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Aare MÄEMETS

DAPHNIA LONGISPINA O. F. MÜLLER 1785 AND *DAPHNIA GALEATA* G. O. SARS 1864 (*CRUSTACEA, CLADOCERA*) AS INDEPENDENT SPECIES. I

Morphological notes

The Cladoceran *Daphnia longispina* described by O. F. Müller at the end of the 18th century is rather variable as regards its morphology; as a species of *Cladocera* it has been differently treated and subdivided by different authors. It is very changeable, having many local and seasonal forms. For example, Pljakič (1955) assumes on the basis of biometrical measurements that a 5—6-century long isolation caused the formation of different phenotypes in two lakes isolated from each other. He also affirms that even a two-year isolation gave rise to a new, statistically distinguishable population.

Already the Russian planktologist Vereshchagin (1912) made a difference between three independent species — *D. longispina* O. F. M., *D. hyalina* Leydig and *D. galeata* G.O.S. — in place of *Daphnia longispina* (s. lat.). He stated the existence of differences in the structure of the antennules and rostrum of male specimens of all the three species.

Lilljeborg (1900), Scourfield (1903), Behning (1941), Johnson (1952), Scourfield and Harding (1958), Šramek-Hušek et al. (1962), Negrea (1962), Naidenov (1968) and several other authors consider *Daphnia longispina* and *D. hyalina* as separate species while no distinction is made between *D. galeata* and *D. hyalina*. Several authors, such as Sars (1903), Ekman (1905), Keilhack (1909), Berg (1932), Berger (1934), Rylow (1935), Wagler (1937), and also Manuilova (1958) consider all these species and forms as one species. Some authors (Kielhack, 1909) have even placed *D. cucullata* and *D. cristata*, now universally accepted as independent species, under *Daphnia longispina*. Lately more and more authors have treated *D. longispina* (s. lat.) as several species. So Brooks (1957), Axelson (1961) and Pejler (1964, 1973) regard *D. galeata* as a separate species. Hrbaček (personal communication, January 1970) distinguishes between three species — *D. longispina*, *D. hyalina* and *D. galeata*, Flössner (1972) — and even four — in addition to the above-mentioned ones *D. rosea* G.O.S. emend. Richard. The distinction of intraspecific units is rather confused. Rylow (1935) and some other authors subdivide the species *D. longispina* into two subspecies, and the subspecies, in turn, into several varieties. Berger (1934) distinguishes between three groups (*dolichocephala*, *mesocephala*, *brachycephala*) and divides each of them into three subgroups (*gigas*, *typica*, *nana*). Wagler (1937) makes a distinction between 7 races (*typica, longispina-caudata*

G.O.S., *longispina-pulchella* G.O.S., *longispina-gracilis* Hellich, *longispina-galeata* G.O.S., *longispina-hyalina* Leydig, *longispina-pellucida* P. E. Müller). Manuilova (1958) asserts that on the basis of the criteria used so far there is no reason for a consideration of the above-mentioned species as independent ones, since all the criteria suggested for that differentiation by Lilljeborg (1900) (for instance formation of helmet, optic vesicle separated from margin of head in lateral view, size of eye), depend on ecological conditions. So large-eyed (similar to *D. longispina* s. lat.) populations live in habitats with poorer light conditions. Manuilova asserts to have managed to enlarge the size of the eye in a blacked-out aquarium. In turn, the circumstance whether there is some distance (a so-called "wedge") between the eye and the ventral edge of the head or not depends on the size of the eye (the absence of that distance is characteristic of *D. longispina*). In support of the above-said is the fact that the populations of *D. longispina*, by biology similar to *D. hyalina*, but having a somewhat larger eye and reduced wedge (while the neonates' eye is smaller and they have a wedge), populate the metalimnion and hypolimnion of several deep Estonian lakes (L. Valgjärv at Koorküla, L. Suurjärv at Rõuge, L. Udsu) (see Fig. 6). But Manuilova inclines to the other extreme and ignores the existence of clearly different forms and populations all of which cannot be placed under the species *D. longispina*.

The author of the present article has analyzed the populations of *D. longispina* (s. lat.) in more than 100 Estonian lakes, compared them with some populations of the River Pechora, as well as those in the lakes of Siberia, Czechoslovakia and German Federal Republic, and come to the conclusion that *D. longispina* in Manuilova's (1958) treatment is a collective species which should be divided into several independent ones, each having distinct morphological and ecological differences.

One reliable criterion for the differentiation of species even in the case of *Cladocera* is the cooccurrence of adult male and female specimens belonging to different taxons, at the period of sexual reproduction, in one and the same habitat, without a formation of intermediate forms or hybrids. Sexual isolation, as generally known, is one of the most reliable features of the independence of a species. So on the 29th of June, 1960, the author found together the aduit females and males of *D. longispina* (s. str.) and *Daphnia galeata* in the open water of a small (5.3 ha) North-Estonian dyseutrophic lake — Lake Mustjärv at Kantküla — the depth of which is less than 3 m (pH 8; HCO_3' 127 mg/l, permanganate consumption 17.6 mg/l O_2, potassium dichromate consumption 52.4 mg/l O_2, transparency of water 2.0 m, and its colour brownish yellow), while not a single hybrid or intermediate form had been formed.

The females of *Daphnia longispina* were clearly characterized by their bigger eye, position and size of the ocellus, structure of the rostrum, shell striations and by spinules on the dorsal margin of the shell or valves (the spinules here reached higher than those of *D. galeata*). Quite different as regards their general form and that of the head were the males of the two populations (Fig. 1, *2* and *4*), especially as for the structure of head and the position and length of spine. Among the population of *D. galeata*, specimens with heads both with rounded and pointed crests occurred, while all the specimens of *D. longispina* had heads with rounded crests. Specimens of both populations were of approximately the same length — ad. ♀♀ of *D. longispina* 1.42 — 2.62 mm, those of *D. galeata* 1.32 — 2.55 mm. Their fecundity was rather similar as well (see Fig. 13).

