CLADOCERA STUDIES IN LAKE BALATON.

II. LITTORAL CLADOCERA FROM THE NORTHEASTERN SHORES OF THE TIHANY PENINSULA.

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With 3 Figures and 1 Table in the text.

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INTRODUCTION.

To evaluate the Cladocera content (live specimens and remnants) of detritus-drifts which form frequently on the shore of the Kis-öböl bay, Lake Balaton (see SEBESTYÉN 1947, p. 1) it seemed advisable to investigate the Cladocera which drifted ashore in their original habitats which are very likely the Kis-öböl, and the bottom of the open water off the E shores of the Tihany peninsula.

A report on the mud-living species has recently been published (SEBESTYÉN l. c.). This paper gives an account of the Cladocera of the Kis-öböl, a small by in the vicinity of the Biological Institute, Tihany. For comparison, samples were taken from the marsh off the peninsular territory named „Gödrös". This marsh is located between the lake shore and an extensive girdle of *Phragmites* about 1500 m NW of the Kis-öböl. There is no other growth of emergent vegetation between these two localities on the margin of the lake.

It had been planned to carry out investigations simultaneously in Aszófői-öböl bay (also called „Fenék") too, a part of the NE shore of the Tihany peninsula. It is an extensive bay, along the shores of which several patches of *Phragmites* grow. The furthest one (NW of Gödrös) merges into the long, continuous reed-girdle decorating the upper part of the NW shores of the lake. The growth at the base of the bay had been selected for study. However the collections could not be carried out with regularity, because in 1945 and 1946 the surrounding country — being close to a temporary military lodge — became polluted to such a degree that the collections had to be discontinued. Though the Table below includes some data from this locality, the results of the investigations made here are not taken into consideration either in the text or in the diagrams (Figs. 2—3).

TIME OF COLLECTIONS. METHOD.

The collections commenced in Oct. 1944, (Kis-öböl) and March 1945, (Gödrös) respectively and were continued regularly (several times a month) till July 1946. At about this time the shore waters at Kis-öböl became very polluted, due to post-

war neglect. Especially habitats 1—3,* and to some extent habitat 4 also, were deprived of their original character and the usual microfauna disappeared. During March-October 1947 the water level of Lake Balaton was unusually high owing to a temporary closing of the outflow of the lake, which is the Sió-channel. The marshy aspect of the habitats investigated disappeared and the "biocoenoses" pertaining thereto could not develop when the favourable season set in. Collections were renewed only in Oct. 1947 (Gödrös) and continued till the end of the year.

Samples were taken in the shallow marginal reaches (Gödrös; habitats 1—2 Kis-öböl) with a hand-net (Swiss bolting cloth No 6; 29 threads per 10 mm). When it seemed more appropriate, the instrument was used from a row-boat (hab. 4, sometimes 6). In habitats of a rather lacustrine type (hab. 5—7) hauls were taken with a plankton net having the same mesh. Samples of the submerged vegetation (hab. 1a) were rinsed in water, the same from wet detritus-drifts from the shore (hab. 3) were picked up with a wooden pincette, put into a porcellain bowl, and a small quantity of water added. The material was surveyed afresh under a bin-

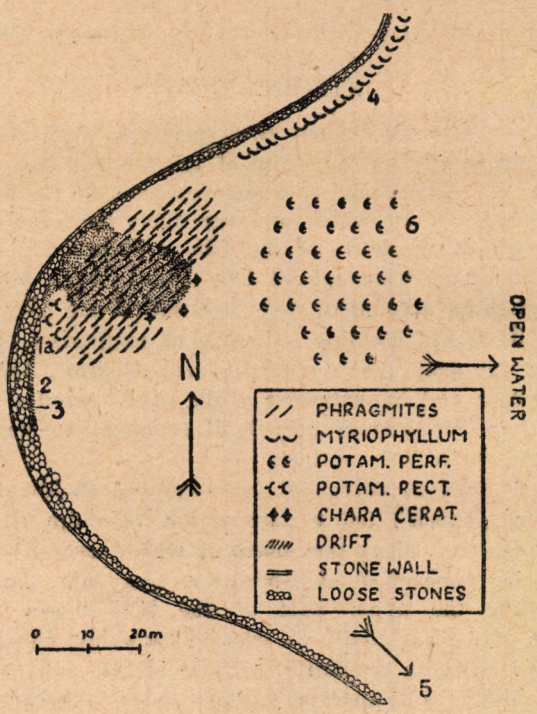


Fig. 1. Sketch of Kis-öböl at medium water level (78 cm) showing shore line, emergent and submersed (partly) vegetation. The territory, dotted, emerges above the surface at low water. The numbers marking some of the localities of collections correspond those given in the Table.

* For meaning of numbers regarding „habitats" (= locations of collections) see explanation of Table below.

ocular microscope (magn. about 30 x), and the Cladocera selected by pipette. For detailed study (viz. identification) the material was investigated under a microscope (magn. 130, 460 and 800 x), either alive or after fixation in alcohol (96 %) and mounting in glycerine.

LOCALITIES INVESTIGATED. ENVIRONMENTAL CONDITIONS. GENERAL REMARKS ON CLADOCERA FOUND.

