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Homoeothrix crustacea Woronichin i glony
towarzyszające w górnym biegu Raby

Homoeothrix crustacea Woronichin and Accompanying
Algae in the Upper Course of the River Raba

Mémoire présenté le 6 décembre 1965 dans la séance de la Commission Biologique
de l'Académie Polonaise des Sciences, Cracovie

The present investigation is concerned with a rare species of blue-green alga, *Homoeothrix crustacea*, collected in September 1962 together with accompanying algae in the Upper Raba from Sieniawa down to Chabówka. Algae at that time were not numerous in the Raba. The stones in the bed of the river were either clean, as if washed out, or else in places of slowly flowing water they were covered with a delicate layer of grey slime. The brown coatings of diatoms characteristic of the autumn season had not yet developed and neither had sods of the green *Cladophora*. The latter alga could be encountered on stones in the form of very low, earthy-grey, silty sods, representing remains of the disappearing summer vegetation. The bottom of the river was rather empty, grey, in strong current entirely swept out, in calm water near the banks somewhat slimy, and only in shallow rapids of none too swiftly flowing water was it covered with brown, pinkish or reddish-brown, sometimes also greyish-yellowish crusts of blue-green algae. It was these crustlike layers, easy to scrape off with a penknife, which were collected at 8 stations (fig. 1) at Sieniawa, Raba Wyżna, Rokiciny, and Chabówka. Towards the end of the summer and early in autumn they represented almost the only larger aggregates of algae in the upper course of the river Raba. They were chiefly composed of the species *Homoeothrix crustacea* Woronichin and also of *Schizothrix fasciculata* (Nägeli) Gomont, which, however, occurred in smaller numbers. Of the accompanying algae the following should be mentioned:

Cladophora glomerata Kützing occurring everywhere on stones in the form of single, low, bushy bundles 1—2 cm. high, of brownish-grey, earthy colour. The branches of *Cladophora*, coated with particles of slime,

were covered by epiphytic diatoms, chiefly of the genera *Cocconeis*, *Achnanthes*, and *Synedra*. In the lower part the branches *Chantransia pygmaea* Kütz. and *Asterocystis smaragdina* Reinsch. occurred in places as epiphytes. In the top parts conglomerations of *Chamaesiphon incrustans* Grunow and *Lyngbya Kützingii* (Kütz.) Schmidle were visible.

