

THE BIOMASS CHANGES OF PHYTOPLANKTON IN LAKE BALATON DURING THE 1960S

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The horizontal distribution of phytoplankton and its fluctuation in the number of species in Lake Balaton are described in some earlier studies (TAMÁS, 1965b; 1967; 1969; 1972b). Partly, they are dealing with species observed in larger quantities in the samples of 1960s and, on the other hand, with water-blooms. The sample series lifted with the Friedinger apparatus and filtered with nets of silk bolting cloth No. 25 and No. 6 fielded information on an increase in the population density of new alga species and the spreading of some species in other parts of the lake (TAMÁS, 1964a, b; 1965 a; 1966; 1972a). On the basis of the quantitative and qualitative data of the algological investigations we can draw conclusions on the changes and their tendency during the past years and decades. On the other hand, with a full knowledge of the phytoplankton stand we are able to give a detailed explanation on the dynamism of the zooplankton population (PONYI, 1969; 1973; PONYI and P.-ZÁNKAI, 1972; P.-ZÁNKAI and PONYI, 1972).

The aim of the present study is to make known the change of phytoplankton biomass on the basis of population data obtained from the horizontal water samples taken in the 1960s.

Methods

To calculate the biomass, in addition to the samples taken horizontally in the warm water periods of 1962, 1965, 1967 and 1969, it was also necessary to measure the species of algae earlier unpublished (SEBESTYÉN, 1954; TAMÁS, 1955). The mean volume of each species was calculated from the average of several hundred individuals. Most of the species were similar to geometrical solids (WELCH, 1948; SCHNESEE and SCHWARTZ, 1971). The number of individuals counted under the Utermöhl plankton microscope was multiplied with the mean volume of algae. In the tables these values are given in $10^6 \mu^3/\text{litre}$ and the weight of algae in the whole water column, in g/m^2 .

The samples lifted on July 19, 1962 from various depths were counted under Utermöhl plankton microscope (UTERMÖHL, 1958). Although the data concern only the population density of the phytoplankton in July, they serve

for good basis of comparing the collecting site in the Keszthely Bay, between Szigliget and Balatonmária (K), to that in front of the Biological Research Institute, between Balatonfüred and Zamárdi (A). The data reflect the state at one point of each of the five transversal sections in 1965 and at 3—3 points of the section in 1966 and 1967. The biomass values of these latter years are averaged now.

For the sake of a good perspicuity next to the biomass values of the transversal sections in the tables we named only those species which amounted to 10 μg wet weight/litre. The biomass values of the other species were summarized and in the list of the phyla they were marked: "other species" (HERODEK and TAMÁS, 1973; 1974).

Results and discussion

To evaluate the biomass values of the horizontal phytoplankton in the sixties we summarized the data concerning the years, months, collecting sites, filtrates and lifted samples in *Table 1* together with the species, varieties and forms.

TABLE 1

Data on the horizontal sample series taken in Lake Balaton in the 1960s

Year	Month	Collecting site	Number of lifted samples	Species	Variety	Form	Total
1962	VII.	8	30	220	27	6	253
1965	VI—X.	5	97	165	14	2	181
1966	V—XI.	15	413	165	17	3	185
1967	IV—XI.	15	495	147	11	2	160

TABLE 2

Distribution in the number of species of the phytoplankton

	M				K			
	1962	1965	1966	1967	1962	1965	1966	1967
IV.				62				55
V.			43	93			21	69
VI.		79	39	120		48	39	81
VII.	75	34	38	128	75	37	44	86
VIII.		45	49	130		43	61	88
IX.		32	27	129		44	32	86
X.		33	32	96		55	51	75
XI.			34	57			36	51
Average		44	37	102		45	40	74

The monthly numerical values of species at each of the transversal sections during the three years are shown in *Table 2*. The highest values together with the mean values can be found at the 1967 columns of each of the transversal sections. In *Table 3* we summed up the yearly, monthly and sectionally distributed data on individuals/litre. On the basis of this latter table the August values at the two farthest transversal sections of the southwestern area of Lake Balaton [between the Keszthely Bay (M) and the Szigliget—Balatonmária section (K)] with their amount of a million are considerable. The third transversal sections of the southern area (between Ságpuszta and Balatonszemes), near Tihany, with its number of individuals being maximum in July approximates that of the section between Balatonfired and Zamárdi (A) in the northern basin of the lake. Between Balatonalmádi and Balatonvilágos (E) the population density amounted to the highest value in various warm water months of each of the three years. The high mean values in 1965 resulted in water discoloration caused by *Asterionella formosa* — *Melosira granulata* and its variety, while at the transversal section "K" the higher number of individuals indicated the growth of population density of blue-green alga *Aphanizomenon flos-aquae* — *Microcystis*.

The result of our biomass calculation to the phyla for 1965 is given in *Tables 4–8*, for 1967 in *Tables 9–13* and for 1967 in *Tables 14–18*.

Similarly to earlier studies we distinguished organisms occurring solitary, in coenobiums or filaments from the point of view of biomass calculation.

Cyanophyta	μ^3
F <i>Anabaena scheremetievi</i>	3500
F <i>A. spiroides</i>	3500
C <i>Aphanocapsa delicatissima</i>	500
C <i>Chroococcus limneticus</i>	100
C <i>C. minutus</i>	150
C <i>Merismopedia tenuissima</i>	4
F <i>Oscillatoria amphibia</i>	424
F <i>O. tenuis</i>	3500
F <i>Pseudanabaena catenata</i>	2500

in Lake Balaton during the years of investigations

G			A				E		
1965	1966	1967	1962	1965	1966	1967	1965	1966	1967
		59				53			50
	31	71			44	77		46	67
46	38	75		69	51	96	56	27	76
36	59	74	59	68	65	100	65	51	86
50	55	79		71	68	96	55	60	74
52	49	75		62	58	94	52	49	78
38	49	61		55	54	72	50	50	66
	38	50			43	48		39	47
44	45	68		65	54	79	55	46	68

TABLE 3

The distribution in *i/l* of the phytoplankton in Lake Balaton

	M				K			
	1962	1965	1966	1967	1962	1965	1966	1967
IV.				104.7				108.5
V.			186.5	299.7			175.7	181.3
VI.		85.4	301.0	691.6		128.5	255.7	479.2
VII.	253.1	116.7	229.7	706.3	581.3	206.1	161.8	499.3
VIII.		4204.6	1300.1	699.6		1185.0	1727.8	548.0
IX.		187.7	723.3	423.3		125.2	1014.2	313.0
X.		54.9	89.1	251.5		73.6	33.5	209.1
XI.			24.1	82.9		25.2	171.0	2.5
Average		929.8	407.6	407.4		343.6	484.8	313.6

TABLE 4

The biomass of the phytoplankton in Lake Balaton, 1965, between Gyenesdiás and the mouth of River Zala (M) $10^6 \mu^3/l$

	VI.	VII.	VIII.	IX.	X.
Cyanophyta					
<i>Aphanizomenon flos-aquae</i>	0.9	—	1.0	1.6	0.2
<i>Microcystis flos-aquae</i>	—	5.0	—	—	7.0
Other	0.5	0.8	3.4	0.7	1.3
Total	1.4	5.8	4.4	2.4	8.5
Euglenophyta					
<i>Euglena oxyuris</i>	6.3	4.5	4.5	18.0	—
Other	5.9	0.1	5.2	1.6	3.5
Total	12.2	4.6	9.7	19.6	3.5
Pyrrophyta					
<i>Ceratium hirundinella</i>	1.0	37.1	392.7	256.0	1.1
<i>Diplopsalis acuta</i>	—	0.7	20.7	3.5	1.0
Other	0.5	—	3.1	1.0	—
Total	1.5	37.8	416.5	260.5	2.1
Chrysophyta					
<i>Dinobryon divergens</i>	—	111.3	—	—	—
<i>Amphora ovalis</i>	22.5	0.8	1.6	1.7	0.7
<i>Asterionella formosa</i>	—	0.3	258.8	0.2	—
<i>Cyclotella bodanica</i>	172.6	40.6	4.0	17.3	9.8
<i>C. ocellata</i>	11.4	6.7	5.3	2.6	3.4
<i>Cymatopleura elliptica</i>	48.0	—	7.5	—	3.0
<i>Melosira granulata</i>	9.7	32.2	6931.6	327.0	71.8
<i>M. granulata</i> var. <i>angustissima</i>	—	17.0	469.6	36.2	9.0
<i>Surirella robusta</i> var. <i>splendida</i>	20.0	—	—	2.5	—
Other	25.8	5.6	11.0	1.4	2.0
Total	310.0	214.5	7729.4	388.9	99.7
Chlorophyta					
Total	5.7	4.6	18.4	2.1	1.8
Total algae	330.8	267.3	8178.4	673.5	115.6

in the 1960s (*i/l* = 1000 individuals per litre)

