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THE DEVELOPMENT OF STRIKING ALGAL MASS PRODUCTIONS AT THE ALPÁR-BASIN REGION OF THE TISZA-VALLEY*

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Abstract

The algal mass productions colouring the waters and soil surfaces at the Alpár-basin have been studied by author since 1975. Before 1984 at total of 25 water blooms and 25 algal mass productions colouring the soil were observed. On May 20, 1984, however, 70 algal mass productions colouing the soil and 10 water blooms were detected on the occasion of one single collection route.

As active component, the electric relations of the atmosphere and the atmospheric ionization, resp. were concluded. Krueger demonstrated in animal experiments that the effect of the monoamine oxidase is supported by small negative air ions, while the small positive air ions hinder this. The fact that auxin or one of its alterations may develop from serotonin in the case of the atmosphere's negative ionization partly explains the relationship between the algal mass production and the cyclonal weather conditions — particularly the showery Spring of the year 1984. Similarly, the large algal mass productions of the arctic areas are also explained by ionization effects. Here the radiation zone is missing and the particles arriving from the interplanetary space may deeply penetrate into our atmosphere. Photoperiodicism may also be a factor of mass production.

Introduction

The Tisza-III-River barrage and its large water-basin will be built in the future at the area located from the village Bokros till Tőserdő of the Tisza-valley lying North from the city Csongrád. Therefore, the safe handling and intensive utilization of this vast technical establishment necessitate the thorough as possible exploration of this area's natural relations. This necessity initiated the Tisza-Research Committee to include this section of the Tisza-valley into the researches carried out on the explorative studies of natural relations. This area is comprehensively called the Alpár-basin since its central region is formed by the relief of the backwater near the village Tiszaalpár and its environs, which relief originates from the beginning of the Holocene and has deep location. To the North of the Alpár backwater the Lakitelek back water is situated near Tőserdő, the Western side of which is joined by one of the processes of Little Cumania's sand land. The Southern section of the Alpár-basin is formed by the streamy meadow besides the village Bokros, called "cow-track" by the former inhabitants. The marshy water-flows here mostly reach the backwater and also carry the dungy soiling washed in from the meadow of the close "cow-track" into the

*Various parts of this paper have been presented by author at the Botanical Section of the Hungarian Society of Biologists on Nov. 5. 1984, at the XXVI. Meetıng of Hydrobiologists on Nov. 15, 1984, and at the XV. Tisza-Research Conference on Nov. 29, 1984.

backwater. Both backwaters are young formations, developing on the effect of cutting of large bends during the course of regulating the river Tisza.

The algological exploration of these two backwaters was performed by author from 1975 till nowadays, and will probably be finished by the time the building of the river-barrage and water-basin will commence, for the purpose of thorough as possible knowledge (Kiss 1978a, 1978b, 1979a, 1979b, 1979c). Our research objective is considerably of benefit to environmental protection, too, as our waters preserved in natural condition are in the danger of becoming eutrophized (eutrophicated?). The enrichment of these waters by anorganic and organic plant-nutrient solution brings forth the mass production of algae, especially the constituents of the phytoplankton. This not only indicates the degree of increase in trophity and saprobity, but also greatly unfavourably influences the possibilities of utilization. It is first of all this which gives reason for examining this area — based on the knowledge regarding the algae forming coloured mass productions in the water and on the soil surface — even according to the viewpoints of water protection and qualification within environmental protection. This work is also of nature conservancy concern since in significant length, the Western section of the Lakitelek—Tőserdő backwater's strong bend belongs to the nature conservancy area of the Kiskunság National Park, together with the elongated patches of the South-located marsh.

Materials and Methods

During the course of author's earlier studies the places of water sampling were determined with the consideration of the ecological fundamentals. At every site samples were also always taken from the algal mass productions colouring the waters and the soil surfaces. The largest amount of mass production appeared in the small shallow puddles and on the soil surfaces near the backwaters. This phenomenon was particularly striking in the showery Spring and early Summer of 1984, since the "water bloom" (flos aquae) and "soil flowering" (flos humi) caused by the algae appeared everywhere at about the same time, almost "accumulatedly". This simultaneously "accumulating" occurrence indicates the studies on the development of the mass productions not only from the viewpoint of nutritive substances, but also from that of the effect of the atmosphere. This also promises newer results for the knowledge on plant life. Besides the species composition of the algal flora, author also always turned attention to its vegetation forms (plankton, neuston, periphyton, psammon, lasion, benthos, krypto-vegetation). Taxonomic determination was carried out on living matter, thus at the time of bioseton-probes 1 litre water always remained unfixed and 1 litre was fixed with formalhedyde. On occasions the algal soil samples kept in Petri-dishes were also used for the preparation of aga-cultures. The quantitative studies were performed with the so-called "drop-method" elaborated earlier by author, with the use of Bürker-chambre. Physiological experiments were also performed occasionally. A few rare or characteristic species are shown on microscopic pictures.

The pH value of the water fluctuated between 7,2—7,8 in both backwaters till 1980, 8,0 pH value was only observed at one place of the Alpár backwater in the Summer of 1978. Recently during the Summers of 1983 and 1984 the waters of both backwaters showed pH values of 8,1—8,2 (This allows the conclusion of alkalinization). The water chemical analysis demonstrated the pH value of the water as being above 8,0 in the holiday resort district of the Alpár backwater. The waters of the so-called "cow-track" at the Bokros region showed pH values somewhat higher than 8,0, furthermore, in the Autumn of 1983 the striking pH value of 9,0—9,5 could be measured at two points of the marshy dip. Therefore, alkalization appears definitely patchedly at times here, too, due to which the chemism of the soil and water is of mosaic heterogenic nature, i.e. briefly: "pied".

Results and discussion

In the followings brief review is given of the algal mass productions detected in the waters and on the soil surfaces at the area of the Alpár-basin. The majority of the aquatic mass productions developed near the backwaters and at times in shallow puddles farther off, since mostly these could become more rich in anorganic and organic plant nutrient solutions.

Following this, the question is analysed how the atmosphere — apart from the favourable temperature and precipitation amount — may stimulate the flora for more enhanced life-functions, in the present case the algae for the development of mass productions. As a matter of fact, this has not been analysed so far in the field of ecology and plant physiology.

A) Water blooming mass productions (flos aquae)

The water blooms detected at three main areas of the Alpár-basin of the Tisza-valley were the followings in chronological order according to dates:

1. On June 15, 1975 the water in a deep puddle at the Northern coastal region of the Alpár backwater was pale green till a depth of cc. 10 cm. This vegetational colouring was caused by the production of the *Pediastrum Boryanum* REINSCH (Plate II. 4).

2. At the same time dark green mass production partly of neuston nature was produced by the A *Phacus pyrum* (EHR.) STEIN at the Eastern border of the village Tiszaalpár (Plate I. 3).

3. Also at this date the water bloom of the *Phacus pseudonordstedtii* POCHM. coloured the water of a deep pit dark green at Tiszaújfalu (Plate I. 1).

