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Zimowa flora w strudze źródliskowej na kamieńcu nad potokiem Mszanka

The Winter Flora of Algae in a Spring Trickle on Gravel Banks near the Stream Mszanka

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The author applies the term spring trickles to waters flowing from under gravels and rock debris on gravel banks near rivers, being directed through a groove-like channel to the river, or infiltrating again into the gravel. Waters of this kind are not uncommon in the lower course of mountain streams flowing over vast stretches of deposited gravels. They usually appear near the border terraces periodically flooded by the river, most frequently in ditches cut during flood and then filled up again in the upper part with rock debris and gravel. The water filtering through the gravel flows out at the bottom of the ditch, forming a trickle which flows slowly along the depression and joins the river or forms a pool of stagnant water unconnected with the river.

In principle, waters of this kind are similar to shallows when they have a connection with the bed of the river, or to backwaters or old river beds when no such connection exists. On gravel banks in the lower course of mountain streams they form as a rule small, shallow water basins rather of the kind of trickles and spring outflows than of shallows and backwaters. These trickles are not permanent, often disappearing after floods or appearing at some other place.

The configuration of the trickle existing on the gravel bank near the stream Mszanka at Mszana Dolna is shown in a freehand drawing (fig. 1) made on the spot. This trickle had existed at the same place for several years, its water flowing off to the near main flow of the stream. It was 60 m. long and 0.5 to 4 m. wide. Its greatest depth did not exceed 40 cm. The water was for the most part shallow (5—15 cm.), oozing through gravel and pebbles which it often did not cover entirely.

The material for investigation was collected from 26—28 December 1963. In this year there were sharp frosts at that period, the temperature

falling to −20°C. On the 25th of December a „halny" wind (fohnlike wind) was blowing and thaw set in. In the following days the temperature ranged from −2 to +5°. On the southern slopes the snow had considerably melted and there appeared on the fields black strips of land. The snow near the stream was ca. 10 cm. thick. The water by the banks was still frozen, while the water pools behind the dikes and still water places were closely covered with ice and snow. Only the spring outflows and partly the trickles flowing out of them remained unfrozen even during