G			A				E		
1965	1966	1967	1962	1965	1966	1967	1965	1966	1967
		122.2				111.2			150.6
	115.7	189.9			89.5	198.9		24.0	158.2
115.4	222.4	299.9		125.3	106.4	297.6	61.0	123.7	261.1
126.7	396.1	399.6	213.3	137.8	134.2	354.1	110.3	94.3	335.2
78.6	158.7	382.9		108.6	105.7	383.7	88.8	97.5	353.6
80.1	69.6	240.2		61.6	68.1	333.4	69.0	95.5	266.8
44.0	22.1	155.1		35.8	23.7	178.0	28.0	23.4	166.8
79.9					89.5	83.5		20.2	80.6
88.9	141.0	233.7		93.8	88.1	242.5	71.4	68.3	221.6

TABLE 5

The biomass of the phytoplankton in Lake Balaton, 1965,
between Szigliget and Balatonmária (K) $10^6 \mu^3/l$

	VI.	VII.	VIII.	IX.	X.
Cyanophyta					
<i>Aphanizomenon flos-aquae</i>	2.8	—	—	1.9	9.4
<i>Microcystis flos-aquae</i>	—	—	—	15.0	—
Other	4.3	2.2	8.7	6.1	2.4
Total	7.1	2.2	8.7	23.0	11.8
Euglenophyta					
<i>Euglena ehrenbergii</i>	6.3	—	17.2	5.0	2.1
<i>E. oxyuris</i>	13.5	22.5	162.0	27.0	4.5
Other	0.5	0.5	6.6	5.1	11.5
Total	20.3	23.0	185.8	37.1	18.1
Pyrrophyta					
<i>Ceratium hirundinella</i>	17.5	96.5	811.4	2445.0	1.0
<i>Diplopsalis acuta</i>	—	0.3	41.0	5.6	0.3
Other	—	—	4.7	3.6	—
Total	17.5	96.8	857.1	2453.2	1.4
Chrysophyta					
<i>Synura uvella</i>	—	—	14.6	0.8	—
<i>Amphora ovalis</i>	98.1	1.0	3.1	1.5	10.3
<i>Asterionella formosa</i>	—	—	28.8	—	—
<i>Cyclotella bodanica</i>	241.2	211.3	32.5	8.4	39.0
<i>C. ocellata</i>	23.5	43.8	5.5	2.5	7.1
<i>Cymatopleura elliptica</i>	90.0	10.5	69.0	—	15.0
<i>Melosira granulata</i>	10.1	98.9	1896.3	99.9	34.8
<i>M. granulata</i> var. <i>angustissima</i>	0.3	17.1	206.9	14.2	7.9
<i>Surirella robusta</i> var. <i>splendida</i>	37.5	6.2	—	—	—
Other	12.0	9.4	2.0	3.8	18.5
Total	512.7	398.6	2258.7	131.3	132.6
Chlorophyta					
Total	15.1	10.9	15.8	10.7	10.2
Total algae	572.7	531.5	3326.1	2655.3	174.1

TABLE 6

The biomass of the phytoplankton in Lake Balaton, 1965,
between Sággpuszta and Balatonszemes (G) $10^6 \mu^3/l$

	VI.	VII.	VIII.	IX.	X.
Cyanophyta	11.7	—	1.9	41.6	38.5
<i>Aphanizomenon flos-aquae</i>	—	5.0	15.0	—	—
<i>Microcystis flos-aquae</i>	—	—	—	—	—
Other	12.7	3.8	6.1	9.3	7.6
Total	24.4	8.8	23.0	50.9	46.1
Euglenophyta					
<i>Euglena ehrenbergii</i>	—	—	4.2	10.0	—
Other	0.6	4.6	4.9	3.8	6.4
Total	0.6	4.6	9.1	13.9	6.4
Pyrrophyta					
<i>Ceratium hirundinella</i>	42.4	835.8	2623.5	1751.1	69.4
Other	—	7.3	6.7	9.7	1.4
Total	42.4	843.1	2630.2	1760.8	70.8
Chrysophyta					
<i>Amphora ovalis</i>	106.5	—	1.5	0.7	3.1
<i>Cyclotella bodanica</i>	162.6	192.4	9.4	14.6	21.6
<i>C. ocellata</i>	16.1	39.6	1.8	3.9	3.9
<i>Cymatopleura elliptica</i>	165.0	1.5	22.5	30.0	—
<i>Melosira granulata</i>	10.3	8.6	8.8	5.3	—
<i>Surirella robusta</i> var. <i>splendida</i>	25.0	2.5	—	8.7	—
Other	17.3	4.5	6.3	6.9	7.1
Total	502.9	249.2	50.5	70.4	36.0
Chlorophyta					
Total	14.1	10.0	12.7	15.4	11.7
Total algae	584.4	1115.7	2725.5	1911.4	171.0

Euglenophyta

 μ^3

<i>Colacium vesiculosum</i>	1570
<i>Euglena ehrenbergii</i>	42000
<i>E. klebsii</i>	3500
<i>E. limnophila</i>	2000
<i>E. oxyuris</i>	90000
<i>Phacus acuminatus</i>	9000
<i>P. pyrum</i>	3320
<i>Trachelomonas volvocina</i>	500

Pyrrophyta

<i>Cryptomonas erosa</i>	2500
<i>Peridinium inconspicuum</i>	30000

Chrysophyta

C <i>Botryococcus braunii</i>	4180
<i>Stipitococcus urceolatus</i>	75
<i>Chromulina</i> sp.	280
<i>Chrysococcus rufescens</i>	270
<i>Mallomonas acaroides</i>	1500
<i>M. tonsurata</i>	1260
<i>Salpingoeca frequentissima</i>	280

TABLE 7

The biomass of the phytoplankton in Lake Balaton, 1965,
between Balatonfüred and Zamárdi (A) $10^6 \mu^3/l$

	VI.	VII.	VIII.	IX.	X.
Cyanophyta					
<i>Aphanizomenon flos-aquae</i>	13.4	112.9	5.4	24.9	16.1
Other	12.9	20.7	11.0	13.5	4.9
Total	26.4	133.6	16.4	38.4	21.0
Euglenophyta					
<i>Euglena oxyuris</i>	9.0	9.0	9.9	2.0	23.4
Other	14.6	3.2	4.7	14.7	8.3
Total	23.6	12.2	14.6	16.7	31.7
Pyrrophyta					
<i>Ceratium hirundinella</i>	58.3	222.6	596.2	304.2	37.6
Other	2.5	6.4	4.0	6.6	—
Total	60.8	229.0	600.2	310.8	37.6
Chrysophyta					
<i>Amphora ovalis</i>	37.4	21.7	10.9	4.5	4.7
<i>Cyclotella bodanica</i>	165.6	82.6	58.3	20.3	19.7
<i>C. ocellata</i>	20.4	17.6	7.7	5.2	3.3
<i>Cymatopleura elliptica</i>	60.0	46.5	4.8	7.5	10.5
<i>Diploneis elliptica</i>	17.3	9.1	18.9	10.2	4.5
<i>Melosira granulata</i>	14.2	26.2	107.5	6.4	1.7
<i>Surirella robusta</i> var. <i>splendida</i>	18.7	43.7	17.5	2.5	—
Other	27.8	29.6	22.8	8.0	12.1
Total	361.4	277.4	248.4	64.7	56.9
Chlorophyta					
Total	17.3	16.0	16.1	19.4	10.2
Total algae	489.5	668.2	895.7	450.0	157.4

