CLADOCERA STUDIES IN LAKE BALATON.

I. MUD-LIVING CLADOCERA AND MUDDY BOTTOM AS ENVIRONMENT.

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With 19 Figures and 1 Table with 4 microphotos.

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INTRODUCTION.

From the results of investigations in the life of the pelagic region as well as of the littoral the conclusion might be drawn that organic detritus plays an important role in the food relations of Lake Balaton. *Dreissena* and *Corophium curvispinum,* species which appeared in the lake about 1931—32 and since have rapidly increased, are consumers of detritus. The significance of the detritus drifts is emphasised by the fact that drift investigations throw light on the mechanism of the origin of the autochtonous detritus in our lake (Entz-Sebestyén, 1946). Thus in plans for further investigation of the life of Lake Balaton more and more place is required for the detritus problem.

Studies in detritus were introduced in our program in the autumn of 1942. However, because of various difficulties caused partly by war conditions as well as by the wide variety of problems involved in the question, the investigations have yet to be completed.

During the qualitative and quantitative analysis of samples collected systematically from detritus-drifts, chitin remnants of Cladocera were frequently found. These remnants consisted mostly of shells not in condition appropriate for indentification, of ephippiums in less number. There were some dead, and a very few living examples. Since species of Cladocera living in the benthic region as well as in the littoral subsist on detritus, it was convenient to combine the detritus

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investigations with studies of Cladocera. The aim in this connection is to find the significance of this group in the cycle of matter in our lake, with stress on the detritus problem. The investigations — still in process — are to be carried out by biotops. This might lead to a revision of the Cladocera fauna of Lake Balaton, too, a thing urgently needed, the work at present existing on the subject being DADAY's (1897) enumeration, nearly half a century old.

The limentic region of our lake has a Cladoceran population not rich in species but large in number of individuals, at least during the favourable season *(Leptodora, Diaphanosoma, Daphnia cucullata).* In the cold season the group is represented only by the scanty populations of eurythermous forms such as *Daphnia cucullata* and *Bosmina longirostris.* Water fleas, on account of their seasonal appearance and periodical increase, as well as because of the cyclomorphosis of certain species *(Daphnia cucullata* and perhaps *Bosmina)* take a leading role in the changing character of the zooplankton throughout the year in Lake Balaton (ENTZ-KOTTÁSZ-SEBESTYÉN, 1937). *Leptodora,* the only rapacious water flea of our lake, has been the subject of manifold studies in Tihany (SEBESTYÉN, 1933). However there are many questions still open: the course of seasonal polymorphism of *Daphnia cucullata* and *Bosmina longirostris* has as yet not been thoroughly studied.

Although the main morphological characteristics of our lake shores are not very variable, during the favourable season many „micro-habitats" are formed within the littoral. It seems that the milieu is determined mainly by the presence or by the lack of different species of water-plants *(Hydrocharis, Utricularia, Myriophyllum, Butomus,* etc.) or of filamentous algae. For this reason satisfactory results in the investigation of the littoral with respect to the Cladocera-fauna could be obtained only if collections were made frequently over a couple of years.

In comparison with conditions in the pelagic region and in the littoral, the Cladocera fauna of the muddy bottom seems to be rather limited as to species and scanty as to numbers of individuals.

In what follows an account is given of the investigations made of mud-living Cladocera of Lake Balaton for over one year. To make the description of the milieu and of the life within it more complete, references are made to the results of former studies on the same subjects.

Method.

Mud samples were taken in the open water at about 300—400 metres distance from the eastern shore of Tihany peninsula, in the direction of the main building of the Biological Institute. The water is about 3 m deep here (medium water level). The sediment is mud. Macrovegetation is wanting. This territory belongs to the eprofundal (in LENZ'S sense. 1928). On most occasions — for comparison — hauls were also made from the sediment of nearby places with scanty growth of *Potamogeton perfoliatus*. There the mud is mixed with sand.

The collections were made with the EKMAN-BIRGE apparatus, which device penetrates with ease into the soft mud but always brings up water too. It is not suitable when hard sand is present, however. The hauls — two each time — amounting to about 2×3.5 dm^3 mud, were put into a common metal bucket. After a while the water which gathered on the surface of the mud was filtered carefully through a net of Swiss silk bolting cloth No. 6 (29 threads per 10 mm). The net was rinsed into a porcellain cup and the catch put aside for a while. More water was added to the mud and this was repeated two or three times. The free-swimming individuals were selected from the cup by means of a pipette, while the ones held by the membrane (Chydoridae) were removed by a hair brush, with the help of a hand-loop.

The method described is inadequate when quantitative conditions are involved. For such purposes some other method must be worked out. But because of the poverty of the microfauna of the mud it seems impossible to avoid looking through a considerable amount of mud.