4. On June 15, 1975 the water of a deep pit at the Eastern border of Tiszaalpár was of pale yellowish-green colour. This mass production was produced by the *Schroederia rubusta* KORS. (Plate II. 1), the *Rhopalosolen cylindricus* (LAMB.) FOTT (Plate II. 8) and the *Rhopalosolen Sebestyenae* FOTT (Plate II. 3).

5. On June 22, 1975 the greenish-gray water bloom of the *Tétrachloris inconstans* PASCHER (Plate I. 5) could be detected in a digged pit beside the Northern section of the Tőserdő backwater. The water was coloured till the depth of about 0,5 m.

6. On May 18, 1976 the lasion-network of the *Spirogyra insignis* (HASS.) CZURDA hindered boating at the Southern, not protected section of the Tőserdő backwater.

7. On September 29, 1976 the bluish-gray water bloom of the *Microcystis aeruginosa* f. *aeruginosa* STARMACH and the *Microcystis aeruginosa* f. *flos aquae* (WITTR.) ELENK. was observable at the Northern section of the Tőserdő backwater (KISS 1978).

8. At the same date, somewhat East to here, the water bloom of the *Aphanizomenon flos aquae* (L.) RALFS coloured the water bluish-gray (KISS 1978).

9. Also on September 29, 1976 the green water bloom of the *Phacus tortus* (LEMM.) SKVORTZOV (Plate II. 5.) was found by author in a small dip containing polluted water at the Alpár backwater's flood area. The water was coloured in almost every layer.

10. On May 28, 1977 the yellowish-green water bloom of the *Dinobryon sertularia* EHR. was noticed at the Northern region of the Tőserdő backwater (KISS 1978).

11. At the same time, also here, the water bloom of the *Eudorina elegans* EHR. coloured the water patchedly bright green on several hundred m² (KISS 1978).

12. The *Phacus longicauda* (EHR.) DUJ. (Plate II. 2) caused the pale green water bloom in a pit besides the Southern section of the Tőserdő backwater. With small individual number, the *Euglena intermedia* (KLEBS) SCHMITZ (Plate II. 9) also participated in the formation of the mass production. Date: May 28, 1977.

13. On August 5, 1978 pale green water bloom was detectable in a deep pit beside the Alpár backwater which was caused by the *Scenedesmus acuminatus* (LAGH.) CHOD. (Plate I. 2, 4), the *Kirchneriella contorta* var. *lunaris* RICH. (Plate I. 7) and the *Oocystis socialis* OSTENF.

14. At the same time, dark green water bloom was observable in another pit of the Alpár backwater caused by the *Lepocinclis acuminata* DEFL. (Plate I. 6).

15. On August 5, 1978 the stagnant water of a channel at the Northern coastal section of the Tőserdő backwater was bluish-black by the masses of *Oscillatoria Boryana* (AGH.) BORY (Plate I. 9). This organism was probably not of termophyl biotype.

16. At the same time, the pale green water bloom of *Scenedesmus ecornis* (RALPH.) CHOD. (Plate II. 6) and *Scenedesmus securiformis* PLAYF. (Plate II. 7) was found in a shallow pit at the border of Tiszaalpár.

17. At the area of Bokros, in the water of the long dip of the "cow-track" the green water bloom of *Euglena polymorpha* DANG. was observable on June 1, 1982.

18. On June 12, 1982 the grayish-blue water bloom of *Microcystis aeruginosa* KÜTZ. was observable at the entrance of the beach section of the Alpár backwater.

19. At the same date the water bloom of the *Aphanizomenon flos aquae* (L.) RALFS coloured the water dark gray about 100 metres from the previous water bloom.

20. On August 4, 1982, the *Euglena Ehrenbergii* KLEBS coloured the water bright green with spectacularity at the Northern part of the Tőserdő backwater.

21. On October 25, 1982 the yellowish-green mass production of neuston-nature of the *Euglena sanguinea* EHR. was detectable in the water of the long dip at the area of Bokros.

22. At the same time, somewhat farther, the *Microcystis aeruginosa* KÜTZ coloured the shallow water bluish-gray.

23. Even farther, also at the same period, the dark-gray mass production of the *Aphanizomenon flos aquae* (L.) RALFS was observable.

24. On June 26, 1983 the mass production of the *Tribonema* species was found at the Tőserdő marsh. The most frequent were the *Tribonema vulgare* PASCHER, *T. minus* (WILLE) HAZEN, *T. elegans* PASCHER, *T. aequale* PASCHER, *T. subtilissimum* PASCHER.

25. On September 6, 1983 such mass production of the *Anabaena spiroides* KLEBAHN was observable in the agricultural co-operative fish pond established at the Alpár basin, in which the trichonomes divided into planococcus cells, and staying together they were remarkably like the *Microcystis* colonies.

On May 20, 1984 the algal mass productions were strikingly frequent in the waters of the Alpár basin. These were the followings:

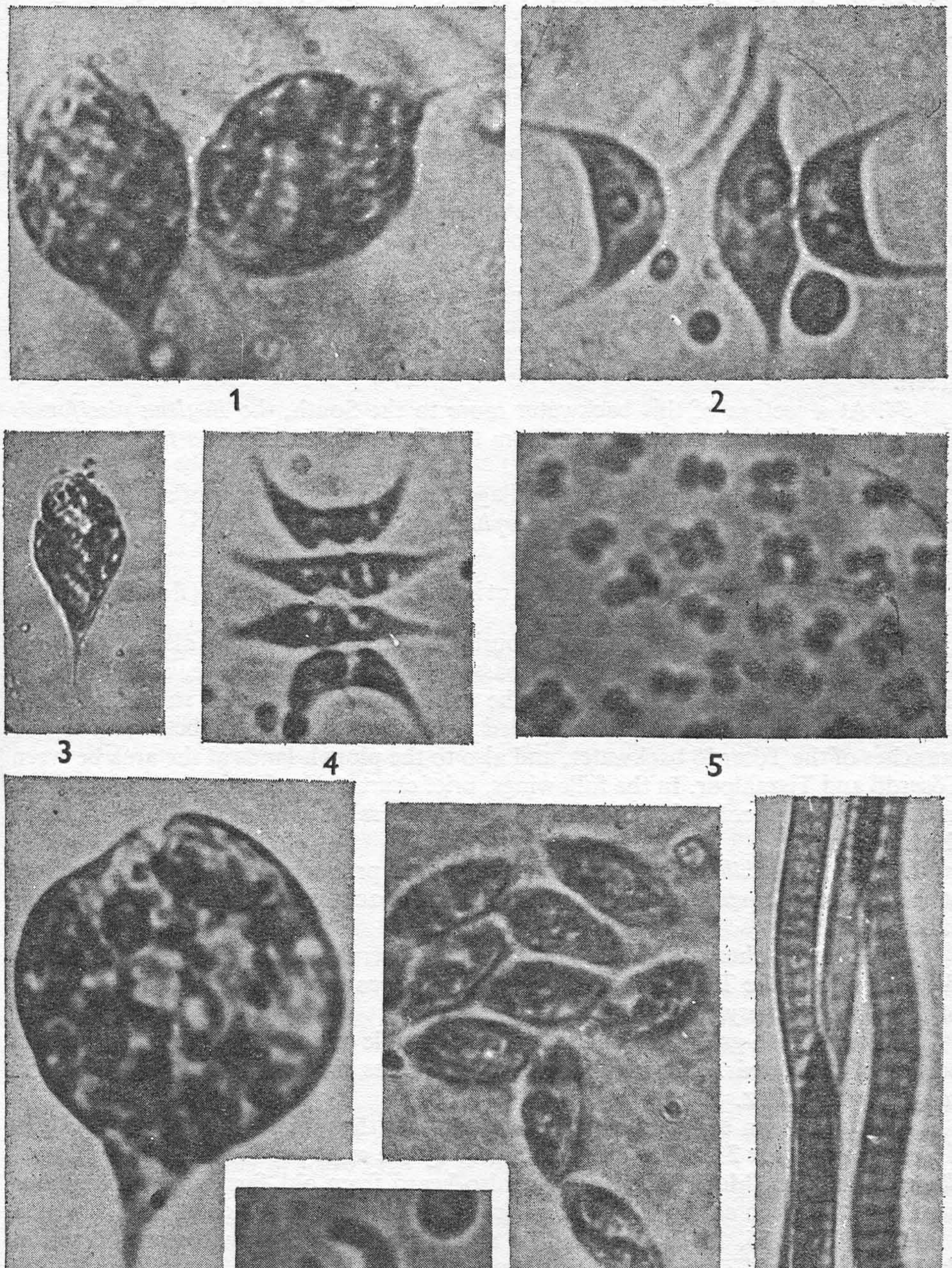
26. At the Northern section of the Tőserdő backwater, the *Eudorina elegans* EHR. coloured the water green at a length of several hundred m^2.