C <i>Synura uella</i>	65000
<i>Amphora ovalis</i>	5300
<i>A. ovalis</i> var. <i>pediculus</i>	1570
<i>Asterionella formosa</i>	200
<i>Attheya zachariasii</i>	500
<i>Caloneis schumanniana</i> var. <i>biconstricta</i>	3900
<i>Campylodiscus noricus</i> var. <i>hibernica</i>	11300
<i>Cocconeis placentula</i>	4000
<i>Cyclotella meneghiniana</i>	3000
<i>Diploneis elliptica</i>	10200
<i>D. puella</i>	1100
<i>Epithemia sorex</i>	500
<i>Fragilaria construens</i>	400
<i>Gyrosigma acuminatum</i>	15400
<i>G. attenuatum</i>	70000
<i>G. distortum</i> var. <i>parkeri</i>	8200
<i>G. kuetzingii</i>	9000
<i>G. prolongatum</i>	12500
<i>Melosira granulata</i> var. <i>angustissima</i>	376
<i>Navicula cryptocephala</i>	400
<i>N. gracilis</i>	4410
<i>N. hungarica</i> var. <i>capitata</i>	350
<i>N. placentula</i>	4600
<i>N. radiosa</i>	3900
<i>Neidium dubium</i> f. <i>constricta</i>	6200

TABLE 8

The biomass of the phytoplankton in Lake Balaton, 1965,
between Balatonalmádi and Balatonvilágos (E) $10^6 \mu^3/l$

	VI.	VII.	VIII.	IX.	X.
Cyanophyta					
<i>Aphanizomenon flos-aquae</i>	17.1	68.6	39.9	50.6	13.8
<i>Microcystis flos-aquae</i>	—	10.0	—	—	—
Other	5.1	15.3	11.5	12.5	6.0
Total	22.3	93.9	51.4	63.1	19.8
Euglenophyta					
<i>Euglena ehrenbergii</i>	—	10.5	2.9	1.2	2.1
Other	8.7	8.6	1.1	1.4	1.8
Total	8.7	19.1	4.0	2.6	3.9
Pyrrophyta					
<i>Ceratium hirundinella</i>	90.1	735.1	1149.7	636.0	5.2
<i>Gonyaulax apiculata</i>	—	1.0	13.0	6.2	—
Other	—	1.7	9.4	4.2	1.4
Total	90.1	737.9	1172.2	646.4	6.6
Chrysophyta					
<i>Cyclotella bodanica</i>	81.4	89.4	14.9	21.1	14.0
<i>C. ocellata</i>	13.1	14.5	2.7	4.8	2.9
<i>Cymatopleura elliptica</i>	7.5	24.0	15.0	30.0	3.0
<i>Melosira granulata</i>	3.6	13.5	41.7	19.2	1.9
Other	24.6	31.5	23.0	24.7	19.2
Total	132.8	173.0	97.4	99.9	40.1
Chlorophyta					
<i>Closterium aciculare</i>	1.5	5.8	18.4	0.9	0.3
Other	7.5	15.3	25.0	10.3	7.1
Total	9.0	21.1	43.5	11.2	7.4
Total algae	262.9	1045.0	1368.5	823.2	77.8

	μ^3
<i>Nitzschia acicularis</i>	268
<i>N. amphibia</i>	628
<i>N. hungarica</i>	3300
<i>N. palea</i>	400
<i>N. sigmoidea</i>	13740
<i>N. subrostrata</i>	198
<i>N. tryblionella</i> var. <i>debilis</i>	1000
<i>N. tryblionella</i> var. <i>levidensis</i>	2360
<i>Opephora martyi</i>	1900
<i>Pinnularia microstauron</i>	4710
<i>Stenopterobia pelagica</i>	9900
<i>Stephanodiscus dubius</i>	3140
<i>Surirella biseriata</i>	141000
<i>S. elegans</i>	120000
<i>S. robusta</i> var. <i>splendida</i>	125000
<i>S. tenera</i>	106000
<i>S. tenera</i> var. <i>nervosa</i>	70650
<i>S. turgida</i>	31400
<i>Synedra acus</i>	2000
<i>S. acus</i> var. <i>angustissima</i>	604
<i>S. parasitica</i>	750
<i>S. ulna</i>	2500
<i>S. ulna</i> var. <i>spathulifera</i>	4200

TABLE 9

The biomass of the phytoplankton in Lake Balaton, 1966,
between Gyenesdiás and the mouth of River Zala (M) $10^6\mu^3/l$

	V.	VI.	VII.	VIII.	IX.	X.	XI.
Cyanophyta							
<i>Aphanizomenon flos-aquae</i>	—	3.2	95.6	3893.7	2433.2	5.0	0.7
<i>Microcystis flos-aquae</i>	—	—	—	854.0	—	—	—
Other	1.2	0.4	1.3	1.8	0.1	—	0.3
Total	1.2	3.6	96.9	4749.6	433.3	5.0	1.0
Euglenophyta							
<i>Euglena ehrenbergii</i>	3.3	6.7	16.8	4.2	1.3	1.2	4.2
<i>E. oxyuris</i>	9.0	46.8	47.7	52.2	—	—	9.0
Other	0.8	4.0	3.1	21.0	0.7	3.8	1.2
Total	13.1	57.5	67.6	77.4	2.0	5.0	14.4
Pyrrophyta							
<i>Ceratium hirundinella</i>	4.2	1121.0	1343.0	913.2	216.8	3.7	1.6
<i>Diplopsalis acuta</i>	—	2.8	51.8	60.6	0.7	0.3	0.4
<i>Gonyaulax apiculata</i>	—	2.1	14.6	98.6	3.6	—	—
Other	—	—	0.3	1.5	—	—	—
Total	4.2	1125.9	1409.7	1074.1	221.1	4.0	2.0
Chrysophyta							
<i>Mallomonas tonsurata</i>	—	—	—	11.4	3.0	—	—
<i>Amphora ovalis</i>	2.5	0.7	2.8	1.4	1.4	11.2	1.2
<i>Cyclotella bodanica</i>	361.0	368.5	238.5	223.8	17.3	65.0	21.7
<i>C. ocellata</i>	56.2	66.2	50.8	50.8	4.6	24.5	5.2
<i>Melosira granulata</i>	34.4	206.4	105.5	21.0	17.2	17.2	34.4
<i>M. granulata</i> var. <i>angustissima</i>	2.8	20.2	—	0.7	—	1.0	0.1
<i>Surirella robusta</i> var. <i>splendida</i>	2.5	—	116.2	10.0	—	16.2	—
<i>Cymatopleura elliptica</i>	22.5	—	120.0	37.5	15.0	60.0	4.6
Other	17.5	3.5	19.4	21.6	6.0	24.0	9.0
Total	499.4	665.5	653.2	378.2	64.5	219.2	72.2
Chlorophyta							
Total	3.6	22.6	9.2	18.2	2.8	0.6	2.5
Total algae	521.5	1875.1	2236.6	6297.5	2723.7	233.8	92.1

Chlorophyta

 μ^3

C <i>Actinastrum hantzschii</i>	70
<i>Ankistrodesmus falcatus</i>	700
<i>A. falcatus</i> var. <i>acicularis</i>	1000
<i>A. falcatus</i> var. <i>spirilliformis</i>	51
<i>A. lacustris</i>	335
<i>Chodatella balatonica</i>	100
<i>C. ciliata</i>	1000
C <i>Crucigenia fenestrata</i>	200
C <i>C. tetrapedia</i>	220
C <i>Dictyosphaerium pulchellum</i>	100
C <i>Oocystis elliptica</i>	2280
C <i>O. elliptica</i> f. <i>minor</i>	1500
<i>O. solitaria</i> f. <i>wittrockiana</i>	3000
C <i>O. submarina</i>	400
<i>Schroederia setigera</i>	210

TABLE 10

The biomass of the phytoplankton in Lake Balaton, 1966,
between Szigliget and Balatonmária (K) $10^6 \mu^3/l$