Part of the material was investigated in a live condition, the rest of it was preserved in alcohol and mounted in glycerine.

CONDITION OF EXISTENCE IN THE MUD.

Physical and chemical features. In „Das Leben des Balaton-Sees", by G. ENTZ and O. SEBESTYÉN (1946), a summary is given of our knowledge of the extent and thickness, as well as of the chemical, mineralogical and physical aspects of the mud. This summary is based on the geological investigations carried out by the Balaton Commission of the Hungarian Geographical Society (LÓCZY, 1916). FRANCÉ'S paper on the mud of Lake Balaton (1894) was also taken into consideration. A few later data were also added. For details the reader is referred to the papers by LÓCZY (1916), TREITZ (1911) and EMSZT (1911) and to the appropriate chapters of ENTZ-SEBESTYÉN'S work (pp. 198—207; 341—349).

In the following the main characteristics of the mud are briefly mentioned. The thickness of the sediment covering the bottom of the basin varies from O cm to about 16 meters. The upper strata of the sediment is made of sand and mud, mud being located along the NW shore, sand on the opposite one. The width of the muddy bottom is about 4—5 times that of the sandy one. The zonal arrangements of the mud and sand are caused by wind and wave action. Above the more or less solid mass of mud is a superficial ooze of varying thickness with a semi-liquid consistency („latyak" in the Hungarian language).

EMSZT's and TREITZ's investigations led to the conclusion that the mud is subaerial in origin, having been brought into the water from the hills of the Balaton Highlands during long ages by northerly winds. Besides these allochtonous ingredients it consists of those originated in the lake itself, namely, products of erosion (LÓCZY, p. 627) and biogen lime, as precipitated carbonates of Ca and Mg, being by-products of plant assimilation (MOON, 1934).

The mud when dried is silvery white in colour. It is made up of very fine particles. Chemical analysis (EMSZT) shows that it contains much carbonate of calcium and magnesium ($\pm$ 60%), the SiO_2 content is also high ($\pm$ 24%), a considerable amount of iron ($\pm$ 3% Fe_2O_3), aluminium ($\pm$ 7% Al_2O_3) being also present. The organic content amounts to $\pm$ 2.84%. As it contains more lime than the falling dust, part of it must have originated in the mussel shells of the lake, according to EMSZT. He did not take into consideration the precipitated lime mentioned above. According to FRANCÉ the SiO_2 content comes from valves of Diatoms, but EMSZT reports a high percentage in the falling dust too. PANTOCSEK (1916) studied the Diatom-content of the mud in the surface and deeper strata from a systematical viewpoint; the results did not give a clue as to the value of Diatoms as a mud-producing factor in our lake.

Temperature. Thermic conditions in the mud of Lake Balaton have not been investigated systematically since SÁRINGER (1906). It must be noted that his measurements were taken 15—20 cm below the surface of the sediment, and no account is given of the method used.

The following is a short summary of SÁRINGER's findings regarding thermic conditions in the mud of Lake Balaton:

The yearly fluctuation of the mud temperature lies between 0.3°—23.7° C. In comparing the temperature of the mud with that of the bottom water we find that during the cold season (November—February) the temperature of the mud is somewhat higher, during the favourable season (May—August) somewhat lower than that of the bottom water; when warming up (March—April) and cooling down

(October—November) the temperatures of both habitats are inconstant, respectively high and lower temperatures being recorded alternately in the mud and in the bottom water. When the water freezes the mud might cool down to as low as below one centigrade, but as soon as ice is formed its temperature rises slowly but constantly, the rise having, however, a low value. When thaw takes place the temperatures both of mud and bottom water sink, but soon rise somewhat.

In the course of the present studies, due to lack of a suitable instrument (a reversing thermometer by which thermic conditions of the surface of the mud and in any depth desired might be recorded) the temperature of the sediment could not be taken when collections were made. However, to get an idea of the thermic conditions in the mud, a RUTTNER's bottle containing a thermometer was occasionally let down, deep enough to stir up the sediment. The following data (in C°) gained in this way correspond well with SÁRINGER's findings:

	19, VIII, 1946 9.30 A. M.	5, IX, 1946 9.30 A. M.	12, X, 1946 10 A. M. (previous night NW wind)
air	26.5	23.4	12.0
water, depth m:			
0	23.2	20.4	11.4
1	23.1	20.4	11.4
2	22.9	20.2	11.4
2.60	22.7	—	11.4
2.80	—	20.0 turbid water	11.4 turbid water
3 (bottom)	22.4	19.8 water contains much mud	11.6 water contains much mud

It is known that in our lake there is no thermocline, and the lake is holomictic. Thermic stratification is direct in summer and indirect in winter but always insignificant — if present at all. (ENTZ-SEBESTYÉN, p. 231—239.)