Kis-öböl* (See the Table below and Figs 1—2).

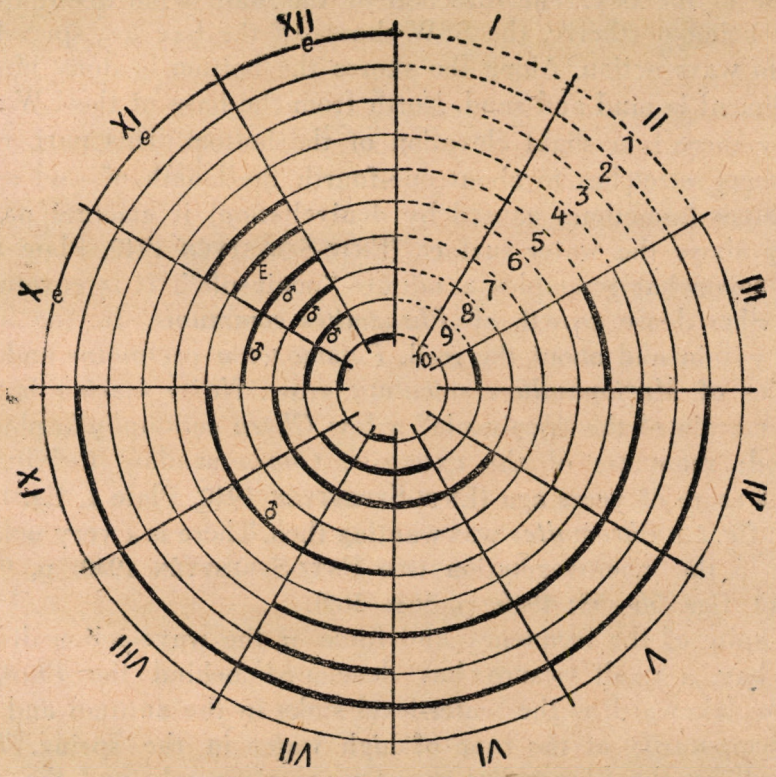


Fig. 2. Monthly distribution of Cladocera, Kis-öböl (Oct. 1944—July 1946). ——— = samples taken; – – – – – = no collections; ▬▬ = species present; ▬▬ = only dead specimens; e = ephippia; E = ephippial females; v = empty.

1. Sida crystallina; 2. Daphnia cucullata; 3. Scapholeberis mucronata; 4. Iliocryptus agilis + I. sp.; 5. Macrothrix laticornis; 6. Eurycercus lamellatus; 7. Acroperus harpae; 8. Alona affinis; 9. Rhynchotalona rostrata; 10. Leydigia acanthocercoides; 11. Pleuroxus Balatonicus; 12. Chydorus sphaericus; 13. Monospilus dispar.

* On account of its handy location the Kis-öböl bay serves the staff of the Institute investigating the biological conditions of the lake as a natural open-air aquarium.

The E and NE shores of the Tihany peninsula are protected by an artifical stone wall supported on the lake side by loose, quarried stones (see ENTZ-SEBESTYÉN 1940, Plate 13, fig. 46). The Kisöböl, a small bowl-shaped bay with an area of about 6000 m^6, opens eastward. Though waves raised by both NE and S winds roll towards the shores, it happens only under very extreme circumstances (unusually high water-level and heavy storm) that they reach the wall at the base of the bay. The direction of the main wind about the lake district being northerly, the SSW shores of the bay are specially exposed to wave-action. Along the shores the bottom is stony elsewhere the sediment is mud and sand. North from the base of the EW axis of the bay there is a slight elevation of the bottom. This part, covered with stones, stretches to about one-fourth the length of said axis. At low waters (sometimes caused by denivellation) it emerges partly or entirely above the water surface (ENTZ-SEBESTYÉN 1940, Plate 15, fig. 58). It somewhat resembles a minute "peninsula". It is covered now by a rather dense growth of *Phragmites communis*. In the shallow waters within and about the reed, *Potamogeton pectinatus* and dwarf examples of *Myriophyllum spicatum* grow. *Najas marina* is sparse. At the margin of the "peninsula" a few *Chara ceratophylla* plants are scattered: remnants of the extensive *Chara*-meadow thriving here nearly a score of years ago (ENTZ-SEBESTYÉN 1940, Plate 1, fig. 1; 1946, Plate I. fig. 1.). *Phragmites* was wanting then. There is a very noticeable change in the macrovegetation (see ENTZ-SEBESTYÉN 1940, p. 95, 125, Plate 15, figs. 56—58; 1946, p. 368—369).

In spite of the frequency and force of the wave-action displayed in the bay, a small swamp has developed behind the *Phragmites*. It moves lakeward as the water-level sinks in the autumn and disappears temporarily at the time of high water in the spring. As the years roll by the *Phragmites* grows more vigorously and the marshy character of the territory behind assumes a more stationary aspect. However storms frequently disturb both "biotop" and "biocoenosis".