As the morphological comparison of the specimens of the two popula-

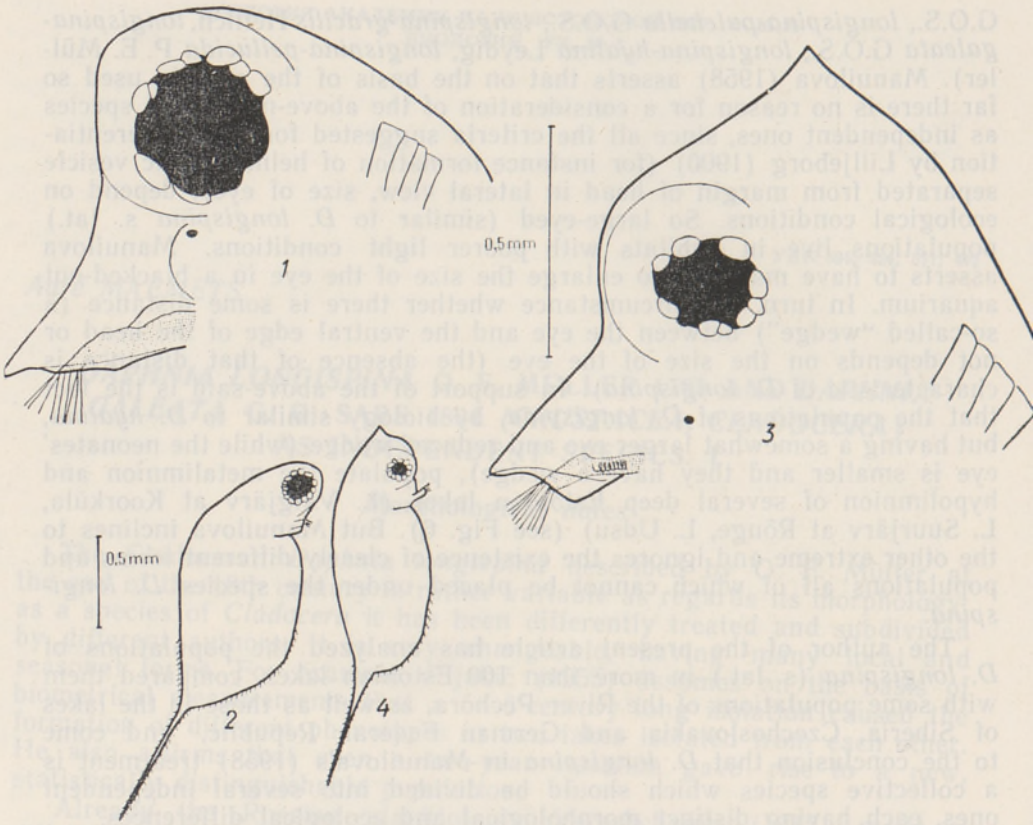

Fig. 1. *Daphnia longispina* (*1—2*) and *D. galeata* (*3—4*) from L. Mustjärv at Kantküla, June 29, 1960 (*1* — head of adult female, *2* — adult male, *3* — head of adult female, *4* — adult male).

tions revealed, the best differentiation criterion for females is the structure of the base margin of the head, especially the form of the antennule mound from which the olfactory setae arise. The antennule mound of ♀♀ of *D. longispina* is low and long, whereas that of *D. galeata* is short and high. The criterion was quite stable and applicable in the differentiation of all populations of *D. longispina* and *D. galeata* found in Estonian lakes. This criterion is correlated with the occurrence or absence of cyclomorphosis. *Daphnia longispina* never has a head with a pointed top, while in the case of *D. galeata* the head may vary from a rounded one to that with a pointed top. B. Pejler (1973) includes populations with pointed heads into *D. longispina*. The author of the present paper cannot consider it justified. It is the occurrence or absence of cyclomorphosis that should be taken for the differentiation criterion of *D. longispina* and *D. galeata*. Only populations with rounded heads may be considered as *D. longispina*.

The above-said gives us every reason to assume that *D. longispina* and *D. galeata* are independent species that do not yield hybrids. Both species live together in other Estonian lakes, as well (for example, in L. Mustjärv at Valguta).

B. Pejler (1973) states the occurrence of clearly distinguishable populations of *D. longispina* and *D. galeata* in Sweden (L. Abelrattnet).

The independence of *D. galeata* and *D. longispina*, also that of

D. hyalina pellucida is further proved by the material of L. Vagula (South Estonia) where the above-mentioned three taxons occur together without producing any hybrids. In the plankton of Estonian lakes *Daphnia hyalina typica* and *D. galeata* (L. Savijärv at Karula) have also been found together, while both taxons were clearly distinguishable. As regards the antennule mound, it turned out that the populations of *D. longispina, D. hyalina typica* and *D. hyalina pellucida* occurring in Estonia, Yakutia, Bay of Pechora and elsewhere, have a low and long antennule mound, while that of the populations of *D. galeata, D. hyalina lacustris* and *D. hyalina gracilis* is high and short. On the basis of this feature the inclusion of *D.h. lacustris* and *D.h. gracilis* in the species *D. galeata* seems to be justified. The above-mentioned forms with rounded heads seem to be stages of cyclomorphosis of *D. galeata.* The material of Estonian lakes where in over 90 per cent of cases specimens of the type of *lacustris* and *gracilis* occur together with *D. galeata*, and several intermediate forms are present, is another proof of that. Specimens with rounded heads are, as a rule, bigger (cold water forms?), while specimens having a helmet with a pointed top are smaller. The range of cyclomorphosis of the populations in different lakes is different. For example, the lengthening of the helmet of the population of *D. galeata* in L. Ermistu is minimal, whereas that in lakes Endla and Saadjärv is much more noticeable.