27. More to the South, the *Aphanizomenon flos aquae* (L.) RALFS formed dark

Plate I

1. *Phacus pseudonordstedtii* POCHM, 1500:1.
2. *Scenedesmus acuminatus* (LAGERH.) CHOD. (? forma) 1200:1.
3. *Phacus pyrum* (EHR.) STEIN 600:1.
4. *Scenedesmus acuminatus* (LAGERH.) CHOD. 1000:1.
5. *Tetrachloris inconstans* PASCHER 1000:1.
6. *Lepocinclis acuminata* DEFL. 1500:1.
7. *Kirchneriella contorta* var. *lunaris* RICH. 1200:1.
8. *Oocystis socialis* OSTENF. 1000:1.
9. *Oscillatoria Boryana* (AGARDH) BORY 1000:1.

Plate I



gray water bloom. The vegetational colouring was even observable at a depth of 20 cm.

28. At the Northern part of the Alpár backwater the *Eudorina elegans* EHR. coloured the water.

29. At the Eastern border of Tiszaalpár the water of a pit was also coloured bright green by the *Eudorina elegans* EHR. The water bloom was starting to waste away.

30. At the central part of the Alpár backwater, the increased amount of the *Phacus tortus* (LEMM.) SKVORTZ. caused green colouring. This was also wasting away.

31. At the central branching of the Alpár backwater the bluish-gray water bloom of the *Microcystis aeruginosa* KÜTZ. coloured the water gray at an area of several hundred m^2.

32. Near the former, the *Euglena polymorpha* DANG. coloured the water green.

33. At the coastal region of the beach at Alpár, the partly neuston-like water bloom of *Euglena intermedia* (KLEBS) SCHMITZ coloured the surface of the water dark green.

34. At a section of this backwater more to the South, the *Euglena pisciformis* KLEBS produced dark green water bloom together with the *Euglena tripteris* (DUJ.) KLEBS.

35. At the Eastern border of the village Tiszaújfalu, the water of a pit was coloured dark green by the *Euglena polymorpha* DANG.

B) Soil-colouring algal productions, "soil blooms" (flos humi)

Many algal mass productions colouring the soil were found also at the area of the Alpár basin. Their amount surpassed 100 by far, therefore, only the most characteristic ones will be reviewed. The soil sampling had been started in 1975, and in 1976 this collection was expanded to the Nagyrét located between the two branches of the Tőserdő backwater, and also to the plough-lands at the area between Tőserdő and Tiszaalpár. In the followings, brief characterization is given of the algal mass productions colouring the various soil surfaces, as well as the layers beneath the surface:

1. The *Planophila asymmetrica* (GERN.) WILLE produced yellowish-green stripes at the soil surface near the bridge of the Tőserdő backwater. Time of observation: June 22, 1975.

2. Green patches of the soil surface were observable on June 22, 1975 at the Western side of the Tőserdő backwater. This was produced by the mass production of the *Planophila asymmetrica* (GERN.) WILLE.

3. Dark bluish-green soil patches were observable on June 15, 1975 at the Eastern border of Tiszaalpár. This was formed by the mass production of the *Gloeocapsa conglomerata* KÜTZ.

4. Bluish-green soil surface was detectable at the maizefield of the Nagyrét at Tőserdő on August 21. 1976. This was caused by the mass production of the *Phormidium floveolarum* (MONT.) GOM. It was also heard from old farmers by the author here, that the green coloration of the plough-lands is the sign of good crop.

5. On May 16, 1976, blackish-blue soil stripes were observable on the soil at the forest brim of Tőserdő. This was caused by the *Oscillatoria laetevirens* (GROU.) GOM. and by the *Gloeothece membranacea* (RABH.) BORN.

6. On September 29, 1976 palm-sized bluish soil surfaces could be detected at the Eastern border of Tiszaalpár, produced by the *Phormidium autumnale* (AG.) GOM.

7. At the same place, on the same date, bluish-green stripes were observable on humid soil surfaces caused by the mass production of the *Phormidium molle* (KÜTZ.) GOM.

8. On September 29, 1976 grayish-blue patches could be observed on humid soil surfaces at the border of the peatmarch at Alpár. This was formed by the *Symploca cartilaginea* (MONT.) GOM.

9. Dark green patches were observable on the plough-land between Tiszaalpár and Tőserdő on September 29, 1976. This was produced by the mass production of the *Plamella miniata* LEIBL.

10. On September 29, 1976 dark bluish-green soil stripes were found at the plough-land between Tiszaalpár and Tőserdő, formed by the *Phormidium autumnale* (AG.) GOM.

11. On September 29, 1976 wide yellowish-green stripes could be detected at the plough-land between Tiszaalpár and Tőserdő, caused by the *Coccomixa dispar* SCHMIDLE.

12. Kitchen-garden-like green patches were observable on the soil surface between Tiszaalpár and Tőserdő, developed by the *Palmella miniata* LEIBL. Time of observation: September 29, 1976.

13. At the same date green patches of the soil surface were observable at the Southern border of Tiszaalpár. This was produced by the *Chlorococcum humicolum* (NAEG.) RABH. The soil was also coloured beneath the surface.

14. At the same place, on the same date, bluish-green soil surface was observable developed jointly by the *Nostoc muscorum* KÜTZ. and the *Phormidium foveolarum* (MONT.) GOM.