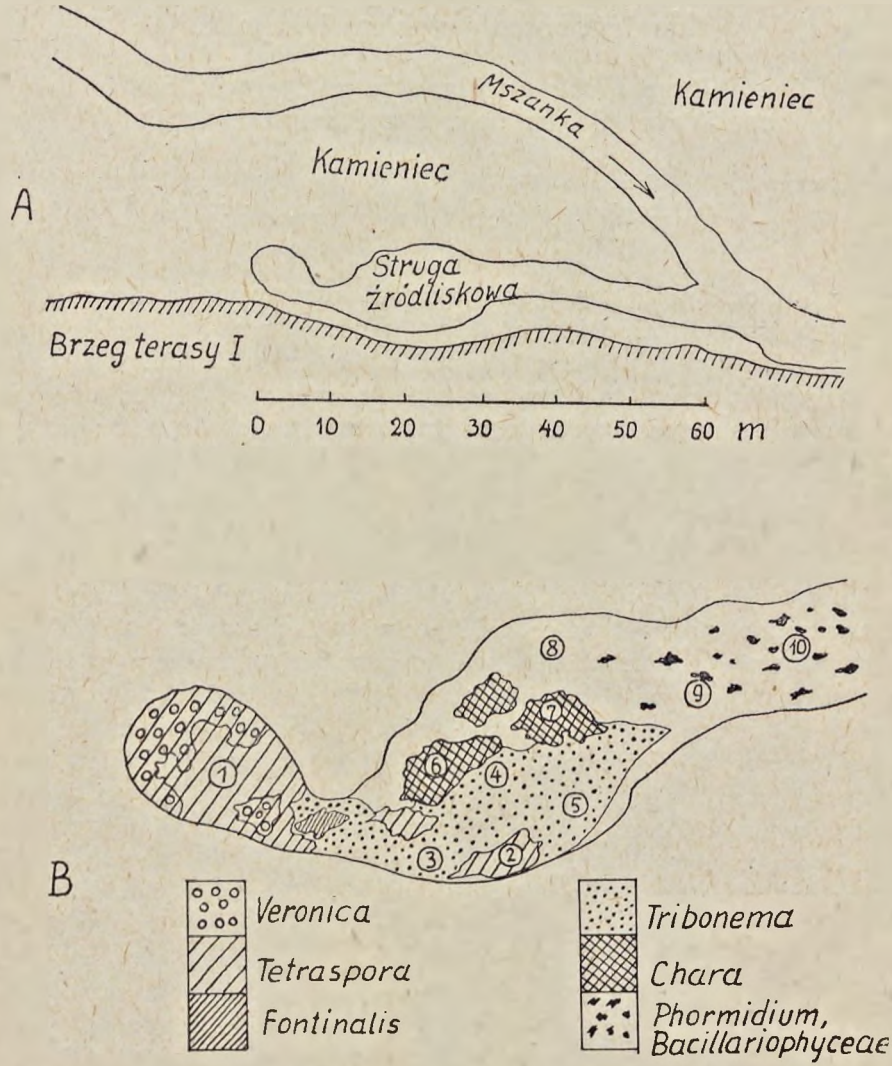

Fig. 1. A — Situation of the trickle spring near the stream Mszanka; B — Freehand drawing showing the distribution of plant covers in the spring trickle and the points at which samples of algae were collected (1—10).

the sharpest frosts. On the 26th of December the temperature of the water in the investigated trickle was 3.4°. Green tussocks of *Veronica beccabunga* and cushions of *Chara* were thriving in it. Tussocks of moss of the genus *Fontinalis* and gelatinous thalli of *Tetraspora* were visible in places, while below in the outflow there appeared dark green sods of *Phormidium* growing on the brown background of diatom coatings. Frail filaments of *Tribonema* undulated in very shallow current. The distribution of these plant assemblages is shown in fig. 1.

From each distinct and apparently homogeneous plant assemblage two or three samples were separately collected. They consisted of

a — thalli of *Tetraspora*, samples 1 and 2,

b — thalli of *Chara*, samples 3 and 4,

c — thalli of *Tribonema*, samples 5, 6, and 7,

d — sods of *Phormidium* and brown coatings of diatoms, samples 8, 9, and 10.

The species identified from the particular samples are assembled in Table I, the samples taken from the particular homogeneous sods being dealt with collectively. The algae are listed in the Table in systematic order. The figures given by the names of species show the quantity estimated according to the 5-grade scale, as well as the coverage index calculated by multiplying the numbers corresponding to the conventional scale of size by the quantity.

Scale of quantity (Abundanz)

+→ Occurs singly, not in each slide.

1 Occurs singly in most slides; small coverage.

2 Occurs in small numbers but in each slide several specimens are present; small coverage.

3 Occurs frequently but the total of individuals present in the slide occupies only about one fourth or less than half of its surface.

4 Occurs very frequently; several individuals appear in each field of view altogether occupying at least half the surface of the slide.

5 Occurs in masses, the total of individuals occupying more than half the surface of the slide.

Scale of size

The average diameter of an alga of ovoid or rectangular shape given in microns was conventionally accepted as basis for their division into classes of size. Algae of different shapes have therefore to be reduced (mentally) to these two essential forms.

5 Diameter of alga 250—375 μ, per cent of coverage in the slide 75—100, 87.5 on the average, coefficient of calculation of size 18 (corresponds to the mean per cent of coverage divided by 5).

4 Diameter of alga 125—250 μ, per cent of coverage 50—75, 62.5 on the average, coefficient of calculation of size 13.
3 Diameter of alga 25—125 μ, per cent of coverage 25—50, 37.5 on the average, coefficient of calculation of size 7.
2 Diameter of alga 5—25 μ, per cent of coverage 5—25, 15 on the average, coefficient of calculation of size 3.
1 Diameter of alga 1—5 μ, per cent of coverage 1—5, 3 on the average, coefficient of calculation of size 1.
+ Diameter of alga 0.1—1 μ, per cent of coverage 0.2—1, 0.6 on the average, coefficient of calculation of size 0.1.

To calculate the degree of coverage it would not be correct to use the degrees of size 1—5, since actually degree 5 is not 5 times greater than degree 1. It was therefore decided to determine the size of the species by multiplying the number determining the quantity by the coefficient corresponding to the mean per cent of coverage in the given class, divided by 5. From these computations figures are obtained giving a certain (general) notion of the size of the given species and of the role it plays in the community.

The Communities Distinguished

On the basis of Table I in which all algae from the particular samples are included and their relative numbers and size (degree of coverage) are marked, it was possible to characterize more exactly the particular communities. It appeared that each of the four conglomerations of algae which could be macroscopically, approximately distinguished in the spring trickle had a distinctly different composition of flora. These conglomerations constituted therefore different communities which, taking into account the composition and dominance of species, can be characterized as follows.