Along the NW shores of the bay a narrow stripe of *Myriophyllum spicatum* flourishes year after year. It is protected against the dislodging effect of the S wind - which can be rather wild at times - by the artifical arrangement of loose stones mentioned above. (ENTZ-SEBESTYÉN 1940. Plate 12, fig. 43; 1946, Plate 7, fig. 24). Patches of submerged vegetation are scattered here and there about the center of the bay *(Potamogeton perfoliatus, P. pectinatus,* and *Myriophyllum spicatum*).

The S and SE shores are of the type of "erosion littoral" with

TABLE

Distribution of Cladocera in the localities investigated, NE shores of the Tihany peninsula, Lake Balaton.

No	Species	Localities																	
			Kis-öböl									Gödrös							Aszófői-ö.
		♀♂eE	1	1a	2	3	4	5	6	7	♀♂eE	8	9	10	11	12	13	14	15	
1.	Sida crystallina	♀♂		⊕			+	+	+	⊕										
2.	Daphnia cucullata	e	(e)								e	(e)								e
3.	Scapholeberis mucronata	♀	+				+				♀	+	⊕	+	⊕					+
4.	Scapholeberis aurita										♀			+						
5.	Simocephalus vetulus										♀	⊕		+	⊕				+	+
6.	Simocephalus exspinosus congener										♀	+							+	
7–8.	Iliocryptus agilis, I. sp.	+	+		+	+														
9.	Macrothrix laticornis	♀	+		+	+														
10.	Eurycercus lamellatus	♀♂	+				+				♀♂E	+	+		+	⊕	+			
11.	Camptocercus rectirostris										♂							+		
12.	Acroperus harpae	♀♂eE	+	+			⊕				♀♂	+	+		+	⊕	+		+	
13.	Alona affinis	♀♂eE	+	+	+	+	+		+		♀♂	+	+		+	+	+		+	+
14.	Alona guttata										♀	+	+		+					
15.	Rhynchotalona rostrata	♀♂eE	⊕	+	+		+				♀	+								
16.	Leydigia acanthocercoides	♀♂e	+			+					ev								ev	ev
17.	Alonella excisa										♀♂E	+	+		+	+	+		+	
18.	*Alonella exigua										♀				+					
19.	*Pleuroxus laevis										♀				+					
20.	*Pleuroxus uncinatus										♂							+		
21.	*Pleuroxus aduncus										♀♂eE	+	+	⊕	+				+	
22.	Pleuroxus Balatonicus	♀♂e	+			+	+			+										
23.	Chydorus sphaericus	♀	+				+				♀	⊕		⊕	+				+	
24.	Monospilus dispar	♀♂eE	+	+	+	+	+		+		♀								+	⊕
	Total	14	11	5	5	6	9	1	3	1	18	11	7	5	11	4	4	2	8	1

Signs used: + = species present in samples; ⊕ = abundant; — = species lacking; e = ephippium; E = ephippial female; v = empty; * = not recorded previously from Lake Balaton.

Localities of collections, Kis-öböl bay exc: 1. shallow marginal water behind Phragmites growth; 1a. same with Potamogeton pectinatus; 2. shore waters during wave action; 3. fresh detritus drift on the shore; 4. Myriophyllum stand about the N shores; 5. Myriophyllum in open water (not in the bay); 6. Potamogeton perfoliatus about the centre of the bay; 7. same situated further off shores (not in the bay). Gödrös: 8. near the W end with floating reed; 9. decaying reed, filamentous algae; 10. decaying reed, Utricularia, Hydrocharis; 11. Butomus umbellatus; 12. Myriophyllum spicatum; 13. Potamogeton pectinatus; 14. E end of marginal water, submerged vegetation lacking; 15. the swamp in general.

only filamentous algae *(Cladophora glomerata)* growing on the stones which at places are left bare.

In the Kis-öböl samples were taken from the following localities

a) regularly:

shallow marshy water behind the *Phragmites*-growth (hab. 1.);

the same with *Potamogeton pectinatus* (hab. 1a);

shore waters (W) during wave action, when the water is detritus-laden (hab. 2.);

fresh detritus-drifts on land (hab. 3);

Myriophyllum girdle about the N shore (hab. 4);

b) occasionally:

Myriophyllum growing in the open water district under the protection of a submerged concrete pipe (hab. 5, not in the bay);

Potamogeton perfoliatus patch at about the center of the bay (hab. 6);

the same situated further off the shores (hab. 7; not in the bay).

All these places differ from each other in many respects.

Hab. 1. The shallow water behind the *Phragmites* is of a marshy type. The water is clear and calm here. On account of its extreme shallowness (when at low water the depth is only few cm) the temperature of the water is subjected to frequent changes (see ENTZ-SEBESTYÉN 1946, p. 235). The pH is but slightly lower than that of the main water body (8.15 resp. 8.24, 24th Nov. 1947). Organic detritus is present in abundance. 12 species of Cladocera were found here (Fam. Sididae 1, Macrothricidae 3, Chydoridae 8) the most common ones being *Alona affinis* and *Rhynchotalona rostrata*. The last one may be abundant on occasion (Aug. 1946). All other species occur but sparsely. During the cold season only resting stages were found. In late autumn ephippia of *Daphnia cucullata* drifted here from the open water.