Dissolved oxygen. It is well known that the entire water-body of Lake Balaton is rich in free oxygen (see ENTZ-SEBESTYÉN, p. 250—254). The effect of wave actions reaches to the bottom, and stirs up the loose sediment. Thus a close contact is created between the mud and the water above it. From this it might be concluded that in open water districts the superficial ooze which harbours the benthos is well provided with dissolved oxygen. The smell of the mud is characteristic but not unpleasant.

pH. With SZONNTAG's electric apparatus for pH investigations the following data were gained on October 26th, 1946:

pH, water	8.10
pH, muddy water	8.15
pH, mud	8.85

Illumination. Because of the turbidity of the Balaton water there exists a stratification of the light in the water. The rate of light-penetration differs during the various seasons and depends on the presence of wind, still or stormy weather. In consequence, light conditions at the bottom vary, and though the lake is shallow they are in general rather unfavourable. Although the presence of holophytic micro-organisms in the mud would be a proof that in the bottom photosynthesis takes place, we have to keep in mind the fact that because of the agitated bottom the algal flora is frequently dislodged and for a while it appears in the higher water-layers, where light is less feeble. (For details of light penetration the reader is referred to ENTZ-SEBESTYÉN'S summary, [1946, pp. 240—244; references]).

Wind and wave action. A wind exceeding the rate of 4 m/sec — a common phenomenon on Lake Balaton — stirs up the sediment (ULLYOTT-KNIGHT, 1938). In such storms fine particles of the bottom become dislocated and are easily moved about. For varying durations they are distributed in the entire mass of the water body of the lake. Intestines of limnetic Cladocera *(Daphnia cucullata)* are filled with mud after stormy weather. The frequent disturbance of the habitat has a strong influence on the life within the mud.

Biological conditions. Food. To determine the nature of the mud from biological viewpoints, investigations were carried out chiefly following NAUMANN's outline (1925). The sample (one haul by the EKMAN-BIRGE apparatus [with an opening of 15x15 cm = 225 cm^2]) derived from the locality already mentioned, October 7th, 1946.

A)	Volume of mud, when wet	3.5 dm^3
	Weight „ „ „ „	4551.4 g
	„ „ „ „ dried	1505.0 g

B) Residue of similar quantity sieved through a brass wire sieve with meshes 1 mm^2:

	pieces	dry weight in mg
a) minerogen particles, < 4 mm	22	120.0
b) phytogen particles (tissues), < 10 mm	—	15.3
charcoal, (from reed burning) ± 6 mm	2	63.0

c) zoogen elements,

empty shells of Lithoglyphus	13	770.0
empty shells of Dreissena (halves)	22	1050.0
empty shells of Pisidium (halves)	9	9.6
fragments of mollusca shells, < 7 mm	—	240.0
otolith	4	13.9
Litoglyphus, alive	1	0.053
Chironomidae larvae, alive	7	0.018
Total dry weight of organogen elements:		2161.871 mg

Organogen elements in the residue make up only 1.4 ‰ of total weight.

C) Microscopic investigations:

1) surface of the mud after sedimentation and decantation (Table I. Fig. 1):

a) the sediment is mainly mineral in character;
b) Diatoms, living, and empty valves, some Cyanophyceae;
c) zoogen elements represented by excrement balls (85—100 μ by 25—40 μ), shells of Thecamoeba (very scarce), spicules and their fragments of fresh water sponges (rare). (FRANCÉ reported them from the mud deriving from the littoral where sponges grow abundantly.)

2) From surface of the mud, set aside in the laboratory in a porcellain dish for 48 hours, more algae could be detected, *Ceratium* cysts, fragments of plant tissues and excrement balls were also noted.

3) Investigations immediately after the collection show also that in the sediment finely distributed mineral particles are dominant. Valves of Diatoms are frequent, spicules of sponges rare, coprogenic elements exceptional. (Table I. Fig. 2—3.)

4) To eliminate the lime which constitutes about half the mud, the material was treated with hydrochloric acid. Valves of Diatoms and other organogen elements could thus be detected more clearly. (Table I. Fig. 4).

Summarizing the result of these investigations — which were however made for only a general inquiry — it may be said that *mud deriving from the eprofundal of the lake off the eastern shore of the Tihany peninsula is made up chiefly of unorganic particles. Characteristic elements are valves of Diatoms* both limnetic and benthic, which are quite frequent, and *spicules. Coprogenic elements are scarce.*

As to the *bacteriological conditions* in the mud in comparison with those in the water, it was found by L. Haranghy (1941) that the mud is poorer in species but richer in individuals, most of them being those which are common in soil.