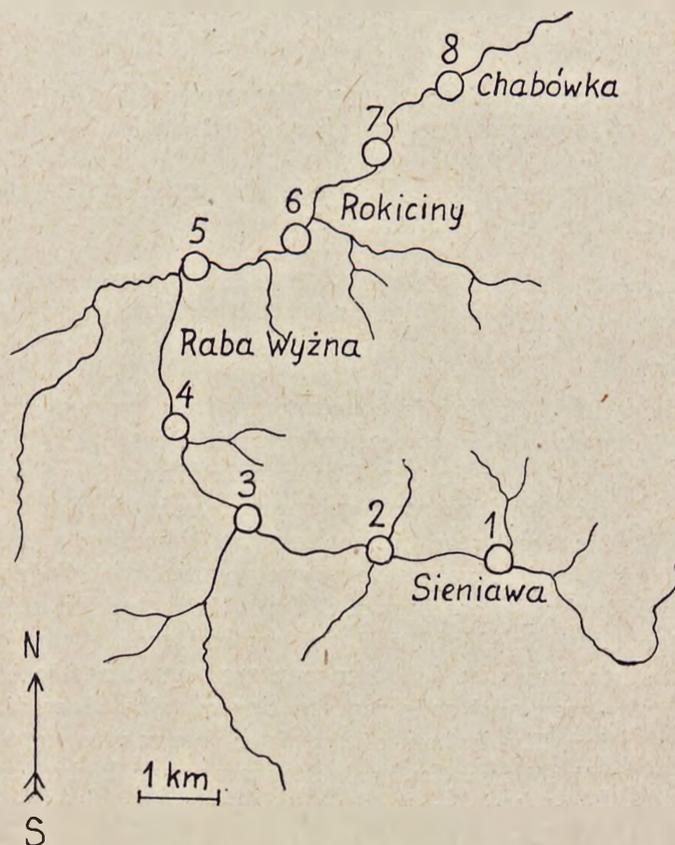


Fig. 1. Upper course of the river Raba; stations 1—8

Black, irregular spots 1—8 mm. in diameter formed by *Chamaesiphon fuscus* (Rostaf.) Hansgirg were found on stones in the company of *Cladophora*.

The blue-green alga *Pseudonocobyrza fluminensis* Fritsch was encountered less frequently. It formed no larger thalli visible to the naked eye and could be detected only under the microscope in the material removed from the surface of stones.

In the sample collected at Rokiciny very small thalli of *Tetraspora lubrica* (Roth) Agardh up to 3 cm. in size were found. Their surface was covered with slime and diatoms.

Diatoms occurred in large numbers mainly covering, however, stones on which other algae were growing, or else they developed in very shallow, slowly flowing water. In strong current the stones were almost entirely clean.

The Characteristic Blue-Green Algae

1. *Homoeothrix crustacea* Woronichin (fig. 2)

It forms large crusts on the surface of stones, being found at all the investigated stations from Sieniawa down to Chabówka. The crusts are of greyish-brown, in places brown or reddish colour. They are often papillary at the surface, up to 3 mm. thick, strongly encrusted with calcium carbonate, friable when scraped off. Sometimes, especially at the borders of stones, there appear separate, almost spherical hard thalli up to 2 mm. in diameter, mostly dark violet, less frequently grey in colour. These small thalli fuse with time into large crusts increasing in thickness and being distinctly stratified in vertical section.

The filaments, more or less straight, grow close together in the vertical direction. The trichomes move upwards in the sheaths, so that the lower parts of the latter are almost always empty. At the apex the trichomes end with a hair protruding above the sheath. The lower cell is rounded or contracted. The lower and middle parts of trichomes have mostly cylindrical cells, not indented near the transversal walls, usually longer than the width, up to 5 μ long and 1.7—2.7 μ wide. In the upper part of the trichomes a meristic zone develops, of cells strongly indented near the transversal walls, 1—3 μ long and mostly 2.7 μ wide. Above this part the trichomes gradually contract, or sometimes pass suddenly into a hair whose end cells are elongated and colourless. However, in normally developed thalli most trichomes have no hairs, these falling off very readily before the formation of hormogonia. Thus, sometimes whole groups of older thalli are composed of trichomes devoid of hairs.

The sheaths in the lower parts of the thallus are brown and layered, while in the upper ones they are colourless, disappearing near the apex of the trichomes. The filaments (trichomes with the sheath) are mostly 3.2—3.6 μ wide.

The thalli are composed of 3—4 layers being well visible in the cross-section through the thallus. The lower layers have mostly empty sheaths, the upper ones contain living filaments of violet-grey or violet-red colour.

The species *Homoeothrix crustacea* was described for the first time by Woronichin (Elenkin, 1949) from a river flowing through the botanical garden in Tiflis (Caucasus). Soon after Woronichin described another similar species: *Homoeothrix globulus*, occurring in streams in the Crimea and in the mountains of Central Asia. The description and drawings made as can be seen, from dead material were

not too exact, however, they reproduced the morphological features so far as to make possible the identification of these species.

