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Glony w górach Gebel Marra w Sudanie Zachodnim

Algae in the Gebel Marra Mts in West Sudan

Wpłynęło 2 września 1974 r.

Abstract — In the samples collected in the mountains of the volcanic massive in 1964, 31 species of blue-green algae, 3 species of green algae, and 34 species of diatoms were determined.

Through the good offices of Dr. Julian Rzóska I received 14 samples of algae collected by Miss McGowan at 5 different sites in the mountains of the volcanic massive Gebel Marra in West Sudan. The samples were not very rich in algae but contained a considerable number of blue-green ones and of diatoms, among which some interesting species occurred. The samples were designated as follows:

Site 1. Saur Erie, Wadi Golol, Gebel Marra.

This was a pool below the waterfall, Saur Erie, approximately 90 m high. The pool was almost circular with an outlet opposite the falls. A fairly strong current passed through it. The deepest part of the pool was below the falls and was 7 m deep. The area was shaded by canopy forest.

Date 18 Nov. 1964. Time of collection 13.30 hrs. Altitude approx. 1620 m. Temperature of water 16.5°. O_2 absolute 7.5. Conductivity 170. pH 8.1. Alkalinity m. eq/l 1.37. Sodium ppm. 16.5.

Samples: 1-A, 1-B.

Site 2. Wadi Golol, Gebel Marra.

This was a fast flowing section of the Wadi Golol above the Saur Erie falls (Site 1). The stream has cut through lava rock. Its depth varied between 0.5 and 4m.

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This part of the stream has a smooth bottom and very little littoral vegetation.

Date 20 Nov. 1964. Time of collection 11.30 hrs. Altitude approx. 1700 m. Temperature of water 17.0°. Conductivity 180. O_2 absolute 7.45. pH 8.2. Alkalinity m. eq/l 6.85. Sodium ppm. 16.5.

Samples: 2-A.

Site 5. Lake Dariba, outer crater lake of Gebel Marra, between the inner and outer crater rims.

Lake Dariba has a large surface area and is shallow, having a maximum depth of 11.58 m. The lake has a very heavy crop of blue-green algae phytoplankton giving it a pea-green colour. Secchi disc visible only to a depth of 31.0 cm. A band of sedge is found round the lake apart from some stony shore at the wastern end. Deposits of salt form a white band at the western end.

Date 30 Nov. 1964. Altitude approx. 2700 m. O_2 absolute 4.9. Conductivity 30.000. pH 9.2. Alkalinity m. eq/l 145. Sodium ppm 6.00.

Samples: 5-A, 5-B.

Site 8. Wadi Keire, south of Kronga on the north-west slopes of Gebel Marra.

The Wadi Keire runs due west to the south of Kronga, connecting up with the Wadi Azum during the rainy season. Sampling was carried out above and below a small waterfall. The depth of the stream is variable. The current varies between 20.3 and 0.75 m/sec. The stream bed is smooth and cut through lava rock but with some stones and boulders present in places. No shading by vegetation.

Date 7 Dec. 1964. Time of collecting 10.0 hrs onwards. Temperature of water variable between 16.0—24.3°C. O_2 absolute 7.15. Conductivity 4.500 pH 8.8. Alkalinity m. eq/l 17.65. Sodium ppm 740.

Samples: 8—A + B + C.

Site 11. Wadi Kule, north-west of Kronga, Gebel Marra.

This Wadi runs along the bottom of a fairly wide valley. It may consist of several streams running through the deepest channels after shrinkage of the main wadi after the rains. Three stations were chosen at a junction of two of these small streams.

Station R. Section of the stream with small falls and a pool between. Heavy shading by palms.

Date 9 Dec. 1964. Altitude approx. 1530 m. Temperature of water 20.5°C. O_2 absolute 7.25. Conductivity 2.900. pH 8.3. Alkalinity 01.1. Sodium 260.

Sample: 11 RA.

Station S. A stream running over stony bottom, only a few cm in depth, not shaded by trees. Temperature of water 25.0°C. O_2 absolute 7.2. Conductivity 2.900. pH 8.4. Alkalinity m. eq/l 10.4. Sodium 310.

Sample: 11-Sc.

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Station T. A point below the junction of the other two stations. The stream bed consists of gravel with some larger rocks and stones. Not shaded. Temperature of water 23.5°C. O_2 absolute 7.2. Conductivity 2.900. pH 8.2. Alkalinity m. eq/l 10.2. Sodium ppm 285.

Samples: 11-TA, 11-TC.