15. On November 3, 1976 the surface of the plough-land at the Tőserdő Nagyrét was bluish-green at places caused by the *Phormidium molle* (KÜTZ.) GOM. and the *Oscillatoria tenuis* AG.

16. On November 3, 1976 the surface of the humid soil at the Southern border of Tiszaalpár was found to be dark green at an area of about 200 m^2. This was caused by the mass production of the *Palmella miniata* LEIBL.

17. On February 18, 1977 the cleftly steep loess-wall beside the church at Tiszaalpár was grayish-green. This kryoproduction was produced by the *Hormidium flaccidum* A. BR.

18. At the same place, on the same date, more to the South, the frosty surface of the loess-wall showed dark green stripes caused by the *Hormidium flaccidum* A. BR. and the *Chlorella miniata* (NAEG.) OLTM.

19. Also on February 18, 1977 blackish-bluish stripes were observable on the steep loess-wall near the beach at Alpár. The *Phormidium foveolarum* (MONT.) GOM., the *Phormidium molle* (KÜTZ.) GOM. and the *Nostoc muscorum* KÜTZ. could be determined in the alga-community.

20. On August 5, 1978 green or bluish-green coloring was found at 12 places on the clefty clayey-loessy wall of the Alpár backwater. The *Hormidium flaccidum* A. BR. was dominating in every case. Blue algae were rarer.

21. On the still damp and dark green soil surface of a dried up puddle at the Western side of the Tőserdő backwater the dark green "soil bloom" of the *Chlamydomonas Reinhardi* DANG. was wasting away. The cells proportioned to mostly protococcoidlike smaller units. Date: August 5, 1978.

22. Also on August 5, 1978 green soil surface was found in a length of cc. 10 m and width of 10—20 cm at the rim of the road at the Tőserdő Nagyrét. This was caused by the mass production of the *Palmella miniata* LEIBL. and the *Coccomyxa dispar* SCHMIDLE.

23. The soil surface of a dried up puddle at the "cow track" near the village Bokros was dark green, formed by the protococcoid forms of a *Chlamydomonas spec.* Date: June 1, 1982.

24. On June 26, 1983 the *Chlorococcum infusionum* (SCHRANK) MENEGH. caused a palm-sized dark green patch at the sodic meadow near the Tőserdő marsh.

25. At the same site, on the same date, light green patches could be seen. Only the *Coccomyxa dispar* SCHMIDLE was determinable from the alga-community. Dungy patch was observable earlier.

On May 20, 1984 a strikingly large number of soil surfaces showed algal mass productions at the area of the Alpár basin. These were caused by the followings:

At the area of Tőserdő:

26. The *Nostoc muscorum* (KÜTZ.) HARIOT caused bluish-green patches on the forest-road.

27. The paved bed and wall of the "Spring" was covered completely with blackish bluish-green periphyton layer. Such developed algal coating was not observed earlier here. It was caused by blue algae; the dominating species was the *Calothrix brevissima* G. S. WEST.

28. Dark green patches were formed by the *Coccomyxa dispar* SCHMIDLE at Nagyrét.

At the environs of Tiszaalpár:

29. Melted bluish-green soil patches were observed, caused by the *Nostoc muscorum* KÜTZ.

30. In a street, the *Coccomyxa dispar* SCHMIDLE formed large green patches.

31—58. Dark green patches appeared on the steep clefty loess-wall at 28 places (areas). In these the *Hormidium flaccidum* A. BR. was of dominant character.

59—95. At 37 areas of the steep clefty wall blackish bluish-green patches, stripes were found in which the *Nostoc muscorum* KÜTZ. was dominating.

Earlier the followings were written by author regarding the striking colorations on the clefty embankment of the Alpár backwater (KISS 1979c): "At times, the coloration caused by algal mass production offered particularly picturesque view at Tiszaalpár on the steep embankment of the backwater at the section falling to the former village Alpár. On occasions, the 6—8 m high wall surface was almost vertically coloured green or bluish-black by stripes or patches of several metres. The animating moisture was provided by the water flowing periodically on the rim of the cleft. In the development of these mass productions the primary role was mainly played by the representatives of the *Cyanophyta* phylum. Elderly farmers

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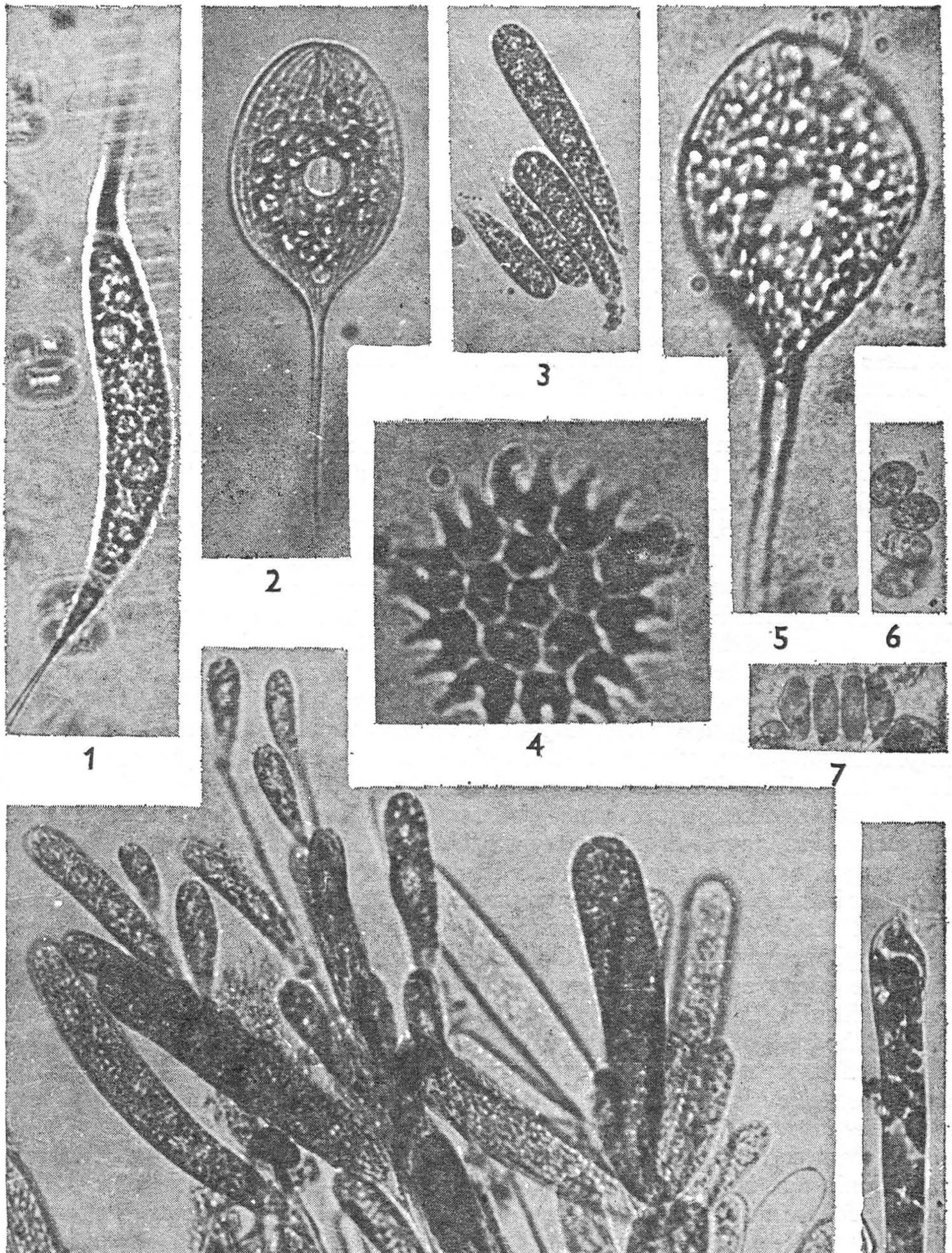
Plate II