	V.	VI.	VII.	VIII.	IX.	X.	XI.
Cyanophyta							
<i>Anabaena spiroides</i>	—	—	0.2	35.0	0.4	—	—
<i>Aphanizomenon flos-aquae</i>	1.0	1.0	52.5	5050.0	3423.0	1.8	0.7
<i>Microcystis flos-aquae</i>	—	—	—	40.0	—	—	—
Other	0.2	1.1	0.8	2.7	0.3	0.2	0.3
Total	1.2	2.1	53.5	5127.7	3423.7	2.0	1.0
Euglenophyta							
<i>Euglena ehrenbergii</i>	5.4	24.0	2.9	53.3	7.5	5.0	2.1
<i>E. oxyuris</i>	5.4	31.5	18.9	414.0	10.8	6.3	9.0
<i>Phacus tortuosus</i>	—	—	—	15.0	—	—	—
Other	0.3	4.7	5.0	29.0	—	1.4	0.5
Total	11.2	60.2	26.8	511.3	18.3	12.7	11.6
Pyrrophyta							
<i>Ceratium hirundinella</i>	61.5	775.4	2767.7	6486.1	755.7	5.8	2.1
<i>Diplopsalis acuta</i>	—	3.5	304.5	41.0	2.1	1.8	0.3
<i>Gonyaulax apiculata</i>	—	4.2	10.4	53.6	4.1	1.0	—
Other	—	0.5	0.5	2.5	—	—	—
Total	61.5	783.6	3083.1	6581.1	762.0	8.6	2.4
Chrysophyta							
<i>Planktonema lauterborni</i>	5.2	12.9	0.6	0.5	0.1	0.2	0.1
<i>Amphora ovalis</i>	—	—	2.1	1.4	1.0	11.7	3.4
<i>Cyclotella bodanica</i>	436.3	384.8	103.0	180.0	16.2	20.3	18.3
<i>C. ocellata</i>	52.7	75.8	25.2	28.8	4.0	4.3	4.2
<i>Cymatopleura elliptica</i>	—	1.5	99.0	30.0	4.5	37.5	15.0
<i>Melosira granulata</i>	18.1	77.4	34.4	24.9	38.7	23.1	40.8
<i>Nitzschia sigmoidea</i>	—	—	6.7	5.5	—	15.1	—
<i>Surirella robusta</i> var. <i>splendida</i>	—	—	83.8	12.5	3.7	95.0	—
Other	1.9	1.8	20.8	26.5	0.7	20.4	8.1
Total	514.2	554.2	375.5	310.1	68.9	227.6	89.9
Chlorophyta							
Total	4.2	13.3	5.6	21.0	6.8	4.1	3.8
Total algae	592.3	1413.4	3544.5	12 551.2	4280.0	255.0	108.7

C <i>Scenedesmus acuminatus</i>	μ^3 70
C <i>S. arcuatus</i>	125
C <i>S. balatonicus</i>	70
C <i>S. ecornis</i>	90
C <i>S. intermedius</i>	90
<i>Selenastrum gracile</i>	62
<i>Stylosphaeridium stipitatum</i>	63
<i>Tetrastrum staurogeniaeforme</i>	500
<i>Tetraedron minimum</i>	30
<i>Closterium parvulum</i>	7000
<i>C. polystictum</i>	39000
<i>C. prolongatum</i>	127170
<i>C. prorum</i>	4000
<i>Staurastrum gracile</i>	6150

Mycophyta

C. Planktomyces békefii

1

TABLE 11

The biomass of the phytoplankton in Lake Balaton, 1966,
between Ságpuszta and Balatonszemes (G) $10^6\mu^3/l$

	V.	VI.	VII.	VIII.	IX.	X.	XI.
Cyanophyta							
<i>Anabaena spiroides</i>	—	—	0.2	—	—	—	—
<i>Aphanizomenon flos-aquae</i>	2.8	3.1	701.4	262.5	56.0	2.0	0.6
<i>Microcystis flos-aquae</i>	—	—	—	—	110.0	—	—
Other	0.8	2.0	4.7	5.6	4.5	1.0	0.3
Total	3.6	5.1	706.3	268.1	170.5	3.0	0.9
Euglenophyta							
<i>Euglena acus</i>	—	—	20.3	4.4	—	0.5	0.2
<i>E. ehrenbergii</i>	8.0	26.9	5.9	6.7	2.5	2.9	4.2
<i>E. oxyuris</i>	4.5	17.1	84.6	81.9	35.1	6.3	6.3
Other	0.7	0.4	4.6	8.1	1.0	0.3	0.6
Total	13.2	44.4	115.4	101.1	38.6	10.0	11.3
Pyrrophyta							
<i>Ceratium hirundinella</i>	198.7	494.0	1445.3	1363.7	521.5	2.7	1.1
<i>Diplopsalis acuta</i>	3.5	14.0	227.5	12.6	0.3	1.4	0.4
<i>Gonyaulax apiculata</i>	4.2	5.7	39.0	33.3	5.7	0.5	—
Other	—	1.1	1.6	0.6	—	—	—
Total	206.4	514.8	1713.4	1410.2	527.5	4.6	1.5
Crysoophyta							
<i>Amphora ovalis</i>	0.5	1.6	12.7	9.6	1.1	1.6	42.4
<i>Cyclotella bodanica</i>	23.3	406.5	238.5	32.5	20.6	11.5	17.6
<i>C. ocellata</i>	32.0	74.8	42.2	7.1	4.6	4.0	5.0
<i>Cymatopleura elliptica</i>	—	15.0	90.0	42.0	6.0	30.0	7.5
<i>C. solea</i>	—	—	26.3	4.3	—	5.9	—
<i>Gyrosigma kuetzingii</i>	—	—	18.0	—	—	—	—
<i>Melosira granulata</i>	0.9	—	38.7	15.1	—	33.3	50.5
<i>Nitzschia sigmoidea</i>	—	—	13.7	4.1	—	2.7	3.4
<i>Surirella robusta</i> var. <i>splendida</i>	—	—	20.0	17.5	3.7	—	—
Other	7.5	8.6	21.1	10.8	8.9	2.9	1.6
Total	64.2	506.5	521.1	143.0	44.9	91.9	128.0
Chlorophyta							
<i>Closterium aciculare</i>	—	13.5	19.8	3.2	2.5	1.8	2.3
<i>Staurastrum gracile</i>	1.2	2.5	9.3	132.2	11.1	0.9	0.6
Other	10.7	6.4	24.9	41.2	15.7	2.6	2.9
Total	11.9	22.4	54.0	176.6	29.3	5.3	5.8
Total algae	299.3	1093.2	3110.2	2099.0	810.8	114.8	147.5

During data processing we also distinguished the instantaneous stand of samples either to be pelagic species or non-pelagic (planktoxon). At a later stage, we added further data concerning size and volume of the species (SEBES-TYÉN, 1954; TAMÁS, 1955; HERODEK and TAMÁS, 1973; 1974).

The difference extant between the southern (M, K, G) and northern area of the lake during the warm water months (first of all from July to September) can be compared on the basis of the detailed tables of biomass (Table 4—18) of the sixties. Conclusions can be drawn on the numerical percentage in the mass of the total algae belonging to various phyla and species included (e.g. the *Aphanizomenon* and *Microcystis* belonging to the blue-green algae; the *Euglena* belonging to the Flagellata; the *Ceratium* and *Diplopsalis* belonging

TABLE 12

The biomass of the phytoplankton in Lake Balaton, 1966,
between Balatonfüred and Zamárdi (A) $10^6 \mu^3/l$