Taxonomic part

Cyanophyceae

1. *Synechocystis salina* Wislouch

This occurs in the form of loose groups of cells, usually two of them at a time, pale blue-green, 3—4 μm wide. A species known from mineral springs and weakly saline waters in the Crimea, in the northern Caucasus, and in western Siberia.

Sample 8 — A + B + C.

2. *Synechococcus cedrorum* Sauv.

Cells elliptic, pale blue-green, 4.4 μm wide, 5.5 μm longal. The species is known from several localities in Europe, among others from the Tatra Mts in Poland.

Sample 1-B.

3. *Microcystis muscicola* (Menegh.) Elenkin (= *Aphanocapsa muscicola* Menegh. (Wille)).

Colonies diffuse, irrregular, blue-green, composed of globular or, before division, slightly elliptical cells, (1.8)—2—3 μm wide. Cells of different size may be seen in the same colony. A species known in Europe, occurring in wet places and in water.

Sample 8-A + B + C.

4. *Chroococcus minutus* (Kütz.) Någ.

This occurs in the form of small colonies disseminated among other algae. They are usually composed of 4 cells, surrounded by fairly broad unstratified coats. Cells are 4.4—5.0 μm wide, colonies 11—12 μm wide. The species is commonly found in various parts of the world.

Sample 2-A.

5. *Xenococcus kerneri* Hansgirg

This forms small colonies on the surface of *Cladophora* filaments. At the beginning the colonies are flat, scutate; later cells grow out from the layer of cells next to the substrate and form semi-globular clusters, usually 15 μm high, covered with a thin tremellose coat. The cells are 3.5 μm wide and up to 8 μm high. They divide in the transverse and vertical direction and hence pulvinate or verrucous formations

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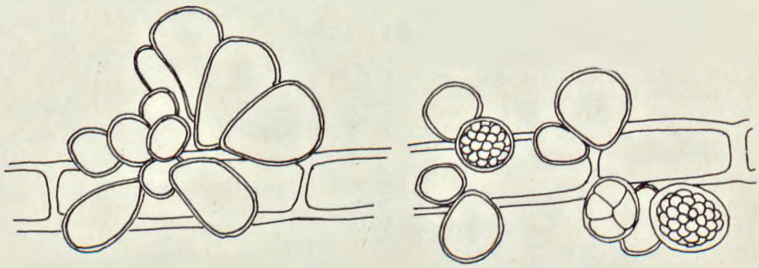
originate. The cells are grey or violet. The species is known in Europe from streams and rivers, where it grows on filamentous algae or mosses.

Sample 8-A+B+C.

6. *Dermocarpa xenococcoides* Geitler (fig. 1)



Ryc. 1— Fig. 1. *Dermocarpa xenococcoides*

It seems that the species is characteristic only for tropical zones; it is described by Geitler from material found on Java and Sumatra, where it occurs epiphytically on *Rhizoclonium*. A similar and probably identical species was described by Frémy from Equatorial Africa under the name *Dermocarpa plectinematis* but the species *D. xenococcoides* is more precisely described and depicted. In the material from the Gebel Marra two forms described by Geitler were found, i.e. *D. xenococcoides typica* and forma *minor*. They are settled singly or in groups on the filaments of the red alga *Audouinella*; single sporangia are globular, semi-globular, or conical; they differ in size. Thus there occur sporangia about 10 µm wide (forma *minor*) as well as those up to 35 µm wide which contain very numerous endospores of a diameter of 3 µm on the average.

Sample 1-B.

7. *Chamaesiphon incrustans* Grunov (fig. 2a)

This always occurs singly or in groups on *Cladophora* filaments. Sporangia contain 1—2 spores and are up to 28 µm long, usually 5 µm wide at the outlet.

Samples 1-B, 2-A, 11-RA.

8. *Chamaesiphon confervicola* A. Braun (fig. 2b)

This is fairly often encountered in small groups on *Cladophora* filaments. Sporangia are 5—8 µm wide at the outlet, 15—36 µm long, and always contain a large number of exospores, the older of them developing even before being detached from the mother plant.

Samples 2-A.