A. Community with *Tetraspora gelatin sa*

This community included 24 species of algae among which *Tetraspora gelatinosa* and *Diatoma hiemale* var. *mesodon* were the dominant forms (quantity 5 and 4). Their joint coverage was expressed by the number 118. The subdominant species were: *Meridion circulare, Diatoma vulgare, Fragilaria bicapitata,* and *Synedra amphicephala* of joint coverage expressed by the number 47. The other species, 18 in number, were occasional (adominant species) of joint coverage 32.5.

From the floristic point of view the community included 5 species of blue-green algae *(Cyanophyceae)* of most insignificant coverage expressed by the number 1.5, 18 species of diatoms *(Bacillariophyceae)* of coverage 109, and 1 species of green algae *(Chlorophyceae)* of coverage 90.

A characteristic appearance was given to the community by gelatinous thalli of *Tetraspora gelatinosa*, as well as by diatoms causing in places a brown colouring of *Tetraspora* thalli. Blue-green algae played no important role in this respect.

B. Community with *Chara vulgaris* f. *subgymnophila*

(The author owes the identification of the stonewort species to Dr. I. Dąmbska for which he wishes to express his grateful thanks).

In the company of large, bushy thalli of *Chara* 16 species of algae were found. The dominant forms were *Chara vulgaris* L. f. *subgymnophila* Migula, *Cymbella ventricosa*, and *Nitzschia palea*. Their joint coverage was expressed by the number 109. The subdominant species were represented by *Diatoma hiemale* var. *mesodon*, *Fragilaria bicapitata*, *Synedra amphicephala*, and *Achnanthes affinis*. Their joint coverage was 39. 10 species were occasional, their joint coverage being 19.

The community was composed of one species of *Charophyta* and 16 of *Bacillariophyceae*. Among the latter epiphytic forms were found, such as *Cocconeis* and *Synedra*, as well as bands and single cells entangled between branches of stonewort.

A characteristic appearance was given to the community by thalli of *Chara* with a yellowish-brown coating of diatoms.

C. Community with *Tribonema viride*

This community was formed by greenish-yellow filaments attached to stones and undulating in shallow current. 64 species of algae were found here of which 3 were dominant: *Tribonema viride*, *Meridion circulare*, and *Cymbella ventricosa*. Their joint coverage was expressed by the number 130. The subdominant species were *Tribonema minus*, *Diatoma hiemale* var. *mesodon*, *Cocconeis placentula* var. *euglypta*, and *Cymbella affinis*. Their coverage was expressed by the number 51. Apart from these there occurred 56 adominant species of joint coverage amounting to 140.

This community was composed of 3 species of *Xanthophyceae*, 60 *Bacillariophyceae* species, and 1 species of *Chlorophyceae*. The general tone was given by filaments of *Tribonema* accompanied by brown nests and coatings of diatoms. The greatest diversity of diatoms was encountered in this community but the particular species always occurred in small numbers.

D. Community of *Phormidium Setchelianum Bacillariophyceae*

This community occupies the whole outflow groove of the spring trickle up to its outlet to the main channel of the stream. It is composed of 38 species of algae among which the dominant forms are *Phormidium*