	V.	VI.	VII.	VIII.	IX.	X.	XI.
Cyanophyta							
<i>Aphanizomenon flos-aquae</i>	2.4	0.7	20.4	38.5	34.3	0.8	0.4
<i>Microcystis flos-aquae</i>	—	—	80.0	70.0	100.0	—	—
Other	0.7	1.3	4.7	6.7	7.2	0.6	0.2
Total	3.1	2.0	105.1	115.2	141.5	1.4	0.7
Euglenophyta							
<i>Euglena acus</i>	0.5	0.2	15.2	0.2	0.5	1.1	—
<i>E. ehrenbergii</i>	3.8	11.0	4.2	5.9	2.5	2.9	4.2
<i>E. oxyuris</i>	9.9	6.3	155.7	25.2	73.8	9.0	4.5
Other	1.5	1.2	7.8	1.0	1.5	0.7	0.9
Total	15.7	18.7	182.9	32.3	78.3	13.7	9.6
Pyrrophyta							
<i>Ceratium hirundinella</i>	223.7	480.7	426.1	560.2	285.7	5.3	1.1
<i>Diplopsalis acuta</i>	3.1	1.1	126.0	4.2	3.9	1.0	0.3
<i>Gonyaulax apiculata</i>	2.1	2.6	13.0	6.2	5.2	0.5	—
Other	—	—	—	1.6	—	—	—
Total	228.9	484.4	565.1	572.2	294.8	6.8	1.4
Chrysophyta							
<i>Botryococcus braunii</i>	—	—	10.9	3.3	3.1	0.4	0.4
<i>Amphora ovalis</i>	4.2	8.0	4.6	7.5	2.2	2.4	2.1
<i>Cyclotella bodanica</i>	151.8	173.4	119.2	24.4	25.5	16.9	33.2
<i>C. ocellata</i>	25.7	21.8	28.6	6.1	5.8	4.2	4.5
<i>Cymatopleura elliptica</i>	6.0	79.5	24.0	63.0	3.0	15.0	10.5
<i>C. solea</i>	—	58.7	—	12.8	8.5	4.3	4.2
<i>Diploneis elliptica</i>	4.1	11.2	14.3	13.3	2.0	1.5	—
<i>Melosira granulata</i>	—	9.4	57.2	45.2	18.3	31.2	24.7
<i>Surirella robusta</i> var. <i>splendida</i>	6.2	70.0	5.0	88.8	6.2	—	—
Other	15.2	46.7	15.7	33.7	6.2	6.4	4.4
Total	213.2	478.7	279.5	298.1	80.8	82.3	84.0
Chlorophyta							
<i>Closterium aciculare</i>	—	1.5	3.1	3.0	10.8	0.9	1.5
<i>Oocystis solitaria</i>	—	0.4	0.9	13.3	1.3	0.5	0.5
Other	5.7	7.6	19.8	22.9	15.2	5.1	3.9
Total	5.7	9.5	23.8	39.2	27.3	6.5	5.9
Total algae	466.6	993.3	1156.4	1057.0	622.7	110.7	101.6

to the Pyrrophyta; the *Asterionella* and *Cyclotella*, *Melosira*, the *Cymatopleura* and *Surirella* of large volume belonging to diatoms and the *Closterium aciculare* belonging to the green algae).

As for 1962, we could calculate the biomass of transversal sections "M" and "K" from only the individual numbers of sample series taken on July 19 and 20. The outstandingly high density of the total algae at the transversal section "K" is due to the great density of *Ceratium hirundinella*.

The biomass values of the species of small and moderate size only amounts to 0.5–1.0 mg wet weight/l in the mass of the total algae during the three warm water months.

The total biomass of algae, with two exceptions, shows a maximum in August at the five transversal sections (Table 19). At transversal section "K" the maximum of phytoplankton (12.5 mg wet weight/l) was noted in August,

TABLE 13

The biomass of the phytoplankton in Lake Balaton, 1966,
between Balatonalmádi and Balatonvilágos (E) $10^6 \mu^3/l$

	V.	VI.	VII.	VIII.	IX.	X.	XI.
Cyanophyta							
<i>Aphanizomenon flos-aquae</i>	2.0	3.1	21.9	95.9	123.2	0.5	0.5
<i>Microcystis flos-aquae</i>	—	—	8.0	80.0	32.0	—	—
Other	1.0	0.7	3.0	7.9	3.2	0.1	0.2
Total	3.0	3.8	32.9	183.8	158.4	0.6	0.7
Euglenophyta							
<i>Euglena ehrenbergii</i>	—	—	11.8	1.3	5.9	3.4	3.3
<i>E. oxyuris</i>	6.9	—	127.8	31.5	44.1	9.0	9.0
Other	0.2	—	5.2	0.6	3.1	2.6	1.1
Total	1.1	—	144.8	33.4	53.1	15.0	13.4
Pyrrophyta							
<i>Ceratium hirundinella</i>	207.7	635.0	1000.6	1294.8	853.3	3.2	1.1
<i>Diplopsalis acuta</i>	2.8	4.2	115.5	7.7	8.7	0.7	0.7
<i>Gonyaulax apiculata</i>	2.6	4.2	17.1	20.8	7.3	1.0	—
Other	—	0.3	1.3	0.2	—	—	—
Total	213.1	643.7	1134.5	1323.5	869.3	4.9	1.8
Chrysophyta							
<i>Botryococcus braunii</i>	0.1	—	1.8	0.6	12.4	0.3	0.4
<i>Amphora ovalis</i>	—	1.6	1.3	3.4	—	3.7	2.6
<i>Cyclotella bodanica</i>	27.5	211.4	60.7	11.3	34.7	21.7	2.5
<i>C. ocellata</i>	3.7	39.4	13.6	2.7	8.1	4.3	5.2
<i>Cymatopleura elliptica</i>	7.5	—	9.0	36.0	3.0	15.0	15.0
<i>C. solea</i>	—	—	1.7	23.8	3.4	6.8	1.7
<i>Melosira granulata</i>	—	2.1	42.1	53.3	8.3	23.2	7.7
<i>Surirella robusta</i> var. <i>splendida</i>	—	—	—	—	27.5	—	—
Other	11.6	5.2	14.4	25.7	3.8	7.8	4.8
Total	50.4	259.7	144.6	184.3	73.7	82.8	39.9
Chlorophyta							
<i>Closterium aciculare</i>	0.7	—	5.7	4.2	19.9	1.8	2.7
Other	5.9	10.8	16.0	16.3	22.6	7.3	5.2
Total	6.6	10.8	21.7	20.5	42.5	9.1	7.9
Total algae	274.2	918.0	1478.5	1745.5	1197.0	112.4	63.7

1966, of which *Aphanizomenon* constitutes 5 mg/l and *Ceratium* nearly 6.5 mg/l. At the same time at transversal section "M" the total algae amounts 6.2 mg/l, of which *Aphanizomenon* constitutes 3.8 mg/l and *Ceratium-Gonyaulax-Diplopsalis* 1.4 mg/l. The second high value of the total algae (8.1 mg/l) was obtained from the August sample in the Keszthely Bay, where the diatoms constituted 7.7 mg/l. The *Melosira granulata* and its variety amounted to 6.9 mg/l. In August, 1967 the values are somewhat lower than in the previous two years, in the Keszthely Bay 5.3 mg/l, at transversal section Szigliget-Balatonmária 5.9 mg/l. At transversal section "M" nearly half of it (2.4 mg/l), while at section "K" 3.4 mg/l was formed by the *Ceratium-Gonyaulax-Diplopsalis* species. The number of individuals causing water-bloom and the discoloration of water significantly influences the local biomass values, too. At transversal section "G" the values were much lower in each of the three years than in sections "M" and "K" (2.7—2.0—3.8 mg/l). At both sections in the northern

TABLE 14

The biomass of the phytoplankton in Lake Balaton, 1967,
between Gyenesdiás and the mouth of River Zala (M) $10^6 \mu^3/l$