9. *Chamaesiphon curvatus* Nordstedt (fig. 2c)

This fairly often occurs on filamentous algae in groups containing up to 30

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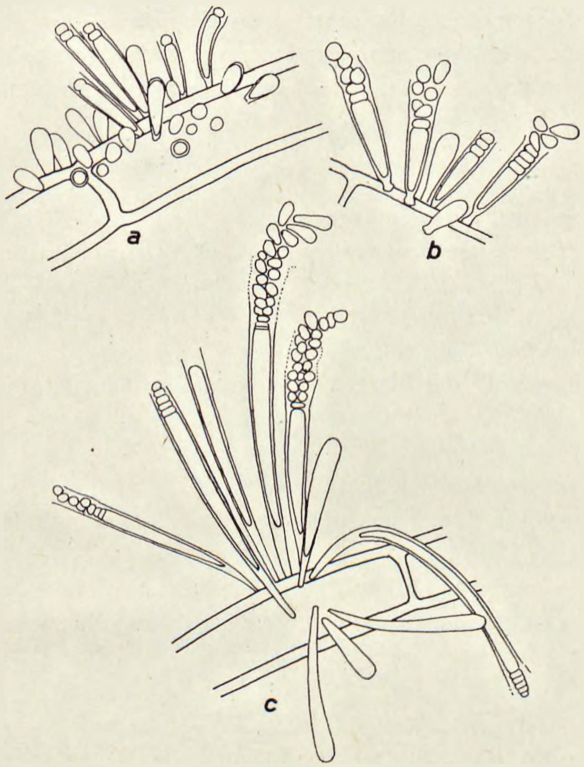

Ryc. 2. — Fig. 2. *Chamaesiphon*: a — *incrustans*, b — *confervicola*, c — *curvatus*

sporangia in various degrees of development. Single sporangia are slender, thin, and more or less curved, in the lower part sheaths are attenuated and empty. As the cells grow they move up in the sheath. Large numbers of exospores always form and they are often arranged in a double file. The width of sporangia is 4—8 μm at the level of the exospore detaching from the mother cell, the length being very variable, often reaching 180 μm. The oldest spores sometimes germinate on the plant.

Samples 1-B, 2-A.

Kann (1972) classified *Ch. curvatus* to *Ch. confervicola*. Indeed, there is a great similarity between these two species in the way in which they form numerous spores and in their width, though in the mature stage the two species differ in shape and if found in the same material they could be easily distinguished. In younger stages they are more similar, although *Ch. curvatus* is always more slender. Personally, I would rather move *Ch. confervicola* var. *elongatus* Skuja to *Ch. curvatus* than *Ch. curvatus* to *Ch. confervicola*, which is much shorter in the mature stage and transforms a greater part of the cell into spores. Sporangia *Ch. confervicola* form a small foot and do not move up in the sheath as *Ch. curvatus*.

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10. *Chamaesiphon subglobosus* (Rostaf.) Lemm.

Small colonies occur on the filaments of *Oscillatoria* cf. *jasorvensis*. Sporangia attenuate at the apex, form one spore, and are sometimes arranged in tiers, though usually they occur in groups side by side. The species is known, among other areas, from the Tatra Mts.

Sample 1-B.

11. *Lyngbya aestuarii* (Mert.) Liebmann

This species did not often occur in sample 11-RA. It is characteristic for saline waters.

12. *Lyngbya kutzingii* Schmidle

This grew epiphytically on filamentous algae: *Cladophora*, *Rhizoclonium*.

Samples 1-B, 2-A.

13. *Phormidium foveolarum* (Mont.) Gom.

Small clusters of this blue-green alga were found in sample II A.

14. *Phormidium mucicola* Huber-Pestal. et Naumann

This species was found in small clusters among the alga filaments and on *Nostoc* thallus in sample 1-B.

15. *Oscillatoria* cf. *jonica* Skuja

The filaments are about 1.2 μm broad, attenuated at the apex and at the very tip slightly widened ending spherically or conically. The cells are about 2 μm long. They occurred as single filaments or a few of them together among other algae in sample 2-A.

16. *Oscillatoria* cf. *jasorvensis* Vouk.

The filaments are usually 2.5 μm broad, cells rather shorter than their length. A few specimens of this blue-green alga occurred among *Cladophora* thalli in sample 1-B.

17. *Spirulina platensis* (Nordst.) Geitler

This species occurred in masses in Lake Dariba, in samples 5-B and 5-D. The filaments are typically formed but show variable breadth. Two groups of filaments could be discerned: one 8.8—12.2 μm in breadth and the other 6.6—7.8 μm. These dimensions do not strictly correspond with the forms quoted in the literature, but I do not see any need to create new varieties of this very characteristic species which above all occurs in tropical and subtropical regions. At any rate it is worth stressing the occurrence in the material from Lake Dariba of a form of filaments broader than those given in the identifications of Geitler and Desikachary. *Spirulina mossartii* was always an accompanying species.