The inexact diagnosis of *H. crustacea* was complemented by Geitler on the basis of material coming from east Java. This author noticed in

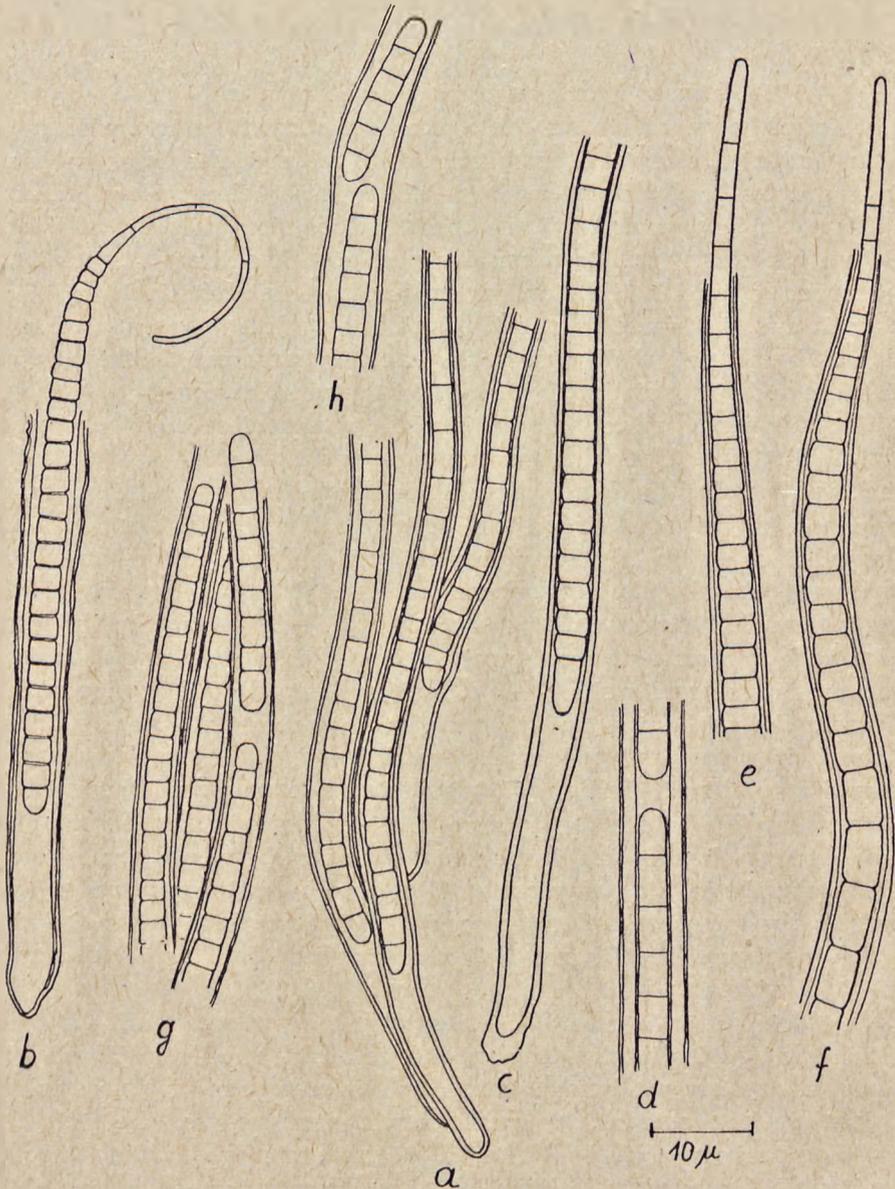


Fig. 2. *Homocothrix crustacea* Woronichin: a, b, c — basal parts of filaments; d — middle of filaments; e, f — apices of trichomes ended with hairs; g — trichomes without hairs; h — hormogonia

the material a lack of hairs, considering it to be probably a property of this species, which was also in agreement with Woronichin's opinion. The present author found this species in the river Dunajec near Ostrowsko (Starmach 1937), where it often forms large, dark brown calcareous incrustations on the surface of stones. The thalli of specimens found in the Dunajec were similar to those in the Raba. However, in the young parts of the thallus there distinctly appeared hairlike endings.