	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.
Cyanophyta								
<i>Aphanizomenon flos-aquae</i>	0.7	1.4	16.8	84.0	70.0	17.5	10.5	0.7
<i>Lyngbya limnetica</i>	0.5	0.6	10.9	2.0	4.9	0.8	0.6	0.5
<i>Microcystis flos-aquae</i>	10.0	40.0	20.0	500.0	720.0	80.0	60.0	20.0
Other	1.4	4.6	0.6	13.5	21.0	32.2	4.4	1.2
Total	12.4	46.5	48.3	599.5	815.9	128.5	75.5	22.4
Euglenophyta								
<i>Euglena ehrenbergii</i>	—	4.2	12.6	25.2	8.4	8.4	4.2	4.2
<i>E. klebsii</i>	—	0.3	1.7	2.8	11.2	2.8	0.7	0.3
<i>E. oxyuris</i>	—	9.0	9.0	72.0	270.0	72.0	9.0	9.0
<i>Phacus tortuosus</i>	—	1.0	1.0	4.0	14.0	6.0	—	—
Other	0.5	2.2	2.1	5.1	13.4	5.9	2.7	1.1
Total	0.5	16.7	26.4	109.1	317.0	95.1	16.6	14.6
Pyrrophyta								
<i>Ceratium hirundinella</i>	10.6	254.4	1208.4	1611.2	2151.8	1070.6	286.2	47.7
<i>Diplopsalis acuta</i>	—	7.0	28.0	119.0	126.0	133.0	28.0	3.5
<i>Glenodinium gymmodinium</i>	—	—	8.0	12.8	9.6	6.4	—	—
<i>Gonyaulax apiculata</i>	—	—	31.2	20.8	145.6	41.6	20.8	—
Other	—	—	0.5	0.8	0.2	0.5	—	—
Total	10.6	261.4	1276.1	1764.6	2433.2	1252.1	335.0	51.2
Chrysophyta								
<i>Mallomonas acaroides</i>	—	—	0.9	6.3	12.0	6.0	—	—
<i>M. elongata</i>	—	—	2.0	0.4	12.0	6.0	3.0	—
<i>M. tonsurata</i>	—	—	0.1	0.1	10.6	8.3	1.0	—
<i>Amphora ovalis</i>	13.3	18.0	24.4	44.5	26.5	26.5	22.2	5.3
<i>Asterionella formosa</i>	6.4	16.0	80.0	32.0	32.0	24.0	6.4	4.8
<i>Cyclotella bodanica</i>	21.6	110.6	138.7	219.5	243.9	216.8	68.3	27.1
<i>C. ocellata</i>	13.6	34.4	61.2	54.4	54.4	20.4	72.2	6.0
<i>Cymatopleura elliptica</i>	60.0	60.0	60.0	120.0	120.0	90.0	60.0	30.0
<i>C. solea</i>	8.5	8.5	17.0	34.0	17.0	8.5	8.5	8.5
<i>Gomphonema intricatum</i> var. <i>vibrio</i>	8.0	—	12.1	20.1	16.1	16.1	12.1	—
<i>Gyrosigma attenuatum</i>	19.6	19.6	39.2	58.9	58.9	78.5	—	—
<i>G. prolongatum</i>	5.0	10.0	7.5	10.0	7.5	5.0	7.5	5.0
<i>Melosira granulata</i>	86.0	215.0	645.0	774.0	860.0	344.0	215.0	64.5
<i>M. granulata</i> var. <i>angustissima</i>	6.8	34.2	76.0	57.0	38.0	30.4	24.7	5.7
<i>Nitzschia sigmoidea</i>	8.2	8.2	6.9	5.5	8.2	11.0	8.2	5.5
<i>Surirella biseriata</i>	14.1	14.1	14.1	14.1	—	—	—	—
<i>S. robusta</i> var. <i>splendida</i>	100.0	100.0	100.0	125.0	100.0	75.0	50.0	50.0
Other	24.6	34.9	46.3	73.5	101.1	84.3	2885.3	14.5
Total	395.8	683.5	1331.4	1649.3	1718.2	1050.8	3444.4	226.9
Chlorophyta								
<i>Closterium aciculare</i>	3.6	5.4	12.6	21.6	19.8	21.6	14.4	3.6
Other	5.3	21.3	42.9	56.2	62.1	52.3	26.6	10.1
Total	8.9	26.7	55.5	77.8	81.9	73.9	41.0	13.7
Total algae	428.4	1034.9	2737.7	4200.2	5366.2	2600.4	3912.5	328.8

TABLE 15

The biomass of the phytoplankton in Lake Balaton, 1967,
between Szigliget and Balatonmária (K) $10^6\mu^3/l$

	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.
Cyanophyta								
<i>Aphanizomenon flos-aquae</i>	0.7	1.1	7.0	70.0	63.0	14.0	7.0	1.0
<i>Anabaena spiroides</i>	—	—	0.3	3.5	7.0	10.5	0.4	—
<i>Microcystis flos-aquae</i>	10.0	50.0	10.0	450.0	500.0	50.0	60.0	20.0
Other	2.6	3.0	5.6	7.9	13.1	7.2	9.3	5.9
Total	13.3	54.1	22.9	531.4	583.1	81.7	76.7	26.9
Euglenophyta								
<i>Euglena acus</i>	1.1	2.2	4.4	5.5	11.0	—	1.1	—
<i>E. ehrenbergii</i>	—	8.4	33.6	33.6	63.0	33.6	8.4	4.2
<i>E. klebsii</i>	—	0.3	2.8	2.8	11.9	1.4	0.3	0.3
<i>E. oxyuris</i>	9.0	18.0	18.0	72.0	585.0	72.0	36.0	9.0
Other	1.0	0.7	1.2	6.5	13.3	4.0	1.6	0.2
Total	11.14	29.6	60.0	120.4	684.2	111.0	47.4	13.7
Pyrrophyta								
<i>Ceratium hirundinella</i>	15.9	132.5	1102.4	2395.6	3222.4	1399.2	169.6	31.8
<i>Diplopsalis acuta</i>	—	7.0	21.0	98.0	115.5	126.0	21.0	3.5
<i>Glenodinium gymnodinium</i>	—	—	6.4	9.6	12.8	3.2	—	—
<i>Gonyaulax apiculata</i>	—	5.2	20.8	31.2	145.6	41.6	20.8	—
Total	15.9	144.7	1150.6	2534.4	3496.3	1570.0	211.4	35.3
Chrysophyta								
<i>Amphora ovalis</i>	10.6	15.9	19.1	13.3	15.9	16.9	12.7	8.0
<i>Asterionella formosa</i>	4.8	8.0	32.0	22.4	16.0	8.0	4.0	3.2
<i>Cyclotella bodanica</i>	24.4	57.5	164.8	193.0	162.6	164.8	45.5	30.4
<i>C. ocellata</i>	17.0	27.2	61.2	48.1	41.1	27.3	23.8	10.7
<i>Cymatopleura elliptica</i>	30.0	30.0	240.0	120.0	60.0	60.0	30.0	15.0
<i>Diploneis elliptica</i>	4.0	6.1	10.2	10.2	12.2	8.2	1.0	1.0
<i>Melosira granulata</i>	107.5	172.0	258.0	344.0	645.0	172.0	86.0	43.0
<i>M. granulata</i> var. <i>angustissima</i>	3.8	11.4	57.0	45.6	34.2	30.4	30.4	7.6
<i>Surirella biseriata</i>	—	—	—	—	—	—	14.1	—
<i>S. robusta</i> var. <i>splendida</i>	25.0	75.0	75.0	75.0	50.0	50.0	62.5	25.0
Other	36.2	34.8	51.4	51.8	57.9	43.3	41.9	25.8
Total	263.3	437.9	968.7	923.4	1094.9	580.9	351.9	169.7
Chlorophyta								
<i>Closterium aciculare</i>	3.6	7.2	12.6	23.4	20.7	28.8	18.0	14.4
<i>Oocystis solitaria</i>	12.5	1.9	4.2	3.0	1.9	0.7	0.4	0.2
Other	3.6	12.5	22.5	30.9	39.1	39.0	26.2	9.5
Total	19.7	21.6	39.3	57.3	61.7	68.6	44.6	24.1
Total algae	323.3	687.9	2241.5	4166.9	5920.2	2412.2	732.0	269.7

basin the biomass fluctuated within lower limits in August (between Balatonfüred and Zamárdi 0.8–1.0–3.1 mg/l, between Balatonalmádi and Balatonvilágos 1.3–1.7–4.0 mg/l).

The yearly averages, except the large water-bloom in 1966 (3.2 mg/l), usually varied between 1.0 and 2.5 mg/l in the southern and between 0.4 and 1.7 mg/l in the northern basin of the lake.