The *algal flora* is rather monotonous, consisting mostly of Diatoms. Most of the examples found alive are representatives of benthic species (*Campylodiscus, Cymatopleura, Cymbella, Surirella, Synedra,* etc.), among the empty valves those of limnetic forms are also frequent (*Melosira, Fragilaria, Cyclotella,* etc.). When mud covered with some water is set aside for a while a yellow-brown coat forms on the surface, made of Diatoms. This phenomenon was already observed by France. The amount of Bacillariaceae so appearing varies according to the season and is influenced by weather conditions past and present.

Algae of other groups — mostly of Cyanophyceae — were obtained from mud cultures by E. Kol (1938) (from resting stages?). During the present investigations Cyanophyceae both filamentous (*Lyngbya limnetica* and *L. circumcreta*) and coccoid types (*Gomphosphaeria, Microcystis*), all of them being limnetic forms were but rarely present. Flagellatae both colorless and those with green chromatophores are somewhat more common. *Trachelomonas* is exceedingly scarce. A sample collected in the autumn (September 25, 1946) was especially rich in Eugleninae (*E. Ehrenbergii, E. oxyuris, E. acus, E. intermedia, E. proxima,* (all of them occur in the plankton) and other minute forms; few *Phacus*-species). These formed a green margin in the thin water layer above the mud. A Rhizopod: *Raphidiophrys intermedia* Penard ($d = 45\ \mu$), which feed on Diatoms and minute Flagellates, was also noted in the same catch. Such an accumulation of green Flagellates in the bottom is however but exceptional. It seems to be in some relation to their occasional decrease from the plankton (see Nagy, 1939).

The chief source of food for the consumers is evidently organic detritus. This is partly subaerial in origin (Treitz), partly planktogen, most of it very likely deriving from the macrovegetation of the littoral. Because of the low specific weight of plant debris and of the restlessness of the water-body of our lake fine particles of detritus from the littoral can be carried away easily into the open water, and for the same reasons can remain floating there for a long time and serve as food for members of the zooplankton (Cladocera, Rotatoria, young fish). A minor part of it, however, sinks to the bottom and mixes there with the mud. If mud is filtered through a net of silk bolting cloth No. 6, a mass of brownish coloured detritus remains, with particles very little larger than those which fall through the meshes. The more finely disintegrated particles could not be detected thus. It seems that food conditions in the mud are less favourable than for pelagic and littoral species of Cladocera. The intestines of mud-living species are filled with mud. When this is treated with hydrochloric acid a mass of fine particles is left, this being very likely residue of organic detritus.

The *micro-fauna* is rather static, limited in species and few in number. In the catches *Ectinosoma Edwardsii,* a minute Harpacticida, of brown colour, occurred the most frequently. Cyclopidae are fewer in number. A few minute Turbellarians, *Micronecta,* Hydracarina and Chironomidae-larvae were always present; here and there a *Lithoglyphus.*

LIST OF CLADOCERA FOUND IN THE MUD SAMPLES.

1. *Macrothrix laticornis* (JURINE) 1820.

A mud-living form. Occurs the year round, being somewhat more frequent in winter. Colourless, sometimes with a yellowish tinge; valves opaque, loaded with mud particles, concealing structure. Females with two eggs or embryos in the brood case. Neither ephippial females nor males were found. Length ♀ ± 450 μ.

Individuals were collected in the margin of the lake after storm among floating detritus particles. These have more colour than those found in mud.

2. *Alona quadrangularis* (O. F. MÜLLER) 1885.

Occurs throughout the favourable season; from November till May but sporadically. It has been found together with *Alona affinis,* being less frequent than the latter. Neither ephippial females nor males were found. Valves transparent, colour different shades of yellow, body sometimes reddish. Length ♀ 520—720 μ.

3. *Alona affinis* (LEYDIG) 1860.

Occurs during the whole year, common in mud and bottom with scanty *Potamogeton perfoliatus* growth. Most individuals were caught in early winter. Colour: various shades of yellow. Males were not found in the mud. Length ♀ 730—900 μ.

It is common among the marginal weeds of the lake also, where it appears as a monocyclical, and warm stenothermous form.

4. *Rhynchotalona rostrata* (KOCH) 1841.

Only few individuals were caught. Males in October. Length ♀ ± 450 μ.

Common in weedy margin of the lake, where it is also a monocyclical warm stenothermous form.

5. *Leydigia acanthocercoides* (FISCHER) 1854.

A typical mud-living form, monocyclic, warm stenothermous.