1. *Schroederia robusta* KORS. 1000:1.
2. *Phacus longicauda* (EHR.) DUJ. 700:1.
3. *Rhopalosolen Sebestyenae* FOTT 500:1.
4. *Pediastrum Boryanum* REINSCH 400:1.
5. *Phacus tortus* (LEMM.) SKVORTZOV 900:1.
6. *Scenedesmus ecornis* (RALFS) CHOD. 400:1.
7. *Scenedesmus securiformis* PLAYF. 800:1.
8. *Rhopalosolen cylindricus* (LAMB.) Fott 400:1.
9. *Euglena intermedia* (KLEBS) SCHMITZ 400:1.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here, too, spoke of the phenomenon that the occasional sudden animation of these stripes are generally the indicators of rain or weather tending to rain. The meteorobiological basis of this will be discussed elsewhere".

The multitude algal colorations now definitely propound this question.

Meteorobiological bases of the algal mass productions of the waters and soils

The productivity in the waters and soils could not have been greater in 1984 than earlier, yet the colorations by mass productions were by far more frequent in the year 1984. At the Alpár basin a total of 25 water- and 25 soil-colourings appeared during the course of 6 years prior to 1984, nevertheless, 70 soil- and 10 water-colourings were found during the May of 1984. The soil surfaces and tree trunks showed greener coloration not only at the area of the Alpár basin, but everywhere. The marks of these were observed by author at the end of June, 1984 even in Transdanubia. However, the Spring and early Summer were unusually showery, which automatically turned the attention to the weather when seeking for the causes.

At the Northern border of Pusztaföldvár, in the Summer of 1930 author's father called the attention to the old Hungarian folklore about the weather, according to which the green coloration of the waters indicates the coming of rain or weather tending to rain. "The water is turning green, rain is coming", or "The water has turned green, we'll be getting some rain" — says the weather regulation. At that time author only smiled at the "prophecy", but by next day he began to suspect that the abundant experiences of sharp-eyed anonyms of centuries or millennia stand in the background of this regulation — since next day the rain arrived. In the followings author compared the mass productions of algae with accurate meteorological front- and air-mass analyses. Author should like to express his sincere thanks here, too, to the expert Hungarian meteorologists, L. Aujeszky and Z. Ozorai, for their kind help. It has been successfully verified that the mass productions of algae are connected in general outline with cyclonal-depressional phases of the weather. If the trophity of the water and the physical state of the organism in question is satisfactory, mass production may appear in such meteorological situation. In such a case mass productions may occur almost simultaneously in whole country regions. This accumulative character in a large space is similar to the so-called "weather-sensitivity" phenomena of man, therefore the algal mass productions could be regarded as the "weather-sensitivity" phenomena of the algae. Only the atmosphere is capable of displaying about the same effects on the living world of whole regions, by this means practically "comprehending" whole regions (Kiss 1957a, 1957b).

On the basis of the front- and air-mass analyses author first thought of the alga-feeding effect of the nitrogenoxids (N_2O, NO) (Kiss 1942), as these had been demonstrated in the descending air flows of the foehn-like weather. Author's work was promoted by knowledge of Kestner's theory which traced the "weather sensitivity" of man back to the descending air flow of the space before shower front (Böe) and to the ionization of the foehn wind's air, resp. (Kestner 1923, 1931a, 1931b). Here, only the followings are recalled in respect to author's first experiments of ionization: "In the knowledge of the foregoings I performed ionization experiments regarding the multiplication of a few unicellular green algae on several occasions from the end of the thirties. The algae proved to be rather sensitive to UV-light" (Kiss 1964). Accepting the existence of ionizational effects author wrote of the role of the foehn-wind at flat country as follows: "Therefore, despite the fact that the fronts and flat country-foehns are differing atmospheric happenings, they must contain such meteoric factors which are of the same effect; i.e. they equally call forth the phenomena of weather sensitivity. These common factors hould be searched for in the ionization and electric state of the air, resp." (KISS 1964). Our ionization experiments were further continued in the second half of the sixties and first part of the seventies, mainly with the phylum species of the *Euglenophyta* and the *Volvocales* order. The ionized air of the sealed glass-cupboard activated the movement of the organisms to a certain extent, which was also evident in the more intensive flapping of the flagella. The cells treated in such manner sometimes perished sooner.

It is known from much earlier that at the time of foehn winds the predominance of the positive ions develops in the atmosphere, and this is by which the so-called annoying effect of the foehnweather on man is explained. The physiological role of the atmospheric ionization had been studied in detail by CSIJEVSZKIJ (1937) on bacteria. It was PECH (1926) who first emphasized the fact that certain plants necessitate determined electric space; demanding either positive or negative electric space. In case they do not obtain this, they fall behind in development and even the harm of parasites may become enhanced. KRUEGER et al. (1962, 1964) studied the effect of the small ions in the air with great detail .These authors manifested cc. 50% enhancement of the growth rate of plants up to a density value of 10,000 ions/cm^3, especially in the case of barley, oat and lettuce. In ion-deficient air the plants' metabolism slowed down, their growth decreased and their vegetative parts fell to withered state (became withered).