It seems that in the investigated material from the Raba both species occur, *H. globulus* being, however, as it were, the developmental stage of *H. crustacea*. Small hard spherules, being at first separately dispersed on the surface of stones, finally merge into compact crusts corresponding to the features of *H. crustacea*. Both these species, i.e. *H. crustacea* and *H. globulus*, resemble each other in all features with the exception of the colour and shape of thalli. Thalli of *H. globulus* are encrusted with calcium, almost spherical, 0.3—1 mm. in diameter, of reddish-violet colour, whereas in *H. crustacea* they are unfurled and brown in colour. The width of filaments and trichomes as well as the structure of trichomes and sheaths are similar. Thus, the observation that very small, almost spherical thalli sometimes encountered on stones fuse into larger aggregates, and finally into outspread crusts, reduces the value of the shape of the thallus as taxonomic feature. The colour of thalli is always greatly variable, being different in young thalli and in the older ones. It rather seems, therefore, that these two species are identical, though *H. globulus* would represent only the developmental stage of *H. crustacea*. Elenkin (l.c.) also reports that *H. globulus* is a species similar to *H. crustacea* from which it differs exclusively in the form of the growth of thalli. Obviously, for lack of comparative material, this is for the present merely a supposition requiring confirmation in further investigations on these species.

2. *Schizothrix fasciculata* (Nageli) Gomont (fig. 3)

Occurs in the form of brown or reddish-brown cushionlike thalli of various size, encrusted with calcium carbonate. The filaments narrow in a characteristic way towards the apex. The sheath is colourless, sometimes layered, containing at first several trichomes; however, in the apex parts of the filaments only one trichome is usually present growing out of the sheath. Sometimes the sheath is closed at the apex and sharply ended. The trichomes are 1.2—1.8 μ wide, the cells mostly 1.0—1.6 μ long, of pale bluish-green colour, sometimes distinctly indented near the transversal walls. The end cells are conical. The hormogonia are short, usually sharpened at both sides, forming in the sheath in a row.

Thalli of this species were disseminated for the most part at the borders and lateral sides of stones in stronger current, chiefly at the

stations of Sieniawa and Raba Wyzna, and everywhere near the outlet of small side streams.

This species is known from Europe and Asia. It is common in the Carpathians but chiefly in the upper course of streams and rivers. In the Vistula, Soła, Skawa, Raba, and in the Dunajec it occurs in its typical form, whereas in the Ropa, Wisłoka, Wisłok, and San the form *semiglobosa* Geitler prevails, of cushions amounting up to 10 mm. in diameter, weakly encrusted with calcium carbonate.