Hab. 1a. The S corner of this swamp with *Potamogeton pectinatus* also harbours several species, none of them abundantly.

Hab. 2. The NE wind frequently stirs up the *förna*-like sediment at the very margin of the water which, being full of detritus, becomes turbid and dark. Species drifted here from their original habitat viz. from the muddy bottom of territories further off the shores (like *Iliocryptus* and *Macrothrix)* might be caught in the net.

Hab. 3. The fate of this floating detritus is to be drifted ashore sooner or later. Right after the formation of a drift several examples of Cladocera might be found alive among the detritus particles. Samples

collected here may contain more species than that of hab. 2. This is, however, merely a matter of luck.

Hab. 4. The aspect of the *Myriophyllum* girdle along the N shores resembles a growth situated far off the shores and surrounded by open water. In the case of the former the likeness is due to wave-action. The type of such a growth is relatively "lacustrine". However when calm weather exists for weeks it assumes a true swampy character: a rich growth of filamentous algae develops near the surface *(Enteromorpha intestinalis* and *E. salina* etc. (see ENTZ-SEBESTYÉN 1946, p. 336) and the water in reach is clear and calm. The Cladocera fauna of this habitat, with its 9 species, resembles somewhat that of hab. 1, *(Scapholeberis mucronata, Eurycercus lamellatus, Pleuroxus Balatonicus, Chydorus sphaericus).* In some years *Acroperus harpae* might be found in great abundance.

Hab. 5. For comparison hauls were taken — only a few occasions — from *Myriophyllum* growth further off the shores resulting in a few examples of *Sida* and *Monospilus.*

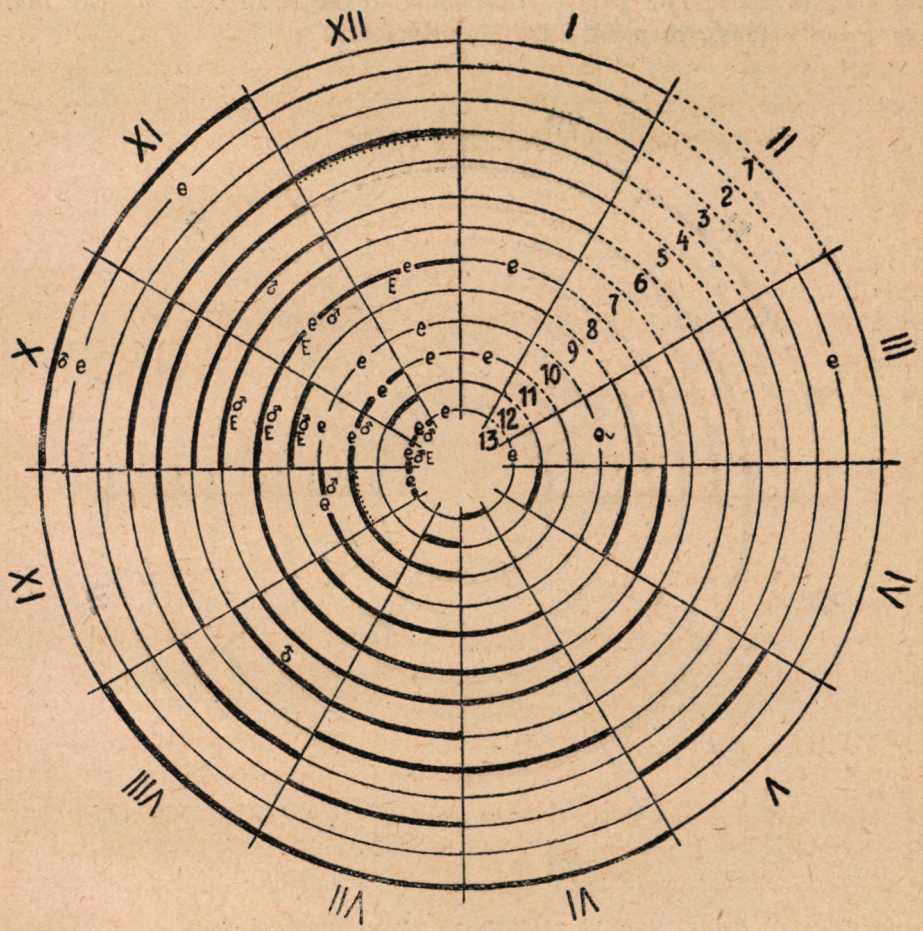
Hab. 6. The Cladocera fauna of the *Potamogeton perfoliatus* growth in the bay is far more monotonous than that of hab. 5, *Sida* being the only species of regular occurrence; it may reach a very great development here. *Alona affinis* — a common form in the littoral in general — is frequently found. From the muddy bottom *Monospilus* is recorded.

Hab. 7. A *Potamogeton* patch situated further off the shores harbours only *Sida* and *Pleuroxus Balatonicus,* this last from the bottom.

Gödrös, (see the Table below and fig. 3 and 3a).