Table I

Algae in the spring trickle on gravel banks near the stream Miszanka

Communities with:	A. Tetraspora	B. Chara	C. Tribonema	D. Phormidium
Synechocystis aquatilis Sauv	+ 0.1			
Merismopedia glauca (Ehr.) Nägeli	+ 0.2			
Oscillatoria mirabilis Bōcher	+ 0.1			
Spirulina laxissima G.S.West	+ 0.1			
Phormidium foveolarum (Mont.) Gom	1 1			
- Setchelianum Gom				4 65
Tribonema viride Pascher			5 90	
- vulgare Pascher			1 3	
- minus Hazen			2 6	
Tetraspora gelatinosa (Vauch.) Desv.	5 90			
Stigeoclonium tenue (Kütz. sensu lato)			1 3	
Chara vulgaris L.f. subgymnophila Mig.		5 90		
Cyclotella comta (Ehr.) Kütz.				+ 1.5
Meridion circulare Kütz.	2 14	1 7	4 28	
Diatoma vulgare Bory	3 21			4 28
- - var.Ehrenbergii(Kütz.) Grun.	+ 3.5		+ 3.5	
- hiemale (Lyngb.) Heib. var.mesodon (Ehr.) Grun.	4 28	2 14	3 21	+ 3.5
- elongatum (Lyngb.) Ag.var.tenue (Ag.) V.H.			+ 1.5	
Fragilaria capucina Desm.				1 7
- bicapitata Mayer	2 6	2 6	1 3	
- intermedia Grun.	+ 1.5		+ 1.5	
- virescens Ralfs var.mesolepta v.Schōrf.			+ 3.5	
Synedra ulna (Nitzsch.) Ehr.			+ 3.5	
- amphicephala Kütz.	2 6	2 6	1 3	
- vaucheriae Kütz.				1 3
Cocconeis diminuta Pant.			1 3	
- placentula Ehr.		+ 1.5	3 9	
- - var.euglypta (Ehr.) Cleve		1 3	2 6	+ 1.5
Achnanthes minutissima Kütz.	+ 0.1			+ 0.1
- affinis Grun.		3 3	1 1	
- exigua Grun.				1 1
- exilis Kütz.				1 1
- lanceolata (Bréb.) Grun.			1 3	
- - var.rostrata Hust.			+ 1.5	
- Biasolettiana (Kütz.) Grun.		+ 0.1		
- linearis (W.Sm.) Grun.		+ 0.1		
- minutissima Kütz. var cryptocephala Grun.				+ 0.1
- flexella Kütz.				+ 1.5
Rhoicosphaenia curvata (Kütz.) Grun.				+ 1.5
Amphipleura pellucida Kütz.			+ 1.5	
Frustulia vulgaris (Thwait.) De-Toni			+ 1.5	
Navicula cryptocephala Kütz.	+ 1.5	+ 1.5	1 3	4 12
- - var. veneta (Kütz.) Grun.			+ 1.5	+ 1.5
- viridula Kütz.		+ 1.5		
- rhynchocephala Kütz.			+ 3.5	
- gracilis Ehr.			1 7	+ 3.5
- tuscula (Ehr.) Grun.				+ 3.5
- peregrina (Ehr.) Kütz. f.minor Kolbe			+ 3.5	
- cari Ehr.			+ 1.5	
- mutica Kütz.		+ 1.5		
- bacillum Ehr.				+ 1.5
- exigua (Gregory) O.Müller			+ 1.5	+ 1.5
- gracilloides W.Meyer				+ 1.5
- radiosa Kütz.	+ 3.5			
Pinnularia microstauron (Ehr.) Cleve				+ 3.5
Neidium dubium (Ehr.) Cleve	+ 1.5			
Caloneis silicula (Ehr.) Cleve			+ 3.5	+ 3.5
- - var.truncatula Grun.	+ 3.5		+ 3.5	
- bacillum (Grun.) Mereschk.			+ 1.5	
Gyrosigma attenuatum (Kütz.) Rabenh.			+ 6.5	
- acuminatum (Ehr.) Rabenh.			+ 3.5	
Amphora ovalis Kütz.			+ 1.5	
- - var.pediculus Kütz.			+ 1.5	+ 1.5
Cymbella affinis Kütz.			3 9	4 12
- aspera (Ehr.) Cleve			+ 3.5	
- sinuata Gregory			+ 1.5	+ 1.5
- naviculiformis Auersw.			+ 1.5	
- ventricosa Kütz.		5 15	4 12	3 9
- turgida (Gregory) Cleve			+ 3.5	+ 3.5
- parva (W.Sm.) Cleve			+ 1.5	
- prostrata (Berkeley) Cleve			+ 3.5	
- Hustedtii Krasske			+ 1.5	
- aequalis W.Sm.			+ 1.5	
- cymbiformis (Kütz.) V.H.			1 7	
Gomphonema olivaceum (Lyngb.) Kütz.	1 3	+ 1.5	1 3	
- bohemicum Reichelt et Fricke			+ 1.5	+ 1.5
- tergestinum (Grun.) Fricke			+ 1.5	

Table I cont.

Communities with:	A. Tetraspora	B. Chara	C. Tribonema	D. Phormidium
Gomphonema constrictum Ehr.			+ 1.5	2 6
- intricatum Kütz. var.pumillum Grun.			+ 1.5	+ 1.5
- parvulum (Kütz.) Grun.	1 3	+ 1.5		2 6
- - var.micropus (Kütz.) Cleve			1 3	
- angustatum (Kütz.) Rabh. var.productum Grun.			+ 1.5	
Nitzschia recta Hantzsch.	+ 1.5		+ 1.5	
- sinuata (W.Smith.) Grun. var.tabellaria Grun.			+ 0.1	+ 0.1
- dissipata (Kütz.) Grun.			1.1	2 2
- palea (Kütz.) W.Sm.		4 4	+ 0.1	
- fonticola Grun.			+ 0.1	+ 0.1
- sigma (Kütz.) W.Sm.			+ 1.5	+ 1.5
- Clausii Hantzsch.			+ 0.1	+ 0.1
- linearis W.Sm.			+ 1.5	2 6
Cymatopleura solea (Breb.) W.Sm.	+ 3.5			
- elliptica (Breb.) W.Sm.	+ 6.5			
Surirella ovata Kütz.				+ 3.5
- - var. pinnata (W.Sm.) Hust.			+ 1.5	
- angustata Kütz.			+ 3.5	
- delicatissima Lewis	+ 1.5		+ 1.5	
Number of species	24	17	64	38