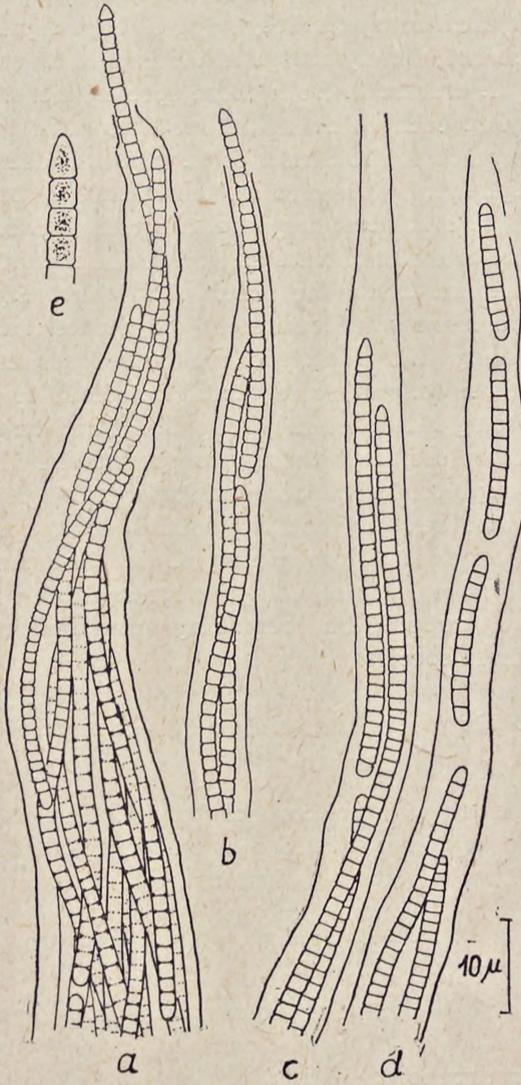


Fig. 3. *Schizothrix fasciculata* (Nägeli) Gomont: a, b, c — apices of filaments; d — hcmogonia; e — ending of trichome greatly magnified

The Community of Algae in the Upper Course of the Raba

Both species of the genus *Homoeothrix*, especially *H. crustacea* occurring at all stations, formed in the river Raba a greatly characteristic community. Apart from the earlier mentioned algae, numerous species of diatoms formed part of the composition of this community. However, while such algae as *Cladophora glomerata*, *Tetraspora lubrica*, *Chantransia pygmaea*, and others occurred only in places and infrequently, diatoms were always numerous, giving the vegetation a characteristic yellowish-brown, or brownish-grey, earthy colouring. Many species of diatoms were identified, but distinctly dominant among them were the following: *Diatoma vulgare*, *Meridion circulare*, *Synedra ulna*, *Cocconeis placentula* var. *euglypta*, *Cocconeis pediculus*, *Acinanthes minutissima*, *A. linearis*, *A. affinis*, *A. lanceolata*, *Navicula cryptocephala*, *N. gracilis*, *Cymbella ventricosa*, and *Gomphonema olivaceum*.

In the list of identified algae given below the number of the station at which it occurs is given beside the name of each species, the signs and figures in brackets showing the frequency of occurrence according to the 5-grade scale. The positions of the stations are marked in fig. 1. The dominant species are printed in heavy type.

List of algae occurring in September 1962 in the upper course of the river Raba

- Homoeothrix crustacea** Woronichin 1—8 (3—5)
Schizotherix fasciculata (Nägeli) Gomont 1—3 (2—3), 5 (1)
Cladophora glomerata Kützing 1—8 (+—1)
Tetraspora lubrica (Roth) Agardh 6 (+)
Chantransia pygmaea Kützing 3, 4, 6 (+)
Asterocystis smaragdina Reinsch 5, 6 (+)
Chamaesiphon incrustans Grunow 1—8 (+)
Lyngbya Kützingii (Kützing) Schmidle 1—8 (+)
Chamaesiphon fuscus (Rostaf.) Hansgirg 1, 3, 4, 5 (+)
Pseudonocobyrsa fluminensis Fritsch 3, 4 (+)

Diatoms

- Melosira varians* C. A. Ag. 3, 4 (+)
Cyclotella Meneghiniana Kützing 3, 4, 5 (+)
Tabellaria flocculosa (Roth) Kützing 2, 5, 6 (+)
Diatoma vulgare Bory 1, 2, 5—8 (1—2)
D. vulgare var. **capitulata** Grun. 1, 7, 8 (1—2)
D. vulgare var. *producta* Grun. 2 (+)
D. hiemale var. *mesodon* (Ehrb.) Grunow 2:3 (+)
Meridion circulare Agardh 1—8 (+—2)
Ceratoneis arcus Kützing 2, 3, 6 (+)