About 17 years ago the *Phragmites* girdle here was divided from the shores by a broader strip of water. This water then fell under the influence of the pelagic region (see (ENTZ-SEBESTYÉN 1940, p. 86). Nowadays the growth stretches shoreward, increasing in all dimensions (length about 300 m: width 25 m; height of stalks about 4 m). It pays now to cut the reed in winter. The stones at the bottom are covered by a *förna*-like organic sediment, derived mostly from decayed reed. Old stalks broken off by the wind float on the surface, mosaic-like. This is the situation especially at the W corner of the water-strip where the stalks accumulate, forming a dam which cuts off the marginal water from the lake proper. Stalks and leaves drift ashore, while the more decayed sink to the bottom. The marginal water is well protected against the wind by the vigorous growth of *Phragmites.* Turbid

water from the pelagic region may enter here only occasionally at the E end in stormy weather, in the thawing season and at high water. Various kind of submersed plants and few bushes of *Butomus umbellatus* have settled here lately. In the first part of the favourable season *Hydrocharis* and *Utricularia* flourish, a rich growth of fila-



Figs. 3 a, b. Monthly distribution of Cladocera, Gödrös (March 1945—July 1946; Oct.—Dec. 1947).

For explanation of signs see Fig. 2.

1. Daphnia cucullata; 2. Scapholeberis mucronata; 3. S. aurita; 4. Simocephalus vetulus; 5. S. exspinosus congener; 6. Eurycercus lamellatus; 7. Camptocercus rectirostris; 8. Acroperus harpae; 9. Alona affinis; 10. A. guttata; 11. Rhynchotalona rostrata; 12. Leydigia acanthocercoides; 13. Alonella excisa; 14. A. exigua; 15. Pleuroxus laevis; 16. P. uncinatus; 17. P. aduncus; 18. Chydorus sphaericus; 19. Monospilus dispar.

mentous algae also appearing *(Spirogyra, Draparnaldia)*, attached to every possible object.

The shallow marginal water is of marshy type throughout (perhaps with the exception of hab. 14). The water is clear and still everywhere. The temperature exhibits the peculiarities of shore water in general (see p. 105). The pH is somewhat lower than that of the main water body (8.06, resp. < 8.24, 30th Oct. 1947).

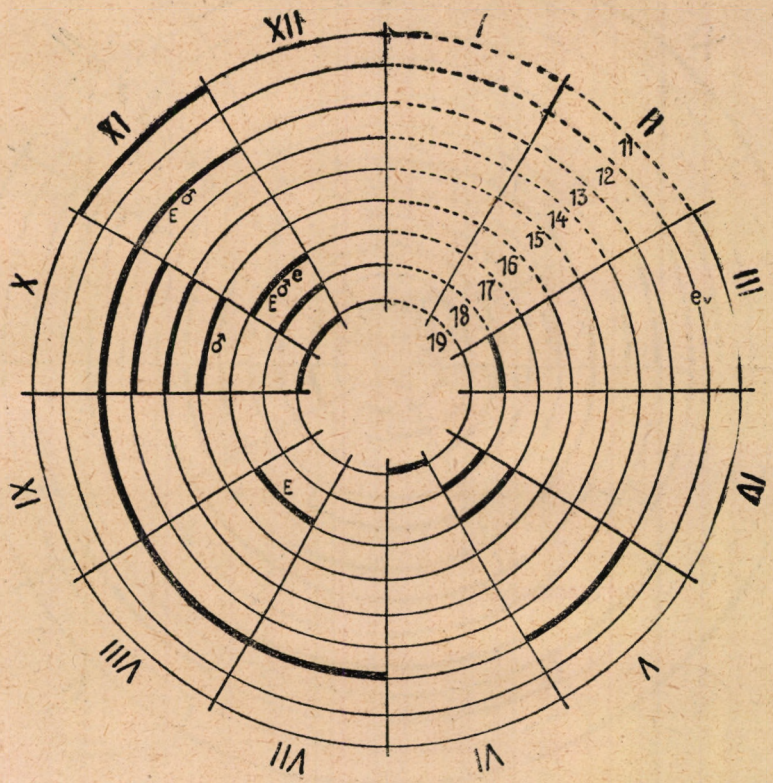


Fig. 3b. (For explanation see previous figure.)

Samples of the marginal water (not from among the reed) were taken at several places from W to E as follows:

near the W end of the water with floating reed (8);
decaying reed and filamentous algae (9);
decaying reed, *Utricularia* and *Hydrocharis* (10);
Butomus umbellatus (11);

Myriophyllum; Potamogeton pectinatus (12; 13);

near the E end where the stones are surrounded with fallen reed leaves, submersed vegetation is lacking (14);

the swamp in general (15).

It seems that conditions of life are not uniform throughout. The hauls are different when taken from among floating reed than from the vicinity of *Butomus* or patches of submersed vegetation. Nevertheless the Daphnidae seems to be distributed everywhere *(Simocephalus vetulus, Scapholeberis mucronata),* and the same is true of most representatives of the Chydoridae *(Eurycercus, Acroperus, Alona affinis, Alonella excisa, Pleuroxus aduncus* and *Chydorus sphaericus).* However the best hauls always came from among the floating reed and from the neighbourhood of *Butomus* plants. Four species, *Camptocercus rectirostris, Pleuroxus uncinatus, P. laevis* and *Alonella exigua* were recorded only from one habitat respectively. In the case of the two last-named species this singularity has hardly any significance, because only one or two specimens were found.