Populations of *Daphnia longispina* (Figs. 2—6)

The analysis of the populations of the type of *D. longispina* reveals an occurrence of wide variations in the structure of the head and other features, although in some geographically similar areas (e.g., in the same group of lakes) the populations have sometimes similar features.

According to the structure of the head, the following populations may be distinguished among the populations of *D. longispina.*

Group 1: populations with a big eye and sharp rostrum. Populations of the pond at the Manor of Rohu (Fig. 2, *1*) and L. Rätsepa (Fig. 2, *2*) are the most typical representatives of the group. The general form of the head of specimens of *D. longispina* of L. Tammetalu located in the vicinity of L. Rätsepa is rather similar to that of the population of L. Rätsepa (materials of the year of 1943). But the location of the ocellus and of the spinules on valve-edges was quite different. The specimens of the L. Tammetalu population had big and strong spinules on the dorsal edge of the valves (covering $^1/_3$—$^1/_2$ of the total length of the edge). One part of the specimens of L. Rätsepa had small and sparse spinules, while the other part possessed big and thick spinules covering $^1/_4$ of the length of the dorsal edge. No essential differences in the structure of the head among the L. Rätsepa population could be observed. Thus a conclusion may be drawn that size, thickness and range of the spinules on valve-edges vary within the limits of one population, and therefore they cannot be considered a good systematic feature. It is interesting to note that big differences in the head structure of the specimens of the L. Tammetalu population were revealed when comparing the material of 1943 with that of 1960 (cf. Fig. 2, *3* and *4*). Even the location of the ocellus is different. The question arises: has a quite new population of *D. longispina* started to reproduce in the lake during the 17 years? The populations from Yakutia have a peculiar ventral edge of the concave head (Fig. 2, *7*). The population of the pond at the Manor of Vohnja (Fig. 2, *8*) has a big eye and a clearly pointed rostrum, while the spinules on the edge of the