TABLE 16

The biomass of the phytoplankton in Lake Balaton, 1967,
between Ságpuszta and Balatonszemes (G) $10^6 \mu^3/l$

	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.
Cyanophyta								
<i>Aphanizomenon flos-aquae</i>	1.0	1.4	3.5	28.0	17.5	21.0	10.5	0.7
<i>Microcystis flos-aquae</i>	10.0	30.0	40.0	200.0	450.0	60.0	40.0	20.0
Other	4.0	3.8	18.8	16.3	13.6	14.7	6.3	5.7
Total	15.0	35.2	62.3	244.3	481.1	95.7	56.8	26.4
Euglenophyta								
<i>Euglena acus</i>	—	—	8.8	30.8	11.0	—	—	1.1
<i>E. ehrenbergii</i>	—	8.4	33.6	16.8	33.6	8.4	4.2	8.4
<i>E. oxyuris</i>	18.0	27.0	—	—	—	—	9.0	9.0
Other	1.2	0.9	1.4	2.5	5.1	1.7	0.9	0.6
Total	19.2	36.3	43.8	50.1	49.7	10.1	14.1	19.1
Pyrrophyta								
<i>Ceratium hirundinella</i>	31.8	243.8	975.2	2120.0	2342.6	1356.8	148.4	42.4
<i>Diplopsalis acuta</i>	—	7.0	21.0	52.5	70.0	119.0	14.0	3.5
<i>Glenodinium gymnodinium</i>	—	—	3.2	12.8	12.8	6.4	—	—
<i>Gonyaulax apiculata</i>	—	5.2	20.4	26.0	93.6	31.2	26.0	—
Total	31.8	256.0	1019.8	2211.3	2519.0	1513.4	188.4	45.9
Chrysophyta								
<i>Botryococcus braunii</i>	0.4	0.8	2.1	8.4	2.1	10.4	2.5	0.8
<i>Amphora ovalis</i>	11.1	10.6	5.3	6.4	12.7	12.2	11.7	7.4
<i>Cyclotella bodanica</i>	43.4	86.7	108.4	219.5	135.5	109.5	43.4	27.1
<i>C. ocellata</i>	20.4	34.0	68.0	13.6	20.7	13.7	10.2	5.1
<i>Cymatopleura elliptica</i>	90.0	150.0	120.0	90.0	90.0	60.0	90.0	15.0
<i>C. solea</i>	17.0	8.5	8.5	8.5	8.5	8.5	34.0	8.5
<i>Melosira granulata</i>	86.0	107.5	129.0	172.0	344.0	129.0	107.5	36.1
<i>M. granulata</i> var. <i>angustissima</i>	7.6	15.2	19.0	57.0	38.0	22.8	19.0	11.4
<i>Surirella robusta</i> var. <i>splendida</i>	—	50.0	50.0	25.0	—	25.0	50.0	25.0
Other	32.8	35.8	44.3	45.3	47.5	38.0	35.9	12.1
Total	308.7	499.1	554.6	645.7	699.0	429.1	404.2	148.5
Chlorophyta								
<i>Closterium aciculare</i>	3.6	7.2	30.6	32.4	43.2	41.4	25.2	7.2
<i>Staurastrum gracile</i>	—	0.6	1.8	15.4	25.8	18.5	12.3	2.4
Other	6.0	18.5	21.6	35.0	34.5	26.9	17.3	6.6
Total	9.6	26.3	54.0	82.8	103.5	86.8	54.8	16.2
Total algae	384.3	852.9	1734.5	3234.2	3852.3	2135.1	718.3	256.1

Summary

The transversal sectional specific composition of phytoplankton in Lake Balaton, the slow or sudden change in the number of individuals of these (the so-called water-bloom and discoloration of water) are the outcome of the conjugate effects of external and internal factors. On the basis of the algological data on water sample series taken sectionally in 1972 and 1973 (HERODEK and TAMÁS, 1973; 1974; TAMÁS, 1974) we may establish that the growth of trophyty is faster in the southern than in the northern basin of the lake.

The author, multiplying the number of individuals of the phytoplankton on 1965, 1966 and 1967 with the mean volume of species in Lake Balaton, calculated the quantity of total algae.

TABLE 17

The biomass of the phytoplankton in Lake Balaton, 1967,
between Balatonfüred and Zamárdi (A) $10^6 \mu^3/l$

	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.
Cyanophyta								
<i>Aphanizomenon flos-aquae</i>	1.7	0.7	15.7	52.5	24.5	21.0	7.0	0.7
<i>Lynghya limnetica</i>	1.6	1.4	8.2	8.6	12.6	11.4	5.4	1.6
<i>Microcystis flos-aquae</i>	10.0	40.0	60.0	80.0	150.0	150.0	60.0	30.0
Other	2.2	4.0	17.3	12.7	13.4	12.2	5.7	3.5
Total	15.6	46.1	101.2	153.8	200.5	194.6	78.1	35.8
Euglenophyta								
<i>Euglena acus</i>	1.1	1.1	16.5	19.8	5.5	1.1	1.1	—
<i>E. ehrenbergii</i>	—	4.2	21.0	8.4	8.4	8.4	4.2	8.4
<i>E. oxyuris</i>	9.0	18.0	27.0	108.0	135.0	90.0	9.0	—
Other	0.3	2.2	3.4	6.7	8.4	5.6	0.6	0.4
Total	10.4	25.5	67.0	142.9	157.3	105.1	14.9	8.8
Pyrrophyta								
<i>Ceratium hirundinella</i>	42.4	116.6	954.0	826.8	1855.0	1590.0	95.4	31.8
<i>Diplopsalis acuta</i>	—	7.0	28.0	63.0	140.0	98.0	28.0	3.5
<i>Glenodinium gymnodinium</i>	—	—	9.6	12.8	9.6	6.4	—	—
<i>Gonyaulax apiculata</i>	—	5.2	41.6	20.8	52.0	41.6	20.8	—
Total	42.4	128.8	1033.2	923.4	2056.6	1736.0	144.2	35.3
Chrysophyta								
<i>Amphora ovalis</i>	15.9	25.4	15.9	11.1	55.6	31.8	27.6	10.6
<i>Cyclotella bodanica</i>	—	47.7	88.9	110.5	81.3	92.1	43.4	46.6
<i>C. ocellata</i>	17.0	24.4	23.8	27.2	20.4	17.0	7.1	4.2
<i>Cymatopleura elliptica</i>	60.0	60.0	60.0	30.0	90.0	60.0	75.0	60.0
<i>C. solea</i>	17.0	17.0	17.0	8.5	8.5	8.5	8.5	8.5
<i>Fragilaria pinnata</i>	1.8	2.4	3.3	32.0	3.3	2.7	2.2	1.9
<i>Gyrosigma attenuatum</i>	—	39.2	19.6	19.6	—	—	39.2	—
<i>Melosira granulata</i>	107.5	111.8	107.5	215.0	260.1	173.7	87.7	43.8
<i>M. granulata</i> var. <i>angustissima</i>	5.7	22.8	30.4	34.2	36.1	38.0	26.6	9.5
<i>Surirella biseriata</i>	—	14.1	—	—	—	14.1	—	—
<i>S. robusta</i> var. <i>splendida</i>	50.0	25.0	50.0	62.5	50.0	50.0	50.0	25.0
Other	23.3	38.9	73.8	81.9	46.4	49.1	29.7	14.0
Total	298.2	428.7	490.2	632.6	651.8	537.1	397.0	224.2
Chlorophyta								
<i>Closterium aciculare</i>	5.4	7.2	32.4	34.2	39.6	43.2	27.0	12.6
Other	5.6	20.0	32.2	41.1	52.9	49.1	27.6	11.9
Total	11.0	27.2	64.6	75.3	92.5	92.3	54.6	24.5
Total algae	377.6	656.3	1757.1	1928.0	3158.7	2665.1	688.8	328.6

The biomass values of species of small and moderate size, in the quantity of total algae, amount to 0.5–1.0 mg wet weight/l in the three warm water months (July–August–September).