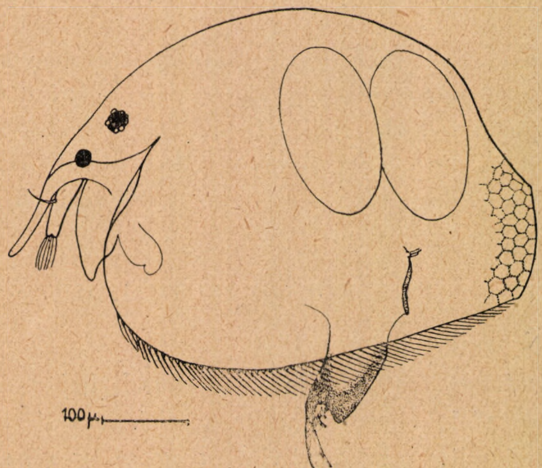


Fig. 1. *Pleuroxus balatonicus* Daday, ♀, from mud. Tihany, Aug. 8th, 1945.

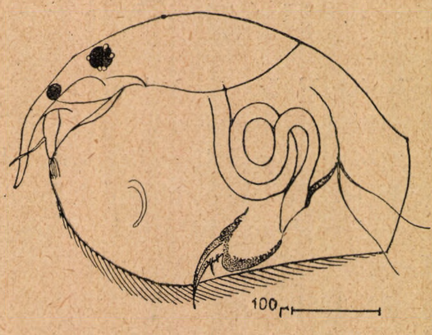
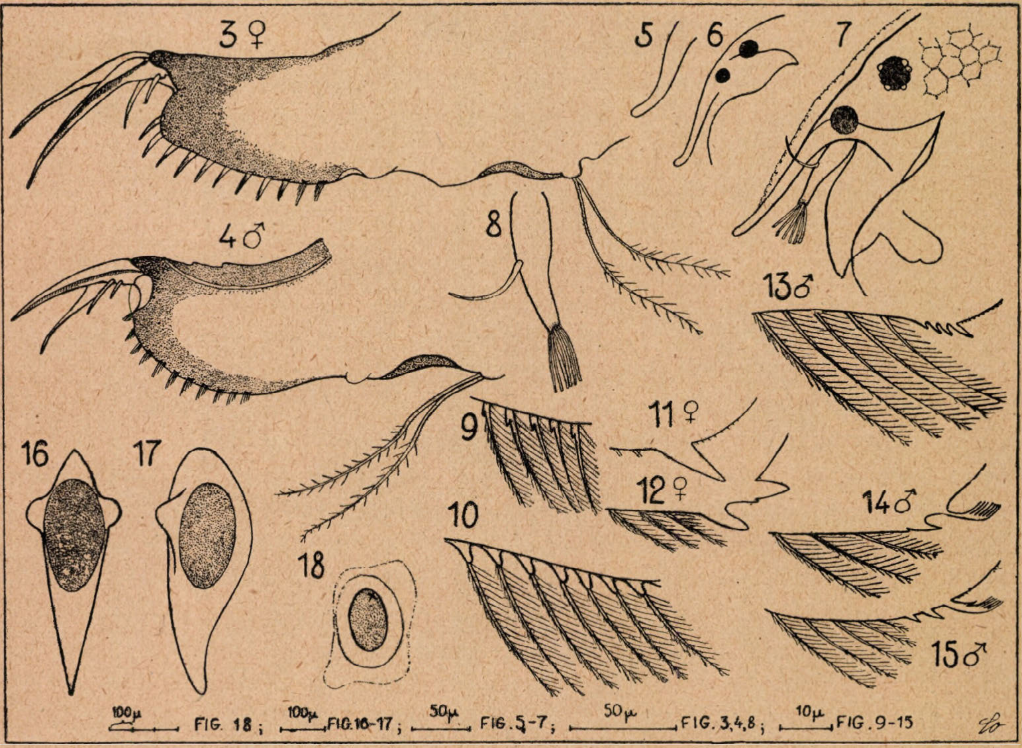


Fig. 2. *Pleuroxus balatonicus* Daday, ♂, from weedy margin of the bay Kis-öböl, Tihany, Oct 18th, 1944.

Ephippial females and males from early August on. Valves yellow; transparent; striated, reticulated, sometimes tuberculated, the reticules often with very fine striae. Claws with delicate pecten; basal spines wanting. Length ♀ 600—800, ♂ ± 560 μ. During the favourable season it was collected, not regularly, from the littoral among weeds.

It seems that individuals with very fine striae on the valves were described by DADAY as Alona Balatonica (1888, 1897). A similar structure of the shell was noted occasionally in other species.



Figs. 3—18. *Pleuroxus balatonicus* Daday figs. 3—4, postabdomen of female and male specimens, collected from mud; figs. 5—7, rostrum forms, ♀ fig. 8, antennula, ♀; figs. 9—10, parts of ventral margin from the infero-anterior region of the valve, showing the long, close-set, plumose setae with basic furca, from different views; figs. 11—15, different form of infero-posteal angle, showing teeth of various number, size and shape; also plumose setae, characteristic of the infero-posterior region of the valve; figs. 16—17, ephippium from different view, showing lateral buckles; fig. 18, ephippium as seen from the side, X place of Buckle.