LIST OF SPECIES.

Fam. Sididae (Baird).

1. *Sida crystallina* (O. F. Müller) the only representative of the family found only in Kis-öböl. Common in submerged vegetation, might be very abundant in *Potamogeton perfoliatus* growth of lacustrine type. One of the most characteristic members of the biocoenosis of such biotop during summer. Males in July.

Fam. Daphnidae (Straus).

2. Ephippia of *Daphnia cucullata* G. O. Sars — one of the leading eupelagic species of our lake — found in the surface film of the marginal waters in abundance. Appearance seasonal (Oct.-Nov.). Most of them were empty (Kis-öböl, Gödrös).

3. *Scapholeberis mucronata* (O. F. Müller). Head with frontal spine. Shell colorless with definite dark grey patches; mandibles, second antennae and part of postabdomen also coloured. One of the first species appearing in the spring (Gödrös), present throughout summer. Uncommon in Kis-öböl. No males were noted.

4. *Scapholeberis aurita* (Fischer). Only one female specimen with embryos; weedy water (Gödrös).

5. *Simocephalus vetulus* (O. F. Müller). Frequent but not abundant, June, July (Gödrös). No males were noted.

6. *S. exspinosus* (KOCH) v. *congener* SCHOEDLER. Appearance more sporadic than that of the preceding species (Gödrös). No males found.

Fam. Macrothricidae. (BAIRD).

7. *Iliocryptus agilis* KURZ. Few examples from the very margin of the Kis-öböl.

8. *I.* sp. Few individuals with shell not cast in moulting (Kis-öböl).

9. *Macrothrix laticornis* (JURINE). Typical mud form (SEBESTYÉN 1947, p. 9) from the very margin of the Kis-öböl, drifted here very likely from the original habitat. Individuals of a greenish tinge and less opacity than the typical mud specimens were also noted. Only females. Absent during winter.

Fam. Chydoridae G. O. SARS.

10. *Eurycercus lamellatus* O. F. MÜLLER. Common in weeds during summer and autumn. First appearance in July. Males August-November (Kis-öböl, Gödrös).

11. *Camptocercus rectirostris* (SCHOEDLER). Only males, Oct-Nov., Gödrös.

12. *Acroperus harpae* BAIRD. Very variable (subsp. *harpae* s. str.; subsp. *angustatus;* and var. *neglectus).* Common in the littoral among weeds (May-Nov., Kis-öböl, Gödrös). In Myriophyllum growth occasionally in huge numbers (VIII, X. 1945; VII—VIII, 1946). (pH of water is higher than 8!, see BREHM 1933, p. 770). Males Oct-Nov.

13. *Alona affinis* (LEYDIG). With the previous species the most common littoral form. Present in almost every sample, but never abundant. Absent during the coldest months (see SEBESTYÉN 1947 p. 9). Males Oct.-Nov. It multiplied abundantly in a rough culture made of plankton sample and lake water kept in outdoor aquarium in the company of the algae *Mougeotia* (pH of the culture water 8, 28, 24th Nov. 1944).

14. *A. guttata* SARS. Only in Gödrös, appearance sporadic, when present is rather frequent. Specimens with tuberculated shell structure (v. *tuberculata* KURZ) noted in October.

15. *Rhynchotalona rostrata* (KOCH). Fairly common among weeds (1945). Colorless examples rare. Shell with greyish tinge, second antennae and postabdomen darker. Ephippium greyish. Males more yellow. Forms of rostrum vary. Body frequently with orange-coloured oil-drops (April-Oct.). Epizoön in summer (June-July). Large population in mud of the bottom of an aquarium kept in the laboratory, arranged the previous autumn. (9th April, 1945).

16. *Leydigia acanthocercoides* (FISCHER). Typical mud form (SEBESTYÉN 1947 p. 10). Both sexes were found in Oct. in shallow water and among drift-particles drifted ashore (Kis-öböl). Ephippia common throughout spring (empty) and autumn. Males in November.

17. *Alonella excisa* (FISCHER). Striae of valves resemble those of *A. nana*. Fairly common but never abundant, May-Nov. (Gödrös). Males in November.

18. *A. exigua* (LILLJEBORG) (?). Only one female specimen with eggs, Oct. 22. 1947, in company of previous species.

19. *Pleuroxus laevis* SARS. Only females with eggs, in same sample with the two previous species.

20. *P. uncinatus* BAIRD. (?). Several males, Oct. 1947, Gödrös.

21. *P. aduncus* (JURINE). Not rare in summer, both sexes abundant in Nov. (Gödrös). Easily adopts laboratory conditions, fed well on powdered waterplants in cultures of lake water.

22. *P. Balatonicus* DADAY. Among weeds and detritus particles drifted ashore (Kis-öböl). Reported previously from muddy bottom. Littoral specimens with deeper yellow colour, prominant fornices, larger size (see SEBESTYÉN 1947 p. 12). Males in October, ephippium in drift.