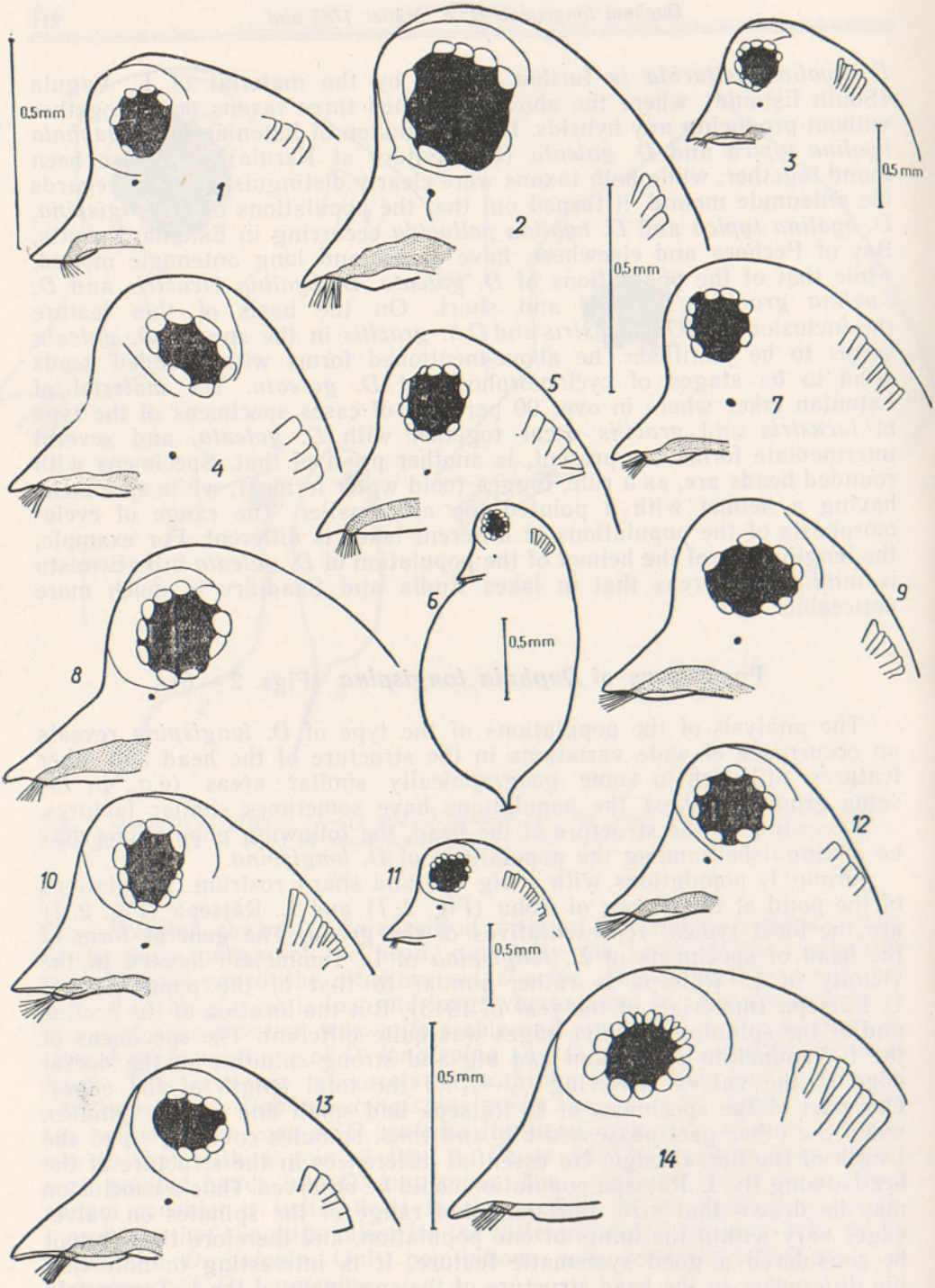

Fig. 2. Heads of *Daphnia longispina* (♀♀): *1* — pond at the Manor of Rohu, Sept. 23, 1956; *2* — L. Rätsepa, July 5, 1960; *3* — L. Tammetalu, July 5, 1960; *4* — L. Tammetalu, July 2, 1943, *5—6* — pond at the Manor of Elistvere, June 26, 1957; *7* — Siberia, Yakutia, L. Hosoi-Kjölv, Aug., 1963; *8* — pond at the Manor of Vohnja, Sept. 22, 1956; *9* — L. Umbjärv at Pupastvere, Oct. 18, 1956; *10* — Bay of Pechora River (Barents-Sea); *11* — L. Mustjärv at Kantküla, June 29, 1960; *12* — L. Parika, June 18, 1953; *13* — L. Mäejärv at Väimela, Sept. 14, 1962; *14* — specimen from the collection of G. O. Sars (det. by G. O. Sars as *Daphnia longispina leydigi*).

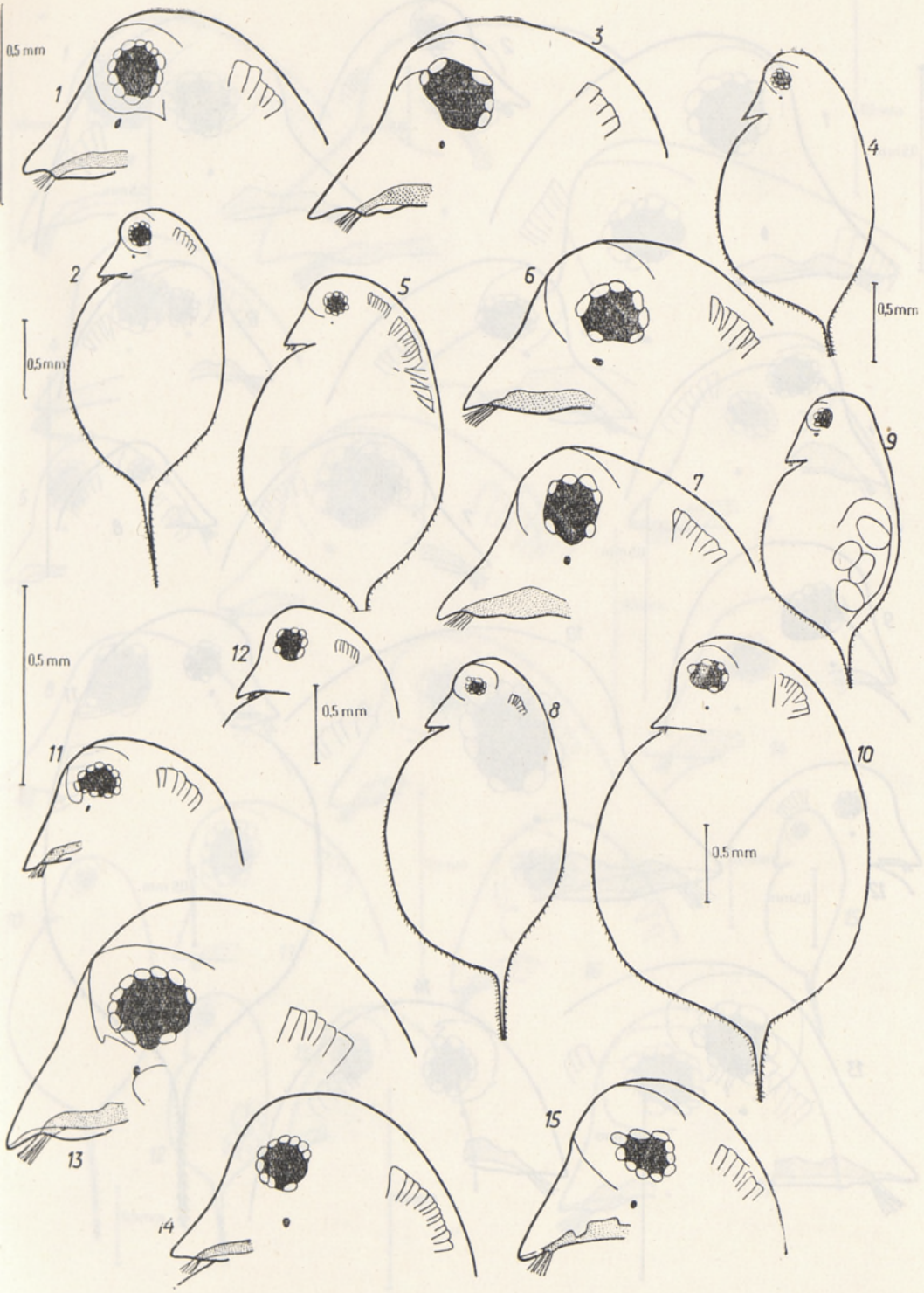

Fig. 3. Heads of *Daphnia longispina* (♀♀): *1 — 2* L. Mustjärv at Partsi, July 16, 1960; *3 — 4* — L. Mustjärv at Piigandi, July 15, 1960; *5 — 6* — L. Soojärv at Vana-Koiola, Aug. 3, 1961; *7 — 8* — L. Mustjärv at Orava, June 24, 1954; *9 — 10* — L. Kivijärv at Holvandi, Aug. 28, 1959; *11* — L. Kõverajärv at Orava, Aug. 27, 1959; *12* — L. Järvselja, July 28, 1958; *13 — 14* — L. Kauru, June 14, 1953; *15* — L. Ubajärv, July 10, 1952.