6. *Pleuroxus balatonicus* DADAY 1885.

During the favourable season a *Pleuroxus* species was found in the mud, and the weedy margin of the lake. It seems to be identical with DADAY's *Pleuroxus balatonicus* 1885. (Figs. 1—18)

It is a monocyclical, warm stenothermous form, missing during most of the year (XII—VI). Males occur in November. It belongs to the short, high-arched form of the genus, having a pointed rostrum curved slightly forwards. (WARD & WHIPPLE p. 726). (Figs. 1, 2, 5—7). Teeth at the infero-posteal angle of the valves are in most cases missing in the female but seem always to be present in the male. (Figs. 11—15). Valves are reticulated, sometimes with tubercules, and are covered with a colourless, adhesive substance, into which particles of mud stick (fig. 7); opaque, colourless, end of post-abdomen, claws and mandibles smoky-gray. Valves with buckles on the sides, which are present on the ephippium too (figs. 16—18).

Post-abdomen of the male differs definitely from any other species of the genus, being very similar to that of the female (figs. 3—4). The species closely resembles *Pleuroxus aduncus* (JURINE) 1820. Length ♀ 550—600 μ.

Individuals found in the littoral among weeds are larger in size, yellow, and have prominant fornices.

7. *Monospilus dispar* (KOCH) 1861.

Mud-living form, monocyclic (?), warm stenothermic. Colour: yellow; transparent. Males from August on. Length ♀ 400—420 μ. Common in the littoral during early spring and late fall.

Occasionally samples of pelagic Cladocera were also found in the catche

GENERAL REMARKS.

As is seen, during the present investigation seven species of Cladocera were found which, with the exception of *Macrothrix laticornis*, all belong to the family Chydoridae. Though the body-structure of *Macrothrix* seems to be more delicate than any of the representatives of the Chydoridae, with the exception perhaps of *Pleuroxus*, the mode of life of all these mud-living species seems to be similar. They live in the superficial ooze and subsist on mud, utilizing its scanty organic content, which is organic detritus. They do swim, but in general rather scramble about within the surface-layer of the mud. Their organs of locomotion are the second antennae which are rather short, except in the *Macrothrix*. The post-abdomen is also an efficient aid to locomotion (WARD-WHIPPLE p. 679). Their legs are especially adjusted for collecting food from a somewhat solid mass and for pushing the particles towards the oral opening. The first pair of legs is a very complicated tool, equipped with numerous hairs, hooks and spines of various sizes, shapes, curvature and armature. The structure and action of the legs, in comparison with those species having different food habits (Daphnidae) must be the object of special studies.

It seems of special interest that though these seven species are harboured in the same milieu the surface of their shells is very different. In the case of *Macrothrix* and *Pleuroxus* the valves are coated by some colourless adhesive substance in which minute particles stick. The surface of the shells of the rest of the Chydoridae found do not moisten. (This quality is expressed in German by „unbenetzbar", in French „non-mouillable". (see BREHM 1930, 2—5).

The species having such shells are easily caught in the surface membrane of the water. The quality does not entirely protect the shell against the attachment of epizoa. They were found during the summer months on *Macrothrix, Pleuroxus, Leydigia* and *Monospilus.* The epizoa when belonging to the group of Peritricha were attached in most cases on the inside of the valves along its hind margin. This reminds one of the location of a clump of *Dreissena* on the free part of the shells of Unionidae. On *Monospilus* a tube-living Rotifer *(Collotheca)* was also found, settled on the outside of the shell. The shell of *Monospilus* not being cast off in moulting seems suitable for the attachments of a sessile organism having such a solid case as this Rotifer.

It seems that *the role the Cladocera* harboured in the mud have *in the cycle of matter in Lake Balaton* has something to do with their mode of life and their minute size. They utilize the organic matter sparsely present in the mud of our lake chiefly in the form of fine particles of organic detritus, so that this matter is saved for a time from immediate decay, and in turn they convert it into live organic matter again, edible for other mud consumers of larger size, or perhaps for carnivorous fresh water animals. On the other hand, by their continuous feeding a considerable amount of excrement is produced, by which the structure of the mud is affected, and the organic particles become more accessible to the activities of bacteria. This however has not much significance in an agitated bottom.