- Fragilaria intermedia* Grun. 2, 3, 4, 7, 8 (+ -1)
F. capucina Desmazières 5, 6 (+)
Synedra ulna (Nitzsch) Ehrenberg 1—8 (2—3)
S. ulna var. *Ramesi* (Hér. et Peragallo) Hustedt 2 (+)
S. ulna var. *danica* (Kützing) Grunow 1, 2 (+)
S. ulna var. *oxyrhynchus* (Kützing) V. Heurck 1, 2 (+)
S. ulna var. *amphirhynchus* (Ehrenberg) Grunow 1 (+)
S. rumpens Kützing 3, 4 (+)
S. vaucheriae Kützing 1—4, 7 (1)
S. vaucheriae var. *capitellata* Grunow 2, 3 (+)
Eunotia valida Hustedt 2 (+)
E. pectinalis var. *minor* (Kützing) Rabenhorst 1—4 (+)
E. tridentula Ehrenberg 3—6 (+)
Cocconeis pediculus Ehrenberg 1,2 (5), 3,4 (2), 5,6 (5), 7,8 (4)
C. placentula var. *euglypta* (Ehrenberg) Cleve 1, 2, (+), 3—6,
 (2—4), 7, 8 (5)
Achnanthes minutissima Kützing 1 (4), 2—4 (1), 5—8 (4—5)
A. minutissima var. *cryptocephala* Grunow 7, 8 (2)
A. linearis W. Smith 1 (4), 2 (1—3), 4—6 (3), 7,8 (5)
A. affinis Grunow 1 (4)
A. hungarica Grunow 7, 8 (1)
A. exigua Grunow 7, 8 (1)
A. conspicua A. Meyer 1 (+)
A. lanceolata Bréb. 1 (1), 2—4 (1—2), 5, 6 (+ -1)
A. lanceolata var. *rostrata* Hustedt 5, 6 (1)
Rhoicosphaenia curvata (Kützing) Grunow 5, 6 (+)
Frustulia vulgaris Thwaites 1—6 (+)
Gyrosigma attenuatum (Kützing) Rabenhorst 1 (+)
G. acuminatum (Kützing) Rabenhorst 3—6 (+)
Caloneis silicula (Ehrenberg) Cleve 2 (+)
C. alpestris (Grunow) Cleve 1 (+)
Neidium iridis f. *vernalis* Reichelt 5, 6 (+)
N. dubium f. *constricta* Hustedt 2 (+)
Stauromeis montana Krasske 2 (+)
Navicula cryptocephala Kützing 1,2 (1), 5,6 (4), 7,8 (2)
N. cryptocephala var. *exilis* (Kützing) Grunow 2 (+)
N. cryptocephala var. *veneta* (Kützing) Grunow 2, 7, 8 (1)
N. cryptocephala var. *intermedia* Grunow 1—8 (1—2)
N. viridula Kützing 1—6 (2—4), 7,8 (1)
N. viridula f. *capitata* Mayer 1—6 (+)
N. hungarica Grunow 7, 8 (+)
N. hungarica var. *linearis* Östrup. 5, 6 (+)
N. hungarica var. *capitata* (Ehrenberg) Cleve 5, 6 (+)
N. hungarica var. *lüneburgensis* Grunow 4, 5 (+)