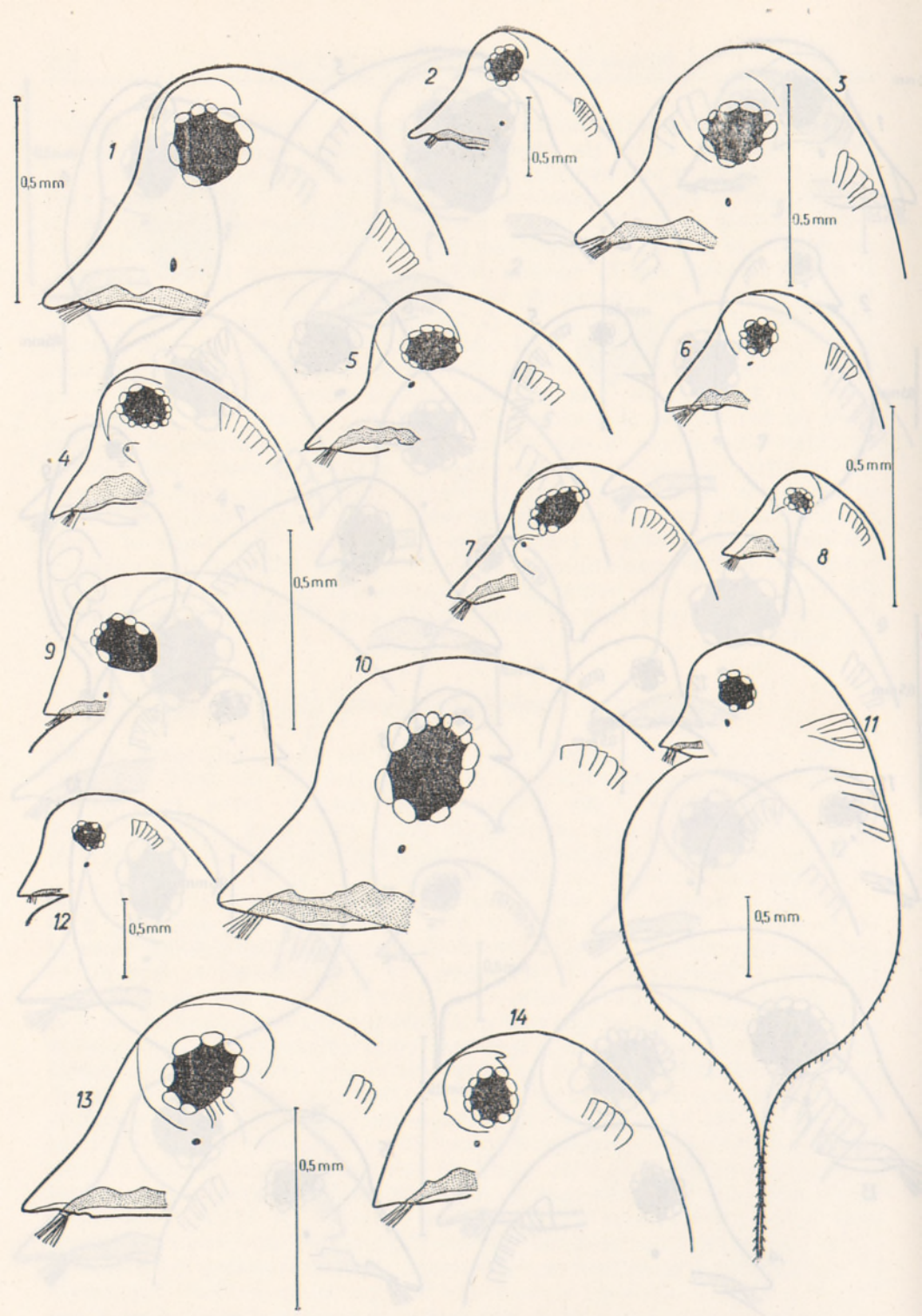

Fig. 4. Heads of *Daphnia longispina* (♀♀): *1* — L. Porkuni, June 5, 1967; *2* — L. Võhmetu, June 4, 1967; *3* — River Pedja, July 14, 1957; *4* — Ahvenjärv at Nelijärve, Aug. 8, 1957; *5* — L. Urbukse, Aug. 9, 1957; *6* — L. Ännijärv, Aug. 20, 1959; *7* — L. Pikkjärv at Viitna, Sept. 22, 1956; *8* — L. Sisaliku järv, July 8, 1935; *9* — L. Arujärv, July 17, 1960, juv. ♀; *10—11* — L. Ainja, July 29, 1955; *12* — River Jägala, June 18, 1957; *13 — 14* — L. Palojärv at Ihamaru, Aug. 8. 1964.