23. *Chydorus sphaericus* O. F. MÜLLER. From March till November, fairly abundant when present. No males found.

24. *Monospilus dispar* SARS. More common in Kis-öböl than in Gödrös. Males Oct.-Nov. Ephippium frequent in floating detritus and among detritus particles cast ashore (Kis-öböl). Typical mud form, having somewhat wider distribution than other benthic species mentioned (See SEBESTYÉN 1947, p. 12).

CONCLUDING REMARKS.

The places investigated are not of equal value from an ecological point of view. In the Kis-öböl, habitats 1, 1a, 4 and 6 might be considered as „subbiotops". Their typical aspect, however does not exist for longer than a few weeks. The fall or rise of the water level, lasting storms or calm periods etc. might be responsible for a change of environmental conditions, which in turn are followed by a change of the respecitve animal communities. Localities such as Nos. 2 and 3 are but temporary lodges of organisms driven ashore.

Habitat 4 might be compared with hab. 5, both being *Myriophyllum* growths, only when both exhibit a relatively lacustrine aspect

and the same is true in the case of *Potamogeton perfoliatus* (hab. 6—7). Only hab. 1 in the Kis-öböl might be compared with the swamp at Gödrös, though environmental conditions of these two habitats have a rather striking difference. Conditions of existence in the Kis-öböl are more uniform and more unstable than in Gödrös, where the swampy character of the place is sustained throughout the year, at least under normal conditions. The size of the *Phragmites* growth seems to be responsible chiefly for this. The emergent vegetation separates the marginal water from the main and acts as a screen for the "biotop" and the respective "biocoenosis". The screen is more perfect in Gödrös than in Kis-öböl. Besides, the variety of the vegetation creates a patterned structure of the biotop „Gödrös". (Yet there is no definite ground for saying that the differences in the hauls taken at different localities here (hab. 8—14) are due to the presence or absence of a certain plant, floating reed, etc, though it might be so).

With these circumstances the Cladocera fauna seem be in accordance. Gödrös harbours more species (17 sp.) than hab. 1 Kis-öböl (13 sp.). There are only 8 species in common, all of them — with the exception of *Scapholeberis* — Chydoridae. The two *Alonella* and most species of the *Pleuroxus* genus are recorded only from Gödrös, while *P. Balatonicus,* the only one of the genus present in the Kis-öböl, is lacking in Gödrös. The presence of the two *Simocephalus* species in Gödrös is in harmony with the true marshy character of the place throughout the year.

The absence of the three Macrothricidae in Gödrös and their presence in Kis-öböl has some significance too. For these forms, as well as for some of the Chydoridae *(P. Balatonicus, Leydigia acanthocercoides),* hab. 1, 2 and 3 Kis-öböl is hardly a primary habitat. These species seem to be dislodged from their true home, which is the muddy bottom of the open water, and appear but temporarily in the marginal waters. Nevertheless it must be noted that at least some of the individuals of *P. Balatonicus* and of *Macrothrix laticornis* differ in their habit from those of the specimens collected directly in the mud (see p. 110-111.)Only *Leydigia a.* exhibits the same morphological characters whether found in the bottom or in the marginal waters. We cannot say definitely, however, that all the specimens collected were stranded individuals. This question needs special investigation. As to *Iliocryptus,* there were several specimens found both in floating detritus and among drift particles. However the primary habitat of these species could not be established during this investigation.

The fauna of hab. 1. has some likeness to that of hab. 4 too, the main difference being the absence of mud-forms in hab. 4, their place being taken by the "semi-lacustrine" *Sida*. The explanation of this difference might be the presence of the artifical stone dam at hab. 4, and the different locations of the two habitats in relation to the lake proper.

Two species of waterplants seemed to be favoured by some of the Cladocera which inhabit them, viz. *Acroperus harpae*, found regularly and at times in rich development among *Myriophyllum spicatum* in relatively lacustrine type (see ENTZ-SEBESTYÉN 1940, p. 103; 1942, p. 201; 1946, p. 336; B. ENTZ 1947, p. 35, table 2). *Sida crystallina* is always present — mostly in abundance — in *Potamogeton perfoliatus* growth of lacustrine-type (see ENTZ-SEBESTYÉN 1940, p. 99; 1942, p. 196; 1946, p. 332; B. ENTZ 1947, p. 35, table 2). These observations, in accordance with the results of ecological survey made in the weedy margin of Lake Balaton, lead to the conclusion that the presence of certain water plants, in our case *Myriophyllum spicatum* and *Potamogeton perfoliatus*, does not determine in itself the character of the environment. The ecological valence of said plants seems to be broader than that of — at least some — members of the animal-community harboured (ENTZ-SEBESTYÉN 1940, p. 109; 1942, p. 179; 1946, p. 321.).

In our lake *Myriophyllum s.* grows in a true swamp, within a monotonous reed stand or in other types of „quiet littoral". It grows abundantly also in wave-washed shores, if there is some protection against the dynamic effect of the water (e. g. in Kis-öböl, hab. 4. this is the artificial stone dam). In open waters the size of the growth itself provides protection. It thrives abudantly in Kis-Balaton and Sió-channel, water bodies connected with the lake. *Acroperus* is found sparsely in the weedy margin of the lake in general, but it may develop abundantly in *Myriophyllum* growth of a semi-lacustrine type (ENTZ-SEBESTYÉN 1946, p. 336). The statement of E. A. BIRGE (WARD & WHIPPLE p. 719) that *Acroperus* is found "in relatively open water" is in harmony with the observations made in Lake Balaton.

