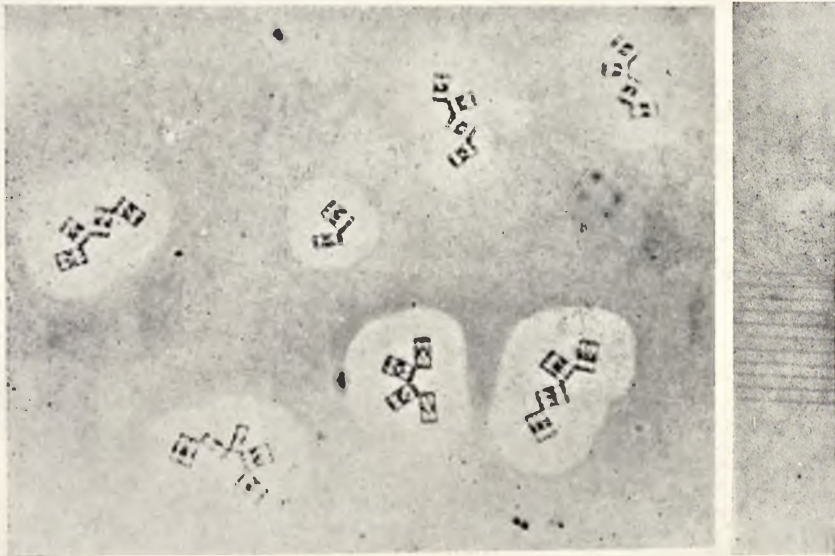


Fig. 7

Fig. 6. Colony attached to the cotton wool filament in Indian ink emulsion.
Fig. 7. Free floating colonies in Indian ink emulsion.