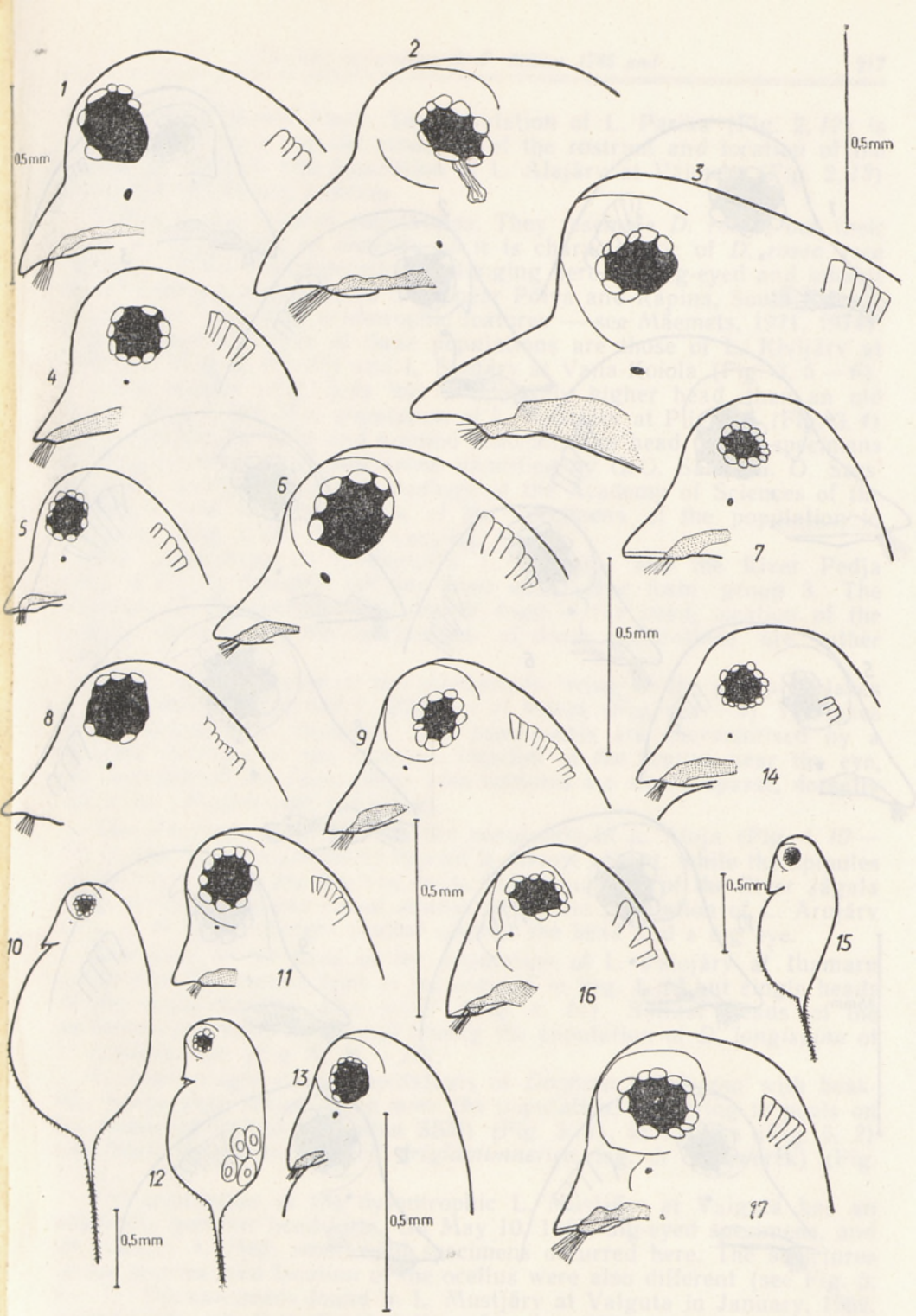

Fig. 5. Heads of *Daphnia longispina* (♀♀): *1* — pool on the Ruhnu Island, July 23, 1958; *2* — Siberia, Yakutia, L. Hosoi-Kjölv, Aug., 1963; *3* — Swedish Lapland, L. Narbr Jaure, June 1965, *Daphnia frigodolimnetica* Ekman (leg. dr. Nauwerck); *4* — L. Väike-Kaksjärv, Aug. 1, 1943 (leg. R. Voore); *5* — L. Linajärv at Holstre, Aug. 22, 1966; *6* — L. Mustjärv at Valguta, May 10, 1957; *7* — L. Mustjärv at Valguta, Jan. 4, 1962; *8* — Pool Keloskiärre on Ruhnu Island, July 23, 1958; *9* — *10* — L. Kivijärv, July 6, 1951; *11* — *12* — L. Linajärv at Jõuga, June 16, 1957; *13* — L. Akste, July 17, 1960; *16* — *17* — L. Usseaiaalune, July 12, 1956.

Fig. 6. Heads of *Daphnia longispina* (♀♀): *1* — L. Sinejärv, July 29, 1955; *2* — L. Udsu, July, 1955; *3* — L. Liivakraavi, Aug. 9, 1968; *4* — L. Kadastiku, Aug. 23, 1961; *5* — L. Suurjärv at Rõuge, July 2, 1955; *6* — L. Kaarmise, July 24, 1956; *7*—*9* — L. Valgjärv at Koorküla (*7*—*8* July 29, 1952; 9 Oct. 23. 1956); *10* — Babinecka backwater Přerov nad Labem. Central Bohemia, June 10. 1969 (det. by dr. J. Hrbaček as *D. longispina lacustris*); *11* — L. Solda, Aug. 27, 1959; *12* — L. Riiska, July, 12, 1956.

valves are extremely small. The population of L. Parika (Fig. 2, *12*) is characterized by a specific structure of the rostrum and location of the ocellus at the eye. The population of L. Alajärv at Väimela (Fig. 2, *13*) has a big and strong rostrum.