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18. *Spirulina massartii* (Kuff.) Geitler

In Lake Dariba this species occurred in almost the same number as the one mentioned above. The filaments are 4.4—5.5 μm wide, the apical cell sometimes being spherical with a weakly developed caliptra.

Samples: 5-B, 5-D.

19. *Nostoc muscorum* Ag.

This was encountered with the remnants of mosses in sample IA but in small numbers.

20. *Nostoc sphaericum* Vaucher

This species also occurred in small numbers in samples 1-B and 2-B. Thalli 1—6 mm in diameter, spherical or plicate, filaments 3.3—4.4 μm wide, heterocysts spherical or elliptical 5.5—6.0—(7.7) μm wide, to 11.9 μm long.

21. *Nostoc minutum* Desm.

This was occasionally found in sample 8-A + B + C.

22. *Nostoc paludosum* Kütz.

This species occurred in not very great numbers in sample 11-Sc. Filaments are usually 3.3 μm wide, heterocysts 5.5 μm wide.

23. *Nostoc calcicola* Bréb.

Cells barrel-shaped 3.3 μm wide, heterocysts 5.5 μm wide, spores 5—6 μm wide with smooth membrane. It occurred in small numbers in sample 8-A + B + C.

24. *Nostoc verrucosum* Vaucher

Thallus plicate with thick periderma on the surface. In the margin parts of the thallus the filaments have distinct brown sheaths.

Sample 11-Tc.

25. *Nodularia spumigena* f. *maior* (Kütz.) Elenkin

Trichomes 11 μm wide, filaments 13—16 μm wide, cells 2—3 μm long, heterocysts 12—13 μm wide and up to 15 μm long, surrounded with a brown coat. Small numbers of this alga occurred in sample 8-A + B + C.

26. *Calothrix gelatinosa* (Böcher) Poljansky

Thalli composed of dense apparently branched filaments, developed in the way more or less characteristic for this species, occurred in not very great numbers in sample 2-A.

27. Calothrix *brevissima* G. S. West (fig. 3)

Filaments 4.6—6, μm broad at the base, trichomes 3.5—5.5 μm broad. Short filaments occurred in groups on *Rhizoclonium* filaments in sample 1-B.

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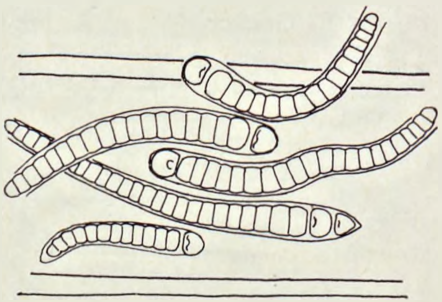


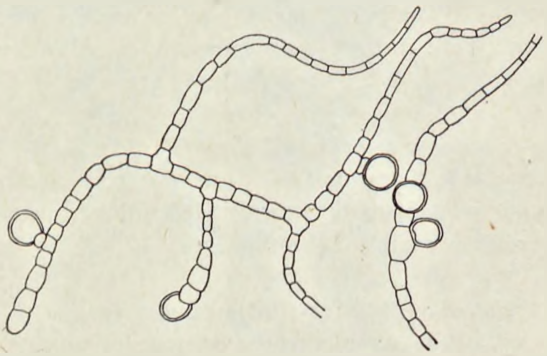
Ryc. 3 — Fig. 3. *Calothrix brevissima*

28. *Calothrix breviarticulata* G. S. West
This occurred fairly often, among other algae, in sample I-B.

29. *Scytonema crispum* (Ag.) Bornet
Filaments 21 µm wide, trichomes 16.6 µm wide, cells 3—(4) µm long, heterocysts 8—9 µm long. Small thalli of this species were encountered among other algae in sample 2-A.

30. *Plectonema puteale* (Kirchner) Hansgirg
Filaments 4.0 µm wide, trichomes 2—2.2 µm wide, occurred in small numbers among other algae in sample 1-B.

31. *Nostochopsis lobatus* (H. C. Wood) em. Geitler (fig. 4)
Filaments usually 4—5.3 µm wide, branches at the apex setulose, 1.8—2.0 µm



Ryc. 4. — Fig. 4. *Nostochopsis lobatus*

wide, heterocysts oval or globular, 5.6—9.0 µm in diameter. This species, characteristic for tropical regions, was found in sample IIA in not very great numbers but with typically developed filaments.