Most members of the Cladocera fauna of the mud are harboured by the weedy margin of the lake too. However there are some differences as to habit *(Pleuroxus, Macrothrix)* and life-cycle. *Rhynchotalona, Leydigia, Pleuroxus* and *Monospilus* are monocyclic and warm stenothermous in both habitats. Although neither males nor ephippial females of *Alona quadrangularis* were found, the life-cycle of this species cannot be determined as yet, because of its sporadic appearance. *Macrothrix* and *Alona affinis* are eurythermous perhaps acyclic in the mud, while warm stenothermous and monocyclic in the littoral. The diversity in the life-cycle and in demand for temperature may find explanation in that the lack of seasonal changes, especially of dominant force (cyclic life of rooted vegetation, effect of the change of water

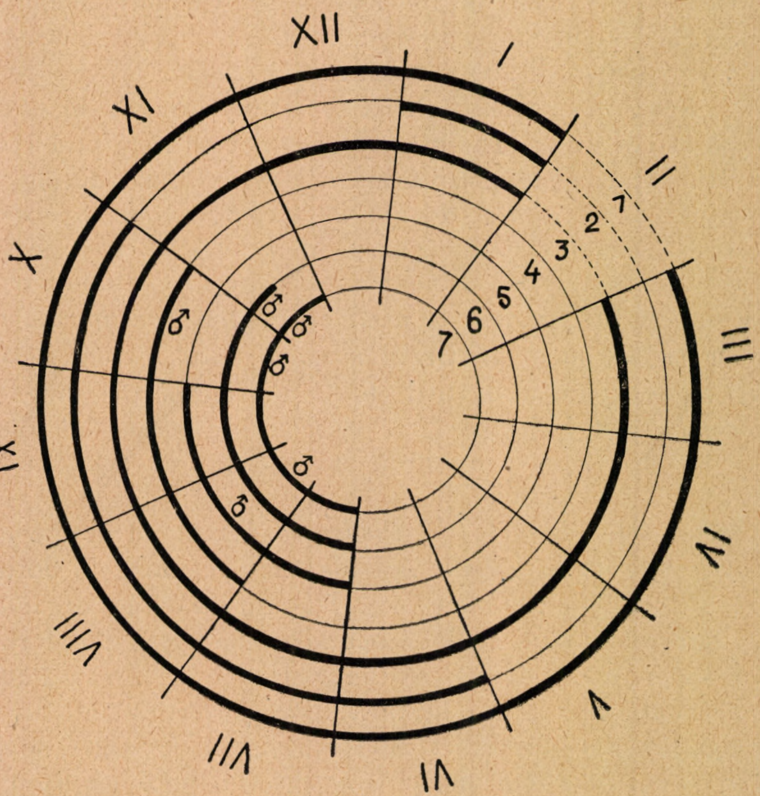


Fig. 19. Diagram showing the presence of Cladocera and the appearance of males in muddy bottom throughout the year, June 1945 — October 1946.
1. *Macrothrix laticornis*; 2. *Alona quadrangularis*; 3. *Alona affinis*; 4. *Rhynchotalona rostrata*; 5. *Leydigia acanthocercoides*; 6. *Pleuroxus balatonicus*. 7. *Monospilus dispar*.

level) makes conditions more uniform throughout the year in the mud. The frequency and scale of mechanical disturbance is less in the bottom than in the littoral. (Fig. 19)

When weighing the factors of the milieu as to their role in influencing the quality and quantity of the micro-fauna of the mud, we come to the conclusion that there are two factors which are principally responsible for its paucity: scarcity of food, and the frequent mechanical disturbance of the habitat. These factors, in addition to a third one: the lack of bottom vegetation, were pointed out by H. P. MOON when studying the bottom fauna of our lake. (It must be noted that in MOON's investigations only those members of the fauna were considered which could be caught in a sieve of meshes 1 mm^2.

The micro-fauna including Cladocera is but a fragment of the association of bottom-organisms. Further knowledge of the micro-flora and micro-fauna — including quantitative items — are needed to unfold the structure of the benthos, to disclose the manifold relations of its members to each other, to their own habitat, and to the life of other biotops of the lake.

SUMMARY.

Investigations extending over one year were made regarding the life of the Cladocera in the mud of Lake Balaton. The muddy bottom as their habitat was also studied.

Mud deriving from the eprofundal is made up mostly of mineral particles, chiefly lime. Characteristic elements are valves of Diatoms and spicules of fresh-water sponges. Excrement balls are scarce.

Conditions of existence of the mud — with the exception of the wind and wave action — are rather monotonous throughout the year.

The micro-flora consists of Diatoms, Flagellates and Cyanophyceae, among which limnetic forms also occur.

The Cladocera fauna of the mud (eprofundal) is more limited than that of the pelagic region and of the littoral. From the seven species found (one Macrothricidae, six Chydoridae) two (perhaps three) are present the year round of which neither males nor ephippial females were found. Representatives of same species when living in the littoral are warm stenothermous and monocyclic (*Macrothrix, Alona affinis*). All Cladocera consume mud, utilizing chiefly its detritus content.