The biomass of total algae, except two maxima in July, showed maxima in August at the five transversal sections. In 1966 the highest value (12.5 mg/l) was recorded at transversal section "K" shared between *Aphanizomenon* (5 mg/l) and *Ceratium* (6.5 mg/l). At this time in the Keszthely Bay the total algae amounted to 6.2 mg/l, of which *Aphanizomenon* (3.8 mg/l) and Pyrrophyta (*Ceratium* — *Gonyaulax* — *Diplopsalis* species 1.4 mg/l) were in large quantities. The second high value was 8.1 mg/l in the Keszthely Bay in August 1965 containing 7.7 mg/l diatoms (*Melosira granulata* and its variety amounted to

TABLE 18
The biomass of the phytoplankton in Lake Balaton, 1967,
between Balatonalmádi and Balatonvilágos (E) $10^6 \mu^3/l$

	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.
Cyanophyta								
<i>Aphanizomenon flos-aquae</i>	1.2	2.8	21.0	70.0	77.0	52.5	24.5	1.4
<i>Lyngbya limnetica</i>	1.6	1.6	8.4	10.8	13.1	10.0	6.8	2.4
<i>Microcystis flos-aquae</i>	20.0	40.0	300.0	300.0	450.0	200.0	400.0	40.0
Other	3.4	5.4	11.8	14.4	14.7	14.5	9.8	1.6
Total	27.1	49.8	341.2	395.2	554.8	277.0	441.1	45.4
Euglenophyta								
<i>Euglena acus</i>	—	—	—	19.8	—	—	2.2	—
<i>E. ehrenbergii</i>	—	—	—	12.6	8.4	8.4	8.4	4.2
<i>E. oxyuris</i>	—	36.0	36.0	126.0	72.0	18.0	18.0	—
Other	0.1	1.8	4.2	8.8	3.0	0.6	0.5	0.3
Total	0.1	37.8	40.2	167.2	83.4	27.0	29.1	4.5
Pyrrophyta								
<i>Ceratium hirundinella</i>	106.0	201.4	1060.0	1367.4	2650.0	1325.0	222.6	42.4
<i>Diplopsalis acuta</i>	—	7.0	14.0	98.0	105.0	84.0	21.0	3.5
<i>Gonyaulax apiculata</i>	—	5.2	31.2	31.2	78.0	41.6	20.8	—
Other	—	—	6.4	9.6	8.0	6.4	—	—
Total	106.0	213.6	1111.6	1506.2	2841.0	1457.0	264.4	45.9
Chrysophyta								
<i>Botryococcus braunii</i>	0.4	0.4	0.4	8.4	4.2	14.2	3.3	0.4
<i>Amphora ovalis</i>	12.7	21.2	10.6	15.9	29.7	18.0	13.2	10.6
<i>Cyclotella bodanica</i>	54.2	78.0	110.6	88.9	55.3	45.5	30.3	18.4
<i>C. ocellata</i>	27.2	20.7	17.0	20.4	17.0	13.6	5.8	5.1
<i>Cymatopleura elliptica</i>	120.0	90.0	60.0	60.0	90.0	90.0	75.0	30.0
<i>C. solea</i>	25.0	25.5	17.0	17.0	8.5	8.5	8.5	17.0
<i>Gyrosigma acuminatum</i>	6.2	—	8.2	12.3	9.2	6.2	6.2	—
<i>G. attenuatum</i>	19.6	—	78.5	39.2	78.5	—	—	—
<i>Melosira granulata</i>	129.0	77.4	86.0	107.5	129.0	110.1	67.1	35.3
<i>M. granulata</i> var. <i>angustissima</i>	7.6	11.4	30.4	38.0	34.2	30.4	22.8	11.4
<i>Surirella robusta</i> var. <i>splendida</i>	—	50.0	25.0	25.0	37.5	50.0	37.5	50.0
<i>S. turgida</i>	—	—	—	6.3	12.5	6.3	—	—
Other	22.4	29.3	33.8	52.4	26.6	29.8	31.4	9.6
Total	424.3	403.9	478.5	491.3	532.2	422.6	301.2	187.8
Chlorophyta								
<i>Closterium aciculare</i>	5.4	7.2	34.2	36.0	37.8	41.4	34.2	7.2
Other	6.9	18.4	28.7	41.1	43.4	44.3	21.6	9.5
Total	12.3	25.6	62.9	77.1	81.2	85.7	55.8	16.7
Total algae	569.8	730.7	2034.4	2637.0	4092.6	2269.3	1091.6	300.3

TABLE 19
The quantitative change in the phytoplankton

	M				K			
	1962	1965	1966	1967	1962	1965	1966	1967
IV.				0.4				0.3
V.			0.5	0.1			0.5	0.6
VI.		0.3	1.8	2.7		0.5	1.4	2.2
VII.	0.7	0.2	2.2	4.2	6.7	0.5	3.5	4.1
VIII.		8.1	6.2	5.3		3.3	12.5	5.9
IX.		0.6	2.7	2.6		2.6	4.2	2.4
X.		0.1	0.2	3.9		0.1	0.2	0.7
XI.			0.1	0.3			0.1	0.2
Average		1.8	1.9	2.5		1.4	3.2	2.0

6.9 mg/l). The values of total algae are rather influenced by the number of individuals of species predominating in the water-bloom and discoloration of water.

At the third transversal section of the southern basin (Ságpusztá—Balatonszemes) the quantity of total algae was essentially lower during each of the three years. At the two transversal sections of the northern basin the values of total algal biomass were also very low (0.8—4.0 mg/l.)

The average of years, except the water-bloom in 1966 (3.2 mg/l), in the southern basin varied between 1.0 and 2.5 mg/l, while in the northern one between 0.4 and 1.7 mg/l.

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of Lake Balaton in the 1960s (mg/l)

G			A				E		
1965	1966	1967	1962	1965	1966	1967	1965	1966	1967
		0.3				0.3			0.5
	0.2	0.8			0.4	0.6		0.2	0.7
0.5	1.0	1.7		0.4	0.9	1.7	0.2	0.9	2.0
1.1	3.1	3.2	0.5	0.6	1.1	1.9	1.0	1.4	2.6
2.7	2.0	3.8		0.8	1.0	3.1	1.3	1.7	4.0
1.9	0.8	2.1		0.4	0.6	2.6	0.8	1.1	2.2
0.1	0.1	0.7		0.1	0.1	0.6	0.1	0.1	0.1
	0.1	0.2			0.1	0.3		0.1	0.3
1.2	1.0	1.6		0.4	0.6	1.4	0.7	0.8	1.7

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A BALATON FITOPLANKTONJÁNAK BIOMASSZA VÁLTOZÁSA A HATVANAS ÉVEKBEN

Tamás Gizella

Összefoglalás

Szerző 1965, 1966 és 1967 évek horizontális fitoplanktonjának egyedszámát a balatoni fajok átlag térfogatával szorozva számította ki az összes alगतömeget.

A kis és közepes termetű fajok biomassa értékei a három melegvízi hónapban (július—augusztus—szeptember) az összsalga tömegében 0,5—1 mg élőszűly/litert tesznek ki.

Az összsalga biomassa az 5 harántszelvényen — két júliusi maximumtól eltekintve — augusztusi maximumot mutat. 1966 évben Szigliget—Balatonmária között 12,5 mg/l a legmagasabb értéket kapta (az érték egyik felét az *Aphanizomenon* (5 mg/l), másik felét pedig a *Ceratium* (6,5 mg/l) tette ki. A Keszthelyi-öbölben ugyanekkor az összsalga tömege 6,2 mg/l, melyben jelentős az *Aphanizomenon* (3,8 mg/l) és a Pyrrophyta (*Ceratium*—*Gonyaulax*—*Diplopsalis* együttes 1,4 mg/l). A második magas értéket 1965 augusztusi Keszthelyi-öböl mintában 8,1 mg/l, ebből az összes kovamoszat 7,7 mg/l (a *Melosira granulata* és változata ebből 6,9 mg/l-t tett ki). Az összes alगतömeg értékét jelentős mértékben befolyásolták a vízvirágzás és vízszíneződésben uralkodó fajok egyedszámái.

A tó déli részének harmadik harántszelvényén (Ságpusztá—Balatonszemes) összes alगतömege lényegesen alacsonyabb volt mindhárom évben. Az északi rész két szelvényének összes algabiomassa adatai ugyancsak lényegesen alacsonyabbak voltak (0,8 és 4,0 mg/l közötti értékek).

Az évi átlagok — kivéve az 1966 évi nagyméretű vízvirágzást 3,2 mg/l — általában a déli tőrészen 1,0—2,5 mg/l, míg az északi szelvényeken 0,4—1,7 mg/l között alakultak.