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Chlorophyceae

32. *Cladophora* cf. *glomerata* (L.) Kütz.
Only small fragments of the thallus were found in sample 2-A, therefore precise identification of this species was not possible.

33. *Rhizoclonium hieroglyphicum* (A. A. Ag.) Kütz.
Matted filaments of this algae occurred in samples 1-B and 2-A.

34. *Oocystis lacustris* Chodat

A few typical colonies of this algae were found in sample 2-A.

Besides, indeterminable filaments of the genera *Oedogonium* (samples IB and IIA), *Spirogyra* (sample IB), *Mougeotia* (sample 2-A), and *Tribonema* (samples 11-TA and 11-TC) were observed.

Rhodophyceae

35. *Audoinella hermanni* (Roth) Duby (= *Chantransia hermanni* Roth). Thalli of this red alga, also occurring in coolwaters of the temperate zone, were found in samples 1-B and 11-A. The blue-green alga *Dermocarpa xenococcides* was always found on the filaments of this alga.

Bacillariophyceae

The diatom species identified in various samples are given in a list (Table I), the frequency of the occurrence being marked.

General characteristic

In the investigated samples blue-green algae distinctly prevailed over other ones. Only the number of diatoms equalling them. Among blue-green algae most characteristic are the *Spirulina platensis* and *S. massartii* species, which produce water blooms in Lake Dariba. The same species occur in masses in the subtropical countries of Asia, Africa, and America. In some regions, e. g. in that of Lake Chad, they are used as food by the natives. In recent years they have been grown in mass cultures as they are believed to be more digestible than *Chlorella*. Various species of *Nostoc* genus were frequent. However, *Dermocarpa xenococcoides* and *Nostochopsis lobatus*, known only from tropical regions, are among the characteristic ones.

Among diatoms particularly characteristic and frequent species are *Biddulphia levis*, *Fragilaria pinnata*, *Epithemia turgida*, *Rhopalodia gibberula* var. *van heurckii*. Other species were found in smaller numbers.

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Tabela I. Zestawienie oznaczonych gatunków

Skala częstości: ooo - bardzo często; oo - często; o - dość często; rrr - rzadko; rr - bardzo rzadko; r - pojedynczo

Table I. List of indentified species

Scale of frequency: ooo - very frequent; oo - frequent; o - fairly frequent; rrr - rarely; rr - very rarely; r - single specimens