The ecological valence of *Potamogeton perfoliatus* seems to be somewhat narrower than that of *Myriophyllum*, though it invades greater depths. *Sida* seems to be more selective as to environmental conditions than *Acroperus*, preferring "clear water" (SCHULZE 14, 24). In plankton hauls taken from the free waters of the lake, *Sida* is always present in the appropriate season, because the net may easily

get into weedy districts. This species have an "intermediate character between the limnetic and the littoral forms" (WARD & WHIPPLE p. 686), or in other words it is a littoral form having an inclination for the limnetic mode of life (v. *limnetica* in Swiss lakes!, BRAUER p. 14, see also DADAY 1888, p. 123).

The 24 species found during the investigations may be divided from the ecological point of view into the following groups:

1. eupelagic (only resting stages, *Daphnia cucullata);*
2. litoral ("eucoen" forms, some of them having inclination to be eurytop:
   a) with inclination to lacustrine life *(Acroperus,* moreover *Sida).*
   b) in marshy type of water (a further division expected only after detailed study) *(Scapholeberis mucronata, Simocephalus vetulus,* and *S. expinosus, Eurycercus, Alona guttata, Alonella excisa, Pleuroxus aduncus, Chydorus sphaericus* etc.);
   c) bottom forms limited to the littoral (?) *(Iliocryptus* and *Rhynchotalona,* the last one of which can endure stagnant water);
3. mud-living forms from the open water (eurytop; "coenophil" and "coenoxen" forms):
   a) bottom forms of wide distribution, inhabiting shore waters too *(Monospilus);* eurytop in benthos;
   b) habitat differing when in mud and in littoral *(Pleuroxus Balatonicus, Macrothrix laticornis);* "coenophil" in the littoral);
   c) stranded specimens („coenoxen" in littoral *(Leydigia acanthocercoides Macrothrix laticornis);*
4. eurytop (having wider distribution than the ones mentioned in 3 *(Alona affinis),* common both in the littoral zone and in the mud of the open water.

The species *Alonella exigua, Pleuroxus laevis, P. uncinatus* and *P. aduncus* have not previously been recorded from Lake Balaton.

It seems that expressions like "littoral species", "found among weeds" and the like are very vague. The littoral zone is a very complicated environment. Both "erosion littoral" and "quiet littoral" have various subdivisions and respective animal communities.

In our lake the years 1944—1947 were not very suitable for pointing out annual differences as to the appearance and size of populations of the species found. During the war and the years fol-

lowing, organic waste in quantity had been discharged into the lake and the change of the chemical properties of the water — slight as it might be — affected the structure of the plankton noticeably (a paper on this subject by the author in press). The same influence was more evident in the littoral.

From the material investigated the life-cycle of all the 24 species could not be established definitely either. During the cold season only resting stages were found, involving but 6 species, one being pelagic. The appearance of males, toward the end of the favourable season, of 7 other species would suggest that these too are warm stenothermous and perhaps monocyclic forms though with different range of temperatures. For 11 species only parthenogenetic females are recorded so far, even of species with rich development such as *Scapholeberis mucronata, Macrothrix laticornis* and *Chydorus sphaericus.*

More detailed studies are needed involving other types of the littoral zone and lasting for a longer period in order to recognise — at least some of — the environmental factors chiefly influencing the distribution, life-cycle, rich or sparse development of the population etc., of each "littoral" form. Culture experiments might aid such investigations considerably. It is very true for this group of organisms too what CARTER says about the complexity of ecological problems (CARTER 1940, p. 127).

SUMMARY.

Distributions of Cladocera were studied in relation to environmental conditions in various localities of the NE shores of the Tihany peninsula, Lake Balaton, Oct. 1944—Dec. 1947.

The 24 species found (Sididae 1, Daphnidae 5, Macrothricidae 3, Chydoridae 15) may be grouped on ecological grounds as follows:

1. eupelagic (only resting stages recorded);
2. littoral ("eucoen" forms some inclined to be eurytop);
3. mud-living forms from the open water (eurytop, "coenophil" and "coenoxen");
4. at home in the littoral as well as in the mud of open water (eurytop forms with wider distribution than the ones belonging to the previously mentioned groups).

Two littoral species seem to prefer certain plant species *(Sida-Potamogeton perfoliatus* and *Acroperus — Myriophyllum spicatum).*

During the cold season only resting stages were found (7 species), in 13 cases males were recorded, for 11 sp. only parthenogenetic females noted. All the species found seem to be warm stenothermous, though with different range of temperature.

Emergent vegetation dividing marshy territories (with almost entirely submersed vegetation) from the main water seems to influence the effectuation of wave-actions, acting as screen for both "biotop" and "biocoenosis" of the marginal water. The "work" of the screen is determined by the dimensions of the growth.

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