For the paucity of the Cladoceran-fauna (and for the micro-fauna in general) two factors might be responsible: the poor trophic conditions of the mud and the agitated bottom.

The presence of pelagic organisms in the benthos seems to be peculiar to Lake Balaton, demonstrating the close contact between epilimnion and bottom in this lake.

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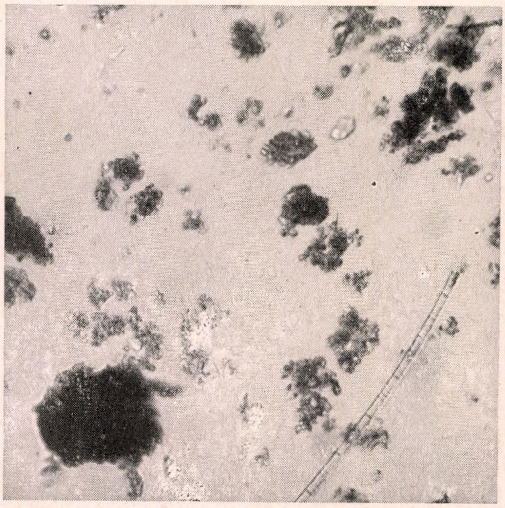
EXPLANATION OF FIGURES IN TABLE I.

Figs. 1—4. Microphotos of slides prepared from mud deriving from open water district off the eastern shore of the Tihany peninsula. October 7. 1946; magnified 210.4 ×. Fig. 1, mud from the surface of test-tube after sedimentation, showing mineral particles, excrement ball and *Melosira*. In water. Fig. 2, mud in natural condition, showing mineral particles and spicula of fresh-water sponge. In water. Fig. 3, mud in natural condition showing mineral particles. Diatoms and fragment of mollusca shell (?). Mounted in Canada balsam. Fig. 4, slide treated with hydrochloric acid and mounted in Canada balsam, showing mineral particles other than lime and *Melosira*.

Table I.



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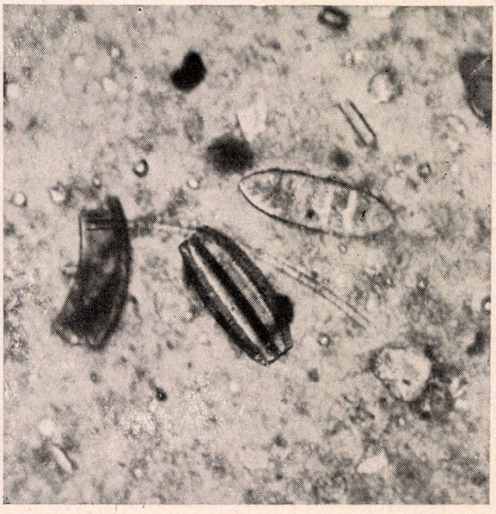
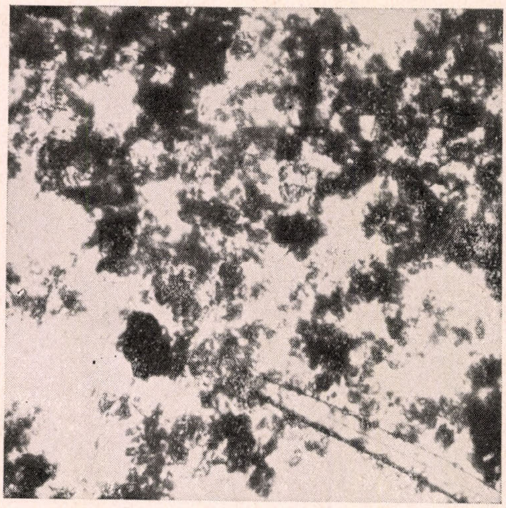
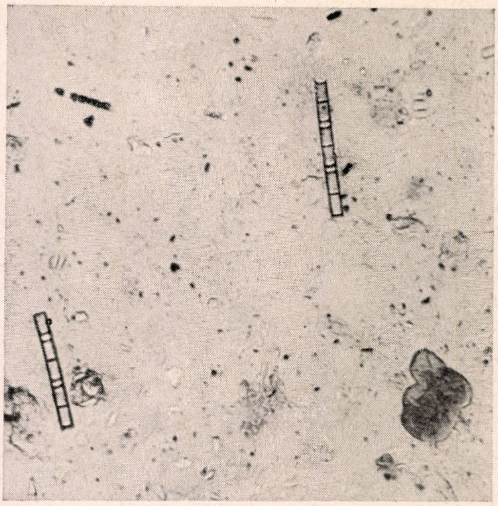


2



3



4