Setchelianum, Diatoma vulgare, Navicula cryptocephala, and *Cymbella affinis.* The joint coverage of the dominant species is expressed by the number 117. The subdominant species were *Cymbella ventricosa, Gomphonema constrictum, G. parvulum, Nitzschia dissipata,* and *N. linearis.* Their coverage is expressed by the number 29. Apart from these there occurred 29 occasional species of joint coverage amounting to 56.5.

This community was composed of one species of *Cyanophyceae* and 37 *Bacillariophyceae* species. It had a very characteristic appearance. There occurred yellowish-brown coatings on gravel and stones, covered with sparsely scattered skin-like sods of *Phormidium.* In winter the main bed of the stream had a similar appearance, though the *Phormidium* sods were visible in the stream only in shallows near the banks where the current was weak.

Comparison of Communities

To compare the communities the formula $P = \frac{c}{a+b-c} 100$ was applied, where P = coefficient of similarity, a = number of species in one community, b = number of species in the other community, c = number of common species.

The thus calculated coefficients of similarity are:

	A	B	C	D
A	—	20	11	8
B		—	15	10
C			—	25
D				—

The highest coefficient of similarity, amounting to 25 per cent, was established in the communities of *Tribonema viride* (C) and *Phormidium* with diatoms (D). The next highest coefficient of similarity, amounting to 20 per cent, was between the community with *Tetraspora* (A) and *Chara* (B). The least similarity — 8 per cent — was found in the communities of *Tetraspora* (A) and *Phormidium* with diatoms (D).

In general, however, the four communities rather differed from one another in the composition of both the dominant and subdominant species. The differences in the composition of flora are marked not only by large algae, visible to the naked eye, but also by microscopic algae occurring as co-dominant and subdominant species. Occupying the largest space in the community they form characteristic compositions accompanied by numerous occasional species which play no important role in the community. It is worth noting that contrary to appearances, i. e. to what one saw when looking with the naked eye at conglomerations of algae in the water, the greatest number and variety of diatom species was found among green coatings of *Tribonema* and not in community D, with *Phormidium* whose yellowish-brown coatings on stones suggested a particular richness of diatoms.

It should also be noted that only two species were found common to all four communities. These were *Diatoma hiemale* var. *mesodon* and *Navicula cryptocephala*. More numerous were the species occurring in three communities, these being represented by *Meridion circulare*, *Fragilaria bicapitata*, *Synedra amphicephala*, *Cocconeis placentula* var. *euglypta*, *Gomphonema olivaceum*, and *G. parvulum*. Thus, species present in all or in most communities should be regarded as non-characteristic ubiquists.

STRESZCZENIE

Opisano 4 zbiorowiska glonów, jakie rozwinęły się w grudniu 1963 r. w strudze źródliskowej na kamieńcu nad potokiem Mszanka w Mszanie Dolnej. Były to zbiorowiska: 1) *Tetraspora gelatinosa* + *Diatoma hiemale* var. *mesodon*, 2) *Chara vulgaris* f. *subgymnophila* + *Cymbella ventricosa* + *Nitzschia palea*, 3) *Tribonema viride* + *Meridion circulare* + *Cymbella ventricosa*, 4) *Phormidium Setchelianum* + *Diatoma vulgare* + *Navicula cryptocephala* + *Cymbella affinis*. Po obliczeniu współczynników podobieństwa stwierdzono, że największe podobieństwo wynoszące 25% istniało pomiędzy zbiorowiskiem 3 i 4. Inne zbiorowiska miały niższy procent podobieństwa. Wymienione zbiorowiska były więc wyraźnie od siebie różne pod względem składu florystycznego i charakterystycznej kombinacji gatunków. Odmienności zbiorowisk dowodzi również fakt, że znaleziono zaledwie dwa gatunki wspólne dla wszystkich czterech zbiorowisk.

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