- N. cincta* (Ehrenberg) Kützing 2, 3 (+)
N. cari Ehrenberg 5, 6 (+)
N. radiosa Kützing 1—8 (1)
N. gracilis Ehrenberg 1—8 (1—2)
N. peregrina (Ehrenberg) Kützing 1, 5—8 (+)
N. menisculus Schumann 2—8 (+)
N. rhynchocephala Kützing 4, 5, 7, 8 (+)
N. gastrum Ehrenberg 5, 6 (+)
N. Reinhardtii Grunow 5, 6 (+)
Pinnularia microstauron var. *Brébissonii* (Kützing) Hustedt 1, 2 (+)
P. Balfouriana Grunow 2 (+)
Amphora ovalis Kützing 3—6 (+)
A. ovalis var. *pediculus* Kützing 5, 6 (+)
A. veneta Kützing 7, 8 (+)
A. coffeaeformis Agardh 2 (+)
Cymbella microcephala Grunow 7, 8 (+)
C. austriaca Grunow 5—8 (+—1)
C. prostrata (Berkeley) Cleve 1, 2, 7 (+)
C. ventricosa Kützing 1—8 (2—4)
C. sinuata Gregory 1—4, 8 (1)
C. sinuata f. *ovata* Hustedt 1, 2, 5, 6 (+)
C. affinis Kützing 2, 3, 7 (+)
C. Hustedtii Krasske 7, 8 (+)
C. cystula (Hemprich) Grunow 7 (+)
C. helvetica Kützing 5, 6 (+)
Gomphonema acuminatum var. *coronata* (Ehrenberg) W. Smith 5, 6 (+)
G. parvulum (Kützing) Grunow 1—8 (1)
G. angustatum var. *producta* Grunow 2, 3, 8 (+)
G. longipes var. *subclavata* Grunow 5, 6 (+)
G. longipes var. *gracilis* Hustedt 5 (+)
G. bohemicum Reichelt et Fricke 1—3, 5, 7 (+)
G. olivaceum (Lyngb.) Kützing 1—8 (1—2)
G. olivaceum var. *minutissima* Hustedt 5, 6, 7, 8 (+)
G. olivaceum var. *calcareo* Cleve 1—4 (+)
G. abbreviatum (Agardh) Kützing 2 (+)
Nitzschia linearis W. Smith 1—6 (+)
N. sublinearis Hustedt 1—4 (+)
N. dissipata (Kützing) Grunow 1—8 (+—1)
N. acuta Hantzsch. 3, 4 (+)
N. amphibia Grunow 5, 6 (+)
N. palea (Kützing) W. Smith 3, 4 (+)
N. sigmoidea (Ehrenberg) W. Smith 1—3, 5, 6 (+)

- N. thermalis* Kützing 2 (+)
N. romana Grunow 7, 8 (+)
N. Clausii Hantzsch 5, 6 (+)
N. acicularis W. Smith 3, 4 (+)
Cymatopleura solea (Brébisson) W. Smith 7, 8 (+)
C. elliptica (Brébisson) W. Smith 1 (+)
Surirella angustata Kützing 1—8 (+—1)
S. tenera Gregory 1 (+)
S. ovata Kützing (+), 3, 4 (2), 5, 6 (1), 7, 8 (+)
S. ovata var. *pinnata* (W. Smith) 2, 5 (+)

Discussion

Communities of algae encrusted with calcium carbonate, growing on stones in streams and rivers are mentioned several times in the algological literature. Algae occurring in the rivers of England were described in detail by Fritsch (1929), who distinguished among them a number of communities, such as: *Hildenbrandia-Lithoderma*, *Chamaesiphon*, and *Phormidium*. In other works (1949, 1950) he dealt more particularly with a community composed of *Phormidium incrustatum*, *Schizothrix*, and *Chantransia pygmaea*. This community is often encountered in waters of Western Europe, which is best evidenced by the herbal collections of algae found in various museums. A similar community is described by Blum (1957) from the "Saline River" (USA). Symoens (1951) mentions under the name of *Cyanophycion incrustans* an alliance of communities forming in streams and rivers calcareous incrustations with a predominance of blue-green algae. However, he gives no particulars on the communities themselves. Diatoms occurring at the bottom of flowing waters are assigned by this author to the alliance of *Bacillario-phycion rheobethicum*. Symoens mentions at the same time a number of communities of which that of *Diatometo-hiemalis Meridionetum* would best correspond to the group of diatoms reported above. Two fairly distinctly defined communities of diatoms are mentioned by Wasyluk (1965) in a description of algae from the river Sola.

These authors, however, make no mention of the very characteristic community with *Homoeothrix crustacea* and *Schizothrix fasciculata*, distinguishing particularly the cover of algae overgrowing stones in the upper Raba (fig. 4), in the Dunajec, and probably in other Carpathian rivers as well. The community of *Phormidium incrustatum* together with various species of *Schizothrix*, occurring in some rivers of Western Europe, is unknown in the Raba. The species *Phormidium incrustatum* was encountered by the author only in a stream at Ojców.