Group 2: low-headed populations. They resemble *D. rosea*, but their spine is not located so dorsally as it is characteristic of *D. rosea* (see Flössner, 1971). The populations belonging here are big-eyed and inhabit the extremely brown-watered lakes near Põlva and Räpina, South Estonia (dystrophic lakes with acidotrophic features — see Mäemets, 1971, 1974). Typical representatives of these populations are those of L. Kivijärv at Holvandi (Fig. 3, *9* — *10*) and L. Soojärv at Vana-Koiola (Fig. 3, *5* — *6*); a young female (Fig. 3, *9*) has a relatively higher head than an old female (Fig. 3, *10*). The population of L. Mustjärv at Piigandi (Fig. 3, *4*) has a specifically long and pointed rostrum. The head of the specimens of the population of *D. longispina* identified by G. O. Sars (G. O. Sars' materials at the Institute of Zoology of the Academy of Sciences of the USSR) is low. The head-form of the specimens of the population in L. Kauru (Fig. 3, *13* — *14*) is varying.

The populations of L. Porkuni, L. Võhmetu and the River Pedja (Fig. 4, *1* — *3*) situated not far from each other form group 3. The structure of the rostrum, the ventral edge of the head, location of the ocellus, spinules on the valve-edges of those populations are rather similar.

Group 4 is made up of the populations living in the group of lakes at Aegviidu-Nelijärve and L. Pikkjärv at Viitna (Fig. 4, *4* — *8*). The lakes are of oligotrophic character. The populations are characterized by a peculiar structure of the rostrum, location of the ocellus near the eye, few spinules on the valve-edges (the spinules are small, sparse, dorsally but a few spinules near the spine).

The structure of the head of the population in L. Ainja (Fig. 4, *10* — *11*) is specific. The antennule mound is almost absent, while the spinules on the valve-edges are big and thick. The population of the River Jägala (Fig. 4, *12*) is to some extent similar to it. The population of L. Arujärv (Fig. 4, *9*) has a straight ventral edge of the head and a big eye.

The form of the head of the population of L. Palojärv at Ihamaru is varying. The typical form is represented in Fig. 4, *13* but single heads of the *pellucida*-type also occur (Fig. 4, *14*). Similar heads of the *pellucida*-type were also found among the population of *D. longispina* of L. Usseaiaaluse (Fig. 5, *16* — *17*).

In some single lakes, populations of *Daphnia longispina* with beak-like heads were stated. Such were the populations occurring in pools on the Island of Ruhnu (Estonian SSR) (Fig. 5, *1*), in Yakutia (Fig. 5, *2*) and North Scandinavia (*D. l. frigidolimnetica,* leg. dr. Nauwerck) (Fig. 5, *3*).

The population of the dyseutrophic L. Mustjärv at Valguta has an extremely peculiar head-form. On May 10, 1957, big-eyed specimens, and on January 4, 1962, small-eyed specimens occurred here. The structures of the rostrum and location of the ocellus were also different (see Fig. 5, *6* — *7*). The specimens found in L. Mustjärv at Valguta in January, 1962, resemble the small-eyed populations found in the oligotrophic L. Valgjärv at Nohipalu (Fig. 5, *14*). The population of *D. longispina* in L. Linajärv at Jõuga has a very short rostrum, a very big eye and a comparatively big head. The antennule mound of the population is poorly developed, the spinules on valve-edges are very small and sparse.

As it becomes clear from the above-said, the populations of *Daphnia*

longispina reveal rather big differences in the structure of the head and spinules on the valve-edges, while the antennule mound seems to be a rather stable feature. The populations of *D. longispina* in the lakes of some geographically near areas (Porkuni — Võhmetu, Aegviidu — Nelijärve, etc.) reveal some similar features in the structure of the head. This may refer to the same genetic origin of these populations. It is not excluded that a more accurate investigation of ultrastructures by the scanning electron microscope may be of use for a better systematization of the populations of *Daphnia longispina.*

In addition to more or less typical populations of *D. longispina*, some intermediate populations between *D. longispina* and *D. hyalina* (identified as *Daphnia lacustris* by dr. J. Hrbaček) also occur in Estonian lakes. For example, such a population lives in L. Udsu, where the eye of the specimens is big, but the ventral edge of the head is straight (thus it is a big-eyed *D. hyalina*) (Fig. 6, *2*). Populations with intermediate features also occur in L. Liivakraavi (Fig. 6, *3*), L. Valgjärv at Koorküla (Fig. 6, *7* — *9*), L. Suurjärv at Rõuge (Fig. 6, *5*). All these lakes are over 20 m deep and with mesotrophic features. *D. longispina* populates there deep layers, whereas the young specimens prefer the surface layers (Mäemets, 1961). The author would include, in this group, the population from Babinecka backwater (Central Bohemia), identified as *D. l. lacustris* by J. Hrbaček.

Populations of *Daphnia hyalina* (Fig. 7)

More or less typical *hyalina* populations in Estonia occur in L. Vokijärv (Fig. 7, *1*), L. Karijärv (Fig. 7, *2* — *3*) and L. Uhtjärv (Fig. 7, *4* — *5*). They are characterized by an almost straight ventral edge of the head, small eye, and small, relatively regular crystal bodies of the eye. The population from L. Odensee (German Federal Republic) is somewhat different (Fig. 7, *6* — *7*). The population of L. Tornijärv has a comparatively strong rostrum (Fig. 7, *8* — *10*), that of L. Kallete (Fig. 7, *11* — *12*) is of small size, while the population of L. Sinejärv (Fig. 7, *13*) has a relatively big eye. The population of L. Viisjaagu has in most cases a head of the *pellucida*-type (Fig. 7, *14*) although some specimens with a concave ventral edge of the head also occur (Fig. 7, *15*). The only more or less typical population of *D. hyalina pellucida* is found in L. Vagula (Fig. 7, *17*), but even here single specimens with the form of the head of *D. hyalina typica* occur. The situation in L. Pühajärv is just the opposite. Johnson (1952) also considers *D. hyalina typica* and *D. h. pellucida* very close forms, since their intermediate forms and transitions occur in lakes of England. According to Wagler, *pellucida* populates mainly northern oligotrophic lakes, while *hyalina typica* is mostly to be found in deep Alpine lakes. According to J. Hrbaček (personal communication), *hyalina* lives in the subalpine lakes of the Alps and Scandinavia, and *pellucida* — in lakes of plains and hills in the region of continental glaciation.