The next question is, by what means does the ionized air cause (bring forth) the phenomena of "weather sensitivity" in man, animals, plants, and in our case, in the algae producing mass productions. Evidently, each one is "weather sensitive" according to its own character, thus their phenomena are rather divergent. Nevertheless, the atmospheric ionization finds "target" in every living plasma, to a large extent in the "leaders" ("managers") of life; the enzymes. Question marks are abundant in this field, but their obliteration promises fundamentally new knowledges. Thus the general question is: how does aeroionization display effect on the functioning of the enzymes? The most expedient is to analyse this basic question on the example of a very important biogenic amine wide-spread in the living-world; the serotonin 5-hydroxy-triptamine (5-HT). It has been known that serotonin is decomposed by the enzyme monoamine-oxidase (MAO): oxidating it to indole-acetic acid. The contradictory effect of the positive and negative air ions on the enzyme monoamine-oxidase has been demonstrated by KRUEGER with animal experiments. Together with his co-worker he wrote the followings (KRUEGER and REED 1976): "In 1959 we found, by direct measurement, that negative air ions reduced the amount of free 5-HT normally present in the tracheae of mice and rabbits. When we exposed guinea pigs to negative ions and collected all the urine, we observed a considerable increment in the amount of 5-hydroxyindoleacetic acid, an inactive end product of the oxidation of 5-HT. These data suggested that negative ions lower tissue levels of 5-HT by accelerating this enzymatic oxidation process. Such a mechanism is consistent with the evidence of earlier experiments indicating that negative air ions can affect tissue oxidative reactions. When we exposed tissue homogenates in vitro to large doses of negative ions the rate of conversion of succinate to fumarate was notably increased. This demonstrates the ability of negative ions to promote one phase of the aerobic metabolism of carbohydrates in the Krebs cycle which produces the lionn's share of energy for all organisms that use oxygen in respiration. Similarly, treatment of the reduced form of cytochrome c with negative ions speeded up the formation of the oxidized form. Later it was observed in experiments with plants that air ions increased the uptake of iron. promoted production of cytochrome and other iron-containing enzymes, and enhanced oxygen consumption.

Many tissues contain the enzyme monoamine oxidase. Because the chief metabolic rouet for removing serotonin depends on oxidative deamination by monoamine oxidase, we advanced the hypothesis that small negative ions stimulate while small positive ions block monoamine oxidase action, thus producing, respectively, a drop or rise in the concentration of free 5-HT present in certain tissues and eliciting a corresponding physiological response. The probable validity of this hypothesis was established in extensive experiments conducted over a period of 16 years, with a genetically uniform strain of mice exposed at ground potential to preselected concentrations of small air ions in pollutant-free air under controlled conditions of temperature and humidity. High concentrations of positive ions raised blood levels of 5-HT, while high concentrations of negative ions had the opposite effect. We also found that the brain content of free 5-HT was responsive to the concentrations of air ions in the air. (In the course of this work, we have performed spectrofluorometric analyses on more than 12,000 brain and 36,000 blood samples from controls and ion-treated mice)."

These rather thorough and lengthy experimental results have also been strengthened by studies of others, therefore these can be regarded as the general mechanism of the atmospheric ionic effect. If the negative ion-overload appearing in the free atmosphere also acts stimulatingly on the enzyme monoamine oxidase, then we also gain a key for getting closer to the understanding of the algal mass productions and in general, the secrets of plant production. Serotonin is also known from the flora (*Lycopersicum esculentum, Gossypium hirsutum, Panacolus campanulatus,* etc.). Enzymatically, indole-acetic acid and 5-hydroxy-indole-acetic acid, resp. is formed from it, i.e. auxin or one of its alterations, in the case of atmospheric negative ion-overload. Auxin can also be found in algae, its effect is in relationship with the photosynthetic alimentary form. It has stimulating effect on the cell division of the green *Euglenophyton* species, but has no effect on their achromatic cognates. The formation of auxin, setting out from the triptophan amino acid, may perhaps even differ according to plant groups. *The fact that enzymatically auxin may develop from serotonin in the case of negative ion-overload, partially explains the relationship be tween the phenomena of algal mass production and the cyclonal atmospheric conditio ns, especially the showery Spring of 1984.* The problem range has been investigated by author for over 50 years, and here we can only refer to the most important stations in this respect (KISS 1942, 1950, 1952, 1953, 1955a, 1955b, 1957a, 1957b, 1958a, 1958b, 1959a, 1959b, 1960, 1961, 1964, 1969, 1979a, 1979b). Author's results proved to be new, and three objections were set forth to them. Namely:

1. Water coloration "forecasting" change in the weather is unfamiliar in ethnography. Author's answer: The following regulation from Veszprém county became known in 1949: "Rain will arrive by the third day if there is a watery moon (if the halo of the moon can be seen), the sun sets amidst coluds if the colour of the puddle, standing water is green" (SÜLE 1949).

2. Water bloom indicating change of weather is not known from the literature. For answer, such publications were searched for by author in which the time-point of the beginning of mass productions was also reported on. Such exact reports were given by SZABADOS (1936), SEBESTYÉN (1934), KOL (1949), 1968, GELEI (1950), PALIK (1955). These were analysed meteorobiologically and completely verified the reality of author's notion.

3. Why doesn't an alga culture always signal the change of weather? Answer: The algae are not instruments which could be handled to preference. Ontogenetic processes take place in their evolution, and the individual development is a process taking place only once, being suitable for signalling only one concrete atmospheric process.

It is also expedient to speak of the relationship between the water bloom of cold seas and aeroionization, Attempt was also made by author to interpret the rich phytoplankton production of polar regions on the base of enhanced aeroionization (Kiss 1979b). It was perhaps Darwin who first discussed this question (who first wrote about this question). He wrote the followings in his book about his trip around the world: "I can mention the remarks of Scoresby, according to which green water can constantly be found at certain parts of the polar seas, which are extremely rich in animals living in surface level". He wrote of their development as follows: "... it should be assumed that the organic bodies are produced at certain favourable places after which the water or wind carry them off (they are carried away by the water or wind). However, I must admit it is difficult to imagine such a place which serves as the place of birth of millions and millions of animals and algae: because how do the initial bodies get to such places?" Darwin himself also mentions the coloration of sea water in several parts of his book and lists several authors in footnotes, who spoke of the planktonic coloration of sea water (Darwin 1951). At the Antarctic Mirnij research establishment Bujnickij, the well-known antartic explorer, carried out experiments over a period of several years. In a brief report an account is given of his experiences as follows: "...the ice is practically engorged by the myriads of tiny, unicellular sea-plants, of which more than one hundred species live and develop on and under the ice — surviving the most coldest weather, too." According to his opinion: "... through the melting of the ice such a nourishing soup is gained by which numerous simple forms of life can subsist on" (Várhelyi 1975). In Hungary, Balogh (1980) writes on the rich living world of the polar regions in detail. He writes the followings in the chapter entitled "Sea currents": "A biologist named the plankton of the sea thin meat soup. This naming is very appropriate, and as the token of the previous scientific explanation it can also be added that this meat soup is the thickest in the cool (cold) seas. The Humboldt-current has probably been carrying up the plankton alongside the shores of South-America since millions of years".

The atmospheric ionization is presumably stronger at the polar regions, as here the particles, protons and electrons arriving from the direction of the sun are less hindered in penetrating to the lower parts of our atmosphere, and constantly maintain the considerable ionization of the air there. The great energy zone, the system of the van Allen-zone or Vernovrings has become known through space-researches. The cause of this great energy radiation zone is that the magnetic field of our planet captures and even holds on to the protons and electrons originating from the sun, being an actual trap for these. This radiation zone extends above the earth surface confinable by the polar circles on an average from 1000 kilometres height upwards till heights of several ten thousand kilometres (Nagy 1964). The radiation zone is practically missing above the areas beyond the polar circles, therefore the particles can penetrate down to the lower layers of our atmosphere. If at the polar regions it is also possible that in case of the negative ion-overload of the atmosphere, auxin or its mentioned alteration may develop enzymatically from serotonin, general in the living world, then partial explanation is obtained to the development of the rich algal mass productions at the polar regions, too. Naturally, photoperiodicism may also be of significance among other factors. If the spaces above the polar regions actually function as planet-sized ionizers, then in the more distant future these can be utilized for the big industrial establishment of organic matter production with algae. This would contribute to the complete utilization of the biomass and at the same time would also mean the setting of the polar regions into the production.