Stanowisko - Site	1		2	5		8	11			
Gatunek - Species	A	B	A	B	D	ABC	RA	So	TA	TC
Cyanophyceae										
Synechococcus cedrorum Sauv.		rr								
Synechocystis salina Wisl.						rrr				
Microcystis muscicola (Menegh) Elenkin						rrr				
Gloeocapsa minuta (Kütz.) Holl.			r							
Xenococcus kerneri Hansg.		rrr				rr				
Dermocarpa xenococcoides Geitl.		rr				r				
Chamaesiphon inorustans Grun.		o	rr				o			
- confervicola A. Br.			rrr							
- curvatus Nordst.		oc	c							
- subglobosus (Rost.) Lemm.		o								
Lyngbya aestuarii (Mert.) Liebm.							o			
- kützingii Schmidle		rrr								
Phormidium foveolarum (Mont.) Gom.			rrr							
- mucicola H-P et Naum.		rr								
Oscillatoria cf. jonica Skuja			c							
- cf. jasorvensis Vouk		rrr								
Spirulina platensis (Nordst.) Geitler				ccc	ooo					
- massartii (Kuff.) Geitler				ccc	ooo					
Nostoc muscorum Ag.	oo									
- sphaericum Vauch.		oo	oo							
- minutum Desm.						o	c			
- paludosum Kütz.						o	o	ccc		
- caloiocla Bréb.						c				
- verrucosum Ag.										oo
Nodularia spumigena f. maior (Kütz.) Elenkin						oo				
Calothrix gelatinosa (Bréb.) Poljansky			o							
- brevissima G.S. West		rrr								
- breviartioulata G.S. West		rrr								
Scytonema crispum (Ag.) Born.			o							
Pleotonema puteala (Kirchn.) Hansg.		o								
Nostochopsis lobatus W.C. Wood em. Geitl.			oo							
Chlorophyceae										
Cladophora cf. glomerata (L) Kütz.			oo							
Rhizoclonium hieroglyphicum (Ag.) Kütz.		oc	oo							
Oocystis lacustris Chod.			o							
Rhodophyceae										
Audouinella hermannii (Roth) Duby.		rr					rr			
Bacillariophyceae										
Cyclotella meneghiniana Kütz.						o			rrr	
Biddulphia levis Ehr.						co			oco	ccc
Diatoma hiemale var. mesodon (Ehr.) Grun.						o				
Fragilaria pinnata Ehr.							o		oo	
- vaucheriae (Kütz.) Peters.			o					rrr		
Synedra ulna (Nitzsch.) Ehr.	r	rrr	rrr				o	rrr		
- ulna v. amphirrhynchus (Ehr.) Grun.		rrr					rrr	rrr	oo	
Cocconeis placentula v. euglypta (Ehr.) Cleve						rrr			rr	
Achnanthes exigua Grun.						rrr			rr	
- lanceolata Bréb.				rrr	rrr		rrr	rrr	rrr	rrr
Diploneis ovalis (Hilse) Cl.									rr	rr
Anomoeoneis sphaerophora (Kütz.) Pfitzer						rrr				
Navicula cryptocephala Kütz.		rr		rr					rr	
- tuscula (Ehr.) Grun.									rrr	
- bicapitellata Hust.								rr	rr	
- dicephala (Ehr.) W. Sm.									rrr	
- radiosa v. tenella (Bréb.) W. Sm.								rrr	rrr	rr
Pinnularia microstauron (Ehr.) Cleve									rr	rrr
Caloneis bacillum (Grun.) Meresch.						o			rr	
Gyrosigma attenuatum (Kütz.) Rabenh.							rrr			
Amphora veneta Kütz.									rrr	rrr
Cymbella leptoceros (Ehr.) Grun.		rrr								
- turgida (Greg.) Cleve		rrr								
Comphonema longiceps Ehr.		rrr				o				
- longiceps f. gracilis Hust.						rrr		rrr		rr
- parvulum (Kütz.) Grun.		o	rrr				rrr		rr	rr
- lanceolatum Ehr.		rrr						rrr		
- capitatum Ehr.		rrr								
Epithemia turgida (Ehr.) Kütz.	r	oo				oo		c	rrr	
Rhopalodia gibba (Ehr.) O. Müll.		o								
- gibberula v. Van-Heurckii O. Müll.				rr		o	o	o	oo	
Nitzschia punctata (W. Sm.) Grun.								rrr		rrr
- microcephala Grun.								rr		rrr
- amphibia Grun.		o					rr	rr	rrr	rrr

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From green algae filamentous forms such as *Rhizoclonium*, *Cladophora*, *Spirogyra*, *Mougeotia*, *Oedogonium*, and *Tribonema* were represented. In some samples they formed the main bulk of algae, but unfortunately they occurred in an indeterminable state.

The presence of the red alga *Audouinella* should also be mentioned. This species also occurs in Europe in rapidly flowing, clear, but not very warm waters.

STRESZCZENIE

W próbkach glonów zebranych w r. 1964 przez Miss McGowan w górach masywu wulkanicznego Gebel-Marra w Sudanie oznaczono 31 gatunków sinic, 3 gatunki zielenic, jeden gatunek krasnorostów i 34 gatunki okrzemek. Do gatunków rzadko spotykanych należą: *Xenococcus kerneri* Hansg. i *Dermocarpa xenococcoides* Geitler. Ten ostatni znany jest jedynie z okolic tropikalnych, podobnie jak gatunki: *Spirulina platensis* (Nordstedt) Geitler i *S. massartii* (Kuff.) Geitler, które tworzyły obfite zakwity w jeziorze Dariba. Na glonach nitkowatych występowały często gatunki *Chamaesiphon*, wśród których można było odróżnić *Chamaesiphon confervicola* i *Ch. curvatus*, jakkolwiek ostatnio raczej łączy się oba te gatunki w jeden. Licznie występowały gatunki *Nostoc*. Do gatunków charakterystycznych dla okolic tropikalnych należy *Nostochopsis lobatus* (H. C. Wood) em. Geitler. W potokach na bystrym prądzie stale występował gatunek *Audouinella* (*Chantransia*) *hermanni* (Roth) Duby, spotykany również w Europie. W Europie spotyka się również wszystkie gatunki okrzemek oznaczone w próbkach ze Sudanu. Do rzadkich należy *Biddulphia laevis* Ehr., występująca raczej w wodach zasolonych.

Próbki otrzymałem za pośrednictwem dra Juliana Rzóski, któremu za przesłanie interesującego materiału serdecznie dziękuję.

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