Thus, the community developing regularly in the upper course of the Raba, in the stream Mszanka, and in the Dunajec from Nowy Targ

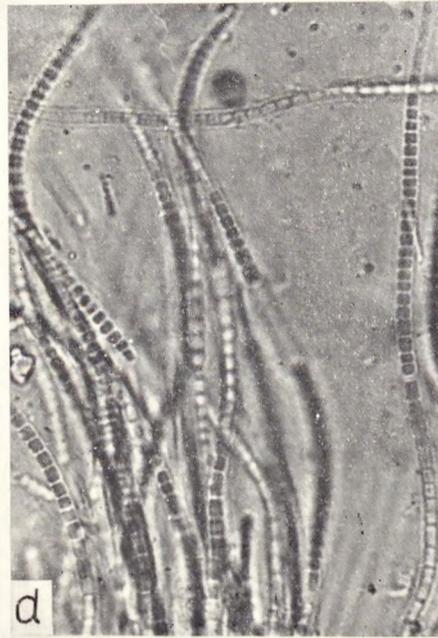


Fig. 4. a, b — Crusty coatings of blue-green algae on stones; in the lower part homogeneous conglomeration of *Homocothrix crustacea*, mixed in the upper part with *Schizothrix fasciculata*; c — vertical section through a thallus of *Homocothrix crustacea*; d — fragment of the top part of the thallus greatly magnified

up to Czorsztyn, composed of the species *Homoeothrix crustacea* and *Schizothrix fasciculata*, as well as of some other species of *Schizothrix* occurring in smaller numbers, should be regarded as characteristic of the late summer and autumn vegetation of algae in the mentioned rivers. These blue-green algae, encrusted with calcium carbonate, are accompanied by numerous species of diatoms which, however, at this time of the year do not yet cover the bottom of the river with the distinctive brownish-yellow coating so characteristic of late autumn and winter.

The conglomeration of diatoms accompanying blue-green algae in the Raba does not exactly correspond either to the community of *Diatometo-hiemalis Meridionetum* described (moreover inaccurately) by Symoens, or to that reported by Wasyluk (1965) from the river Soła. From the long list of diatom species many occur in large quantities of individuals but very irregularly at the particular stations. The species characteristic of the whole investigated section of the river are *Cocconeis pediculus*, *C. placentula* var. *euglypta*, *Achnanthes linearis*, as well as *A. minutissima* and *A. lanceolata*, *Navicula cryptocephala*, and *Surirella ovata*.

However, in the general autumnal aspect of algae in the upper course of the Raba diatoms do not form a distinctly developed community. They constitute a numerous group accompanying only the characteristic community of crusty blue-green algae, composed of the species *Homoeothrix crustacea* and *Schizothrix fasciculata*.

STRESZCZENIE

Opisano zbiorowisko skorupiastych sinic pokrywających wraz z licznymi gatunkami okrzemek kamienie w korycie Górnej Raby w okresie późnoletnim i wczesnojesiennym. Zbiorowisko to, występujące stale w górnym biegu Raby, Mszanki, Dunajca i zdaje się także innych rzek karpackich tworzy przede wszystkim gatunek *Homoeothrix crustacea* Woronichin i *Schizothrix fasciculata* (Näg.) Gomon t. Wśród glonów towarzyszących, które zestawiono w osobnej liście, dominują gatunki okrzemek. Przedstawiono uzupełniony opis i rysunki oraz fotografie gatunku *Homoeothrix crustacea* i *Schizothrix fasciculata*. Pierwszy z nich był dotąd rzadko podawany. Został on opisany z Kaukazu, potem znaleziony na Wyspach Sundajskich oraz w Dunajcu w okolicy Ostrowska. Drugi jest w Europie dość pospolity. Zbiorowisko o składzie *Homoeothrix crustacea* i *Schizothrix* wraz z okrzemkami nie było notowane w literaturze algologicznej.

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