Despite the many showers, the Spring and early Summer of 1984 were droughty, which damaged (was harmful to) our cultivated plants. Nevertheless, the *Helianthus annuus* shot up suddenly at places, and the *Lycopersicum esculentum,* the *Armeniaca vulgaris (Prunus armeniaca)* and the *Prunus domestica* crops were also unusually high at places. It is presumable that the air-ionizing effect of the weather with lightnings and showers also played role in this.

We hardly have any knowledge on the effect of air ions on enzymes, thus further explorations in this regard may contribute much to physiological and ecological sciences. In any case, it must be considered that from the external conditions not only the temperature and pH-value have great effect on the enzyme functions, but also the character and degree of aeroionization.

References

BALOGH, J. (1980): Bioszféra-expedíció. Minerva, Budapest.

CSIJEVSZKIJ, A. L. (1937): L'influences de l'inspiration d'air ionisé négativement ou positivement sur le pH du sang. — J. Physiol. et Path. générale *35,* 364—367.

DARWIN, CH. (1951): Egy természettudós utazásai. Művelt nép Könyvkiadó Darwin's Journal of a Voyage Round the World.

KESTNER, O. (1923): Die Ursache der Schwüle. — Klin. Wochenschr. *2,* 18.

KESTNER, O. (1931a): Scirocco-Studien in Neapel. Strahlenterapie *39,* 391.

KESTNER, O., JOHNSON, C. E., LAUBMANN, W. (1931b): Über eine physiologische Einwirkung des Föhns. Strahlenterapie *41,* 171.

GELEI, J. (1950): Tömegprodukció városi esővízpocsolyában. (Massenproduktion in einer städtischen Regenwasserpfütze). Annal. Biol. Univ. Szegediensis *1,* 81—94.

KISS, I. (1942): Bioklimatológiai megfigyelések az Eudorina elegans vízvirágzásában. Bioklimatologische Beobachtungen bei der Wasserblüte der Eudorina elegans. Acta Botanica (Szeged) *1,* 81—94.

KISS, I. (1951): Meteorobiológiai vizsgálatok a mikroszervezetek víz- és hóvirágzásában. Meteorobiological investigations of the water and snow bloom of microorganisms. M. Tud. Akadémia Biológiai és Agrártudományi Osztály Közleményei *2,* 53—100.

KISS, I. (1952): Meteorobiologicseszkie iszledovanije mikroorganizmov vizivajuscsih cvetenije vodi i sznega. Meteorobiologische Untersuchungen von der Wasser- und Schneeblüte der Mikroorganismen. Acta Biologica Academiae Scientiarum Hungaricae *3,* 159—220.

KISS, I. (1953): A növényi mikroszervezetek időérzékenysége. Météoropathie des microorganismes végétales. Időjárás *57,* 137—144.

KISS, I. (1955a): Az aerob és anaerob légzés vizsgálatának szerepe az időérzékenység kutatásában. Die Rolle der Untersuchung der aeroben und anaeroben Atmung in der Erforschung der Meteoropathie. Időjárás *59,* 218—223.

KISS, I. (1955b): A talaj növényi mikroszervezeteinek élete és az időjárás. Leben von pflanzenartigen Mikroorganismen des Bodens und Witterung. Időjárás *59,* 339—343.

KISS, I. (1957a): Időérzékenységi jelenségek ellenőrző vizsgálata a növényi mikroszervezetek életében. Überprüfungs-Untersuchungen der meteoropathischen Erscheinungen im Leben pflanzlicher Mikroorganismen. Időjárás *61,* 15—21, 75—80.

KISS, I. (1957b): A Balatonból 1934-ben leírt vízvirágzás meteorobiológiai elemzése. Meteorobiological analysis of algalbloom on Lake Balaton. Annales Inst. Biol. (Tihany) Hung. Acad. Scientiarum *24,* 93—101.

KISS, I. (1958a): A Tihanyi Biológiai Kutatóintézet parkjában 1933-ban észlelt Euglena-vízvirágzás meteorobiológiai elemzése. Meteorobiologische Analyse der im Park des Biologischen Forschungsinstitutes (Tihany) in Jahre 1933 beobachteten Euglena-Wasserblüte. Annal. Inst. Biol. (Tihany) Hungaricae Academiae Scientiarum *25,* 251—255.

KISS, I. (1958b): A növényi mikroszervezetek tömeges felszaporodásának meteorobiológiai vizsgálata. Meteorobiologische Untersuchung der Massenproduktion von pflanzlichen Mikroorganismen. Kézirat, Manuscript 1—462.

KISS, I. (1959a): A „talajvirágzás" szinoptikus meteorobiológiai vizsgálata. Synoptische-meteorobiologische Untersuchung der "Bodenblüte". Agrokémia és talajtan *8*, 49—58.

KISS, I. (1959b): A növényi mikroszervezetek tömeges felszaporodása (tömegprodukciója) mint bioindikátor-jelenség. Die Vermehrung (Massenproduktion) der pflanzlichen Mikroorganismen als Bioindikator-Erscheinung. Biológiai Közlemények *6*, 111—118.

KISS, I. (1959c): Synoptische meteorobiologische Analyse der Massernproduktion einiger pflanzlichen Mikroorganismen. Acta Biologica Academiae Scientiarum Hungaricae *9*, 317—342.

KISS, I. (1960): Eine nachträgliche synoptisch-meteorobiologische Untersuchung der Gametenbildung und der geschtlichen Vermehrung von *Endorina illinoisensis*. Botanikai Közlemények *48*, 224—227.

KISS, I. (1961): A synoptic meteorobiological analysis on plant microroganisms with special reference to the form variation of Lepocinclis fusiformis. Acta Botanica Academiae Scientiarum Hungaricae *7*, 81—92.

KISS. I. (964): Volvocales- és Euglena-félék tömegprodukcióinak halmozódásos megjelenése "síkvidéki föhn" és "Szirokkó-helyzet" időszakában a Duna—Tisza-közén. Angehäufte Erscheinung der Massenproduktionen der Volvocales und Euglena—Arten Zwischen der Duna und der Tisza in einer Periode des "Freinen Föhns" und der "Shirokko-Lage". A Szegedi Tanárképző Főiskola Tudományos Közleményi *2*, 3—23.

KISS, I. (1969): Die Rolle der meteorologichen Verhältnisse in der Entstehung der Wasserblüten-Massenproduktionen der Algen. Trudi Fonferencii po izotscheniu vodoroslej Vengrija *1*, 289—310.

KISS, I. (1979a): Szikes alga-tömegprodukcióktól az „időérzékenység" rejtélyének újabb megközelítése felé. Von Natron-Wasser Algenmassenproduktionen zur neuen Näherung des Rätsels der "Wetterempfindlichkeit". Juhász Gy. Tanárképző Főiskola Tudományos Közleményei *2*, 31—46.

KISS, I. (1979b): Az ionizációs környezet élettani szerepe. Die Rolle der ionisiertes Milieu. In: Növényszervezettan és növényélettan (Die Organlehre für Pflanzen und Pflanzenphysiologie, 725—727. (Lehrbuch für Universität und Hochschule.)

KISS, I. (1979c): Algological investigations in the dead arms of the river Tisza at Tiszaalpár and Tiszaug. Tiscia (Szeged) *14*, 41—61.

KOL, E. (1949): A vácrátóti park zöldszínű jegéről. The green coloration of ice and snow in the Park Vácrátót. Borbásia *9*, 1—2.

KOL, E. (1968): Kryobiologie. Biologie und Limnologie des Schnees und Eises I. Kryovegetation Die Binnengewässer *24*, Stuttgart.

KRUEGER, A. P., KOTAKA, S., ANDRIESE, P. C. (1962): Some observations on the physiological Effects of gaseous ions. Int. J. Biometeor. *6*, 33—48.

KRUEGER, A. P., KOTAKA, S., ANDRIESE, P. C. (1964): The effect of air containig O_2 and CO_2 on. the Growth of Seedlings of Hordeum vulgare Int. J. Biometeor. *8*, 17—25.

KRUEGER, A. P. and REED, E. J. (1976): Biological Impact of Small Air Ions. Despite a history of contention, there is evidence that small air ions can affect life processes. Science *193*, 1209—1213.

NAGY, E. (1964): Az űrkutatás eredményei (Die Ergebnisse der Raumforschung). Gondolat Kiadó, Budapest.

PALIK, P. (1955): Neuere Beiträge zur Entwicklung der *Eudorina illinoisensis* (Kofoid) Pascher. Botanikai Közlemények *46*, 69—81.

PECH, J. L. (1926): Les differences de potenciel Biologie. Presse Médicale *12*, 30.

SEBESTYÉN, O. (1934): Vízvirágzás a Balatonon? "Water-Bloom" in Lake Balaton? A Magyar Biológiai Kutatóintézet Munkáiból. Arbeiten der I. Abteilung des Ungarischen Biologischen Forschungsinstitutes *7*, 205—208.

SÜLE, S. (1949): Kerta község éghajlata, időjárása. Das Klima und Wetter von Gemeinde Kerta., Időjárás *53*, 313—319.

SZABADOS, M. (1936): Euglena vizsgálatok. Euglena Untersuchungen. Acta Biologica (Szeged) *4* 49—95.

VÁRHELYI, T. (1975): Jégevő parányok. Eisfresserische Winzigkeiten. Delta *6*, 7.

Feltűnő algatömegprodukciók kialakulása a Tisza-völgy Alpári-medencéje területén

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Szerző az algatömegprodukciók kialakulásának légköri tényezőit több mint 50 éven át kutatva azt állapította meg, hogy azok az időjárás ciklonális-depressziós helyzeteihez kapcsolódnak, s többnyire előre jelzik az időjárás megváltozását, eső közeledtét. Hatótényezőként a légköri ionizáció fokozódására következtetett. Az Alpári-medencében például 1975—1983-ig 25 esetben talajt és ugyanennyi vizet színező algatömegprodukciót talált, 1984. május 20-án pedig 70 talajt színező és 10 vizet színező algatömegprodukciót észlelt. Ez évben a tavasz szokatlanul zivataros volt, s a légkör jelentősen ionizálódott. Az a tény, hogy a serotonin (5-hidroxi-triptamin = 5-HT) biogén amin-ból jelentős negatív aeroionizáció esetén indolecetsav (auxin), vagy annak egyik módosulata képződik, részben magyarázza az algatömegprodukciók ciklonális időjáráshoz való kapcsolódását. Ionizációs hatásokkal magyarázza szerző a sarkvidékek gazdag algatömegprodukcióit is. Itt egyéb tényezők között a fotoperiodizmus szintén szerepelhet.

Заметное развитие водорослевой продукции на территории долины Тисы Алпарской котловины

Кишш И.

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Резюме

На протяжении 1975—1983 годов автор в 25 местах Алпарской котловины отмечал «цветение воды» и в 25 местах — «цветение почвы». Но в мае 1984 года только во время единственного выезда было обнаружено 70 случаев «цветения почвы» и 10 случаев «цветения воды». Причиной возникшего явления автор считает ранюю и бурную весну, то есть климатические условия. В этом направлении автор ведет наблюдения больше 50 лет. При метеорологическом анализе было обнаружено, что массовое развитие водорослей зависит от циклональной депрессии климатических условий. Большое значение в этой связи имеет атмосферное электричество и атмосферная ионизация, которая стимулирует у водорослей обмен веществ и тем самым ускоряет их размножение. Триптамина моноамин-оксидаз энзим оксидует на индолецет (ауксин). Кругер в своих работах показал, что отрицательные ионы стимулируют, а положительные тормозят влияние этих энзимов. Известно, что при бурных климатических условиях ионизация воздуха значительно изменяется. Тот факт, что под влиянием отрицательной ионизации может возникнуть ауксин, стимулирующий развитие водорослей, объясняет и массовое размножение их в 1984 году, вследствие бурных климатических условий.

Masovna produkcija alga na području basena Alpár u dolini reke Tise

Kiss I.

Istraživačka grupa reke Tise, Szeged

Absract

Autor je u periodu 1975—1983. godine registrovao ukupno 25 pojava „svetanja vode" u vodama basena Alpár, a takodje i 25 pojava masovne produkcije alga na tlu, „cvetanje tla". Takodje je 20. maja 1984. godine zabeležio 10 „cvetanja vode" i 70 „cvetanja tla".

Autor, uzročnu povezanost izmedju masovne produkcije alga i klime, izučava već više od 50 godina. Utvrdio je da se masovna produkcija alga obično javlja u vezi sa ciklonalnim depresivnim pojavama klime. Ukazao je na elektricitet i jonizaciju vazduha, kao uzročnike ove pojava. Naime, poznata je činjenica da se razlaganje serotonina (5-hidroksi-triptamin) u biljkama vrši pod uticajem enzima monoamino-oksidaze, koji ga oksidiše do indol-sirćetne kiseline, odnosno 5-hidroksi-indol-sirćetne kiseline. Poznata je pojava da se za vreme oluja jonski sastav vazduha često i značajno menja. Činjenica, da se pri povećanoj negativnoj jonizaciji vazduha iz serotonina može javiti indol-sirćetna kiselina, odnosno njegov neki derivat, delom ukazuje na zavisnost mesovne produkcije alga od ciklonske aktivnosti. Ova uslovljenost je naročito uočljiva u toku proleća 1984. godine sa čestim olujama. I fotoperiodizam može izazvati masovnu produkciju alga.