As a rule, the populations of *hyalina* (s. lat.) are characterized by peculiar thin spinules on the valve-edges, those spinules cover $^1/_2$ of the length of the ventral edge and $^1/_3$ of the length of the dorsal edge (the only exception being the populations of the lakes Savijärv and Kallete, situated not far from each other, where only single spinules occurred on the dorsal edge of the valves).

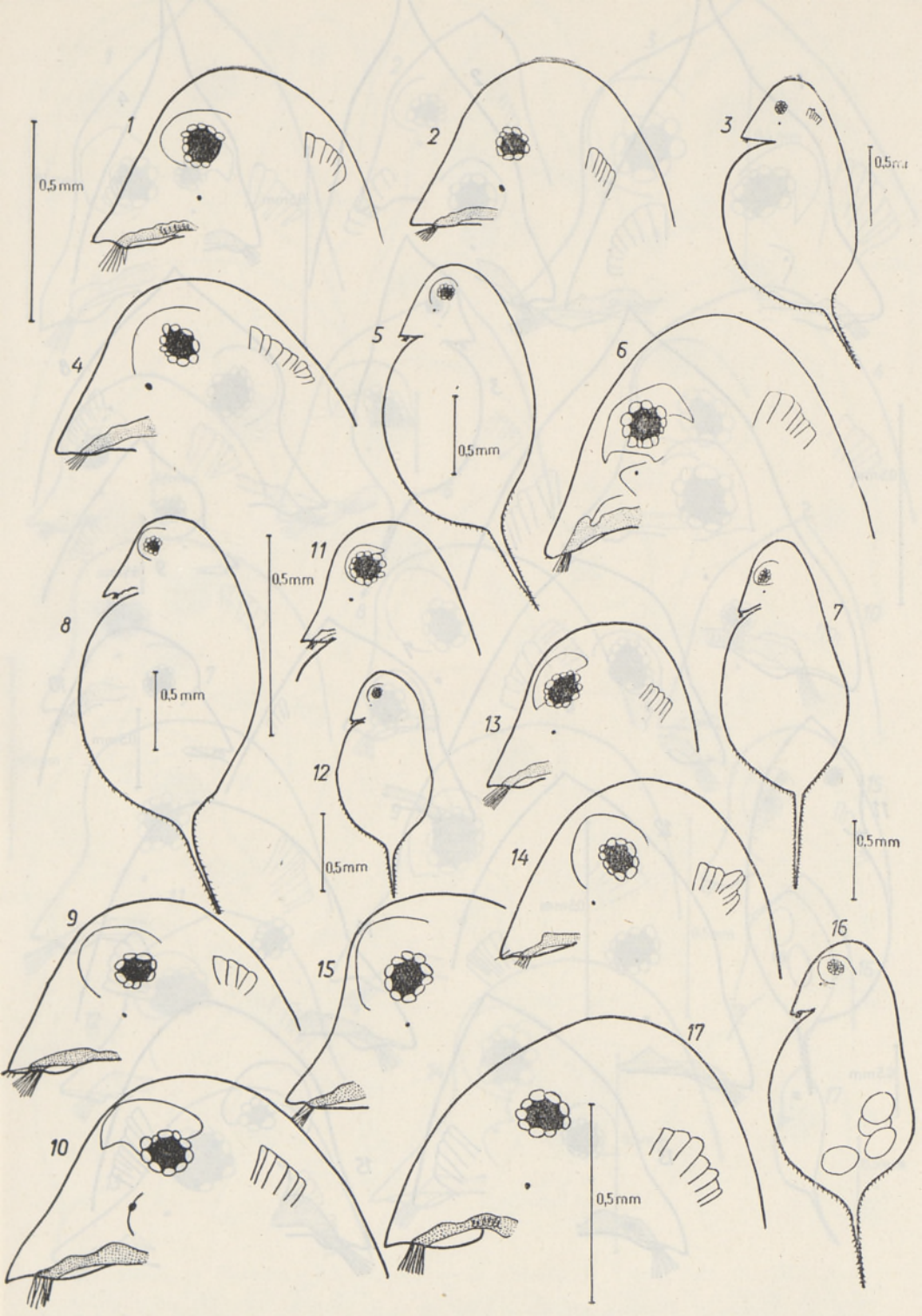

Fig. 7. Heads of *Daphnia hyalina* (♀♀): *1* — L. Vokijärv, June 14, 1953; *2 — 3* — L. Karijärv, Aug. 9, 1951; *4 — 5* — L. Uhtjärv, July 24, 1952; *6 — 7* — L. Odensee, W-Germany (leg. dr. Einsle); *8 — 10* — L. Tornijärv, July 9, 1954; *11 — 12* — L. Kallete, Aug. 17, 1961; *13* — L. Savijärv, Aug. 17, 1961; *14 — 15* — L. Viisjaagu, July 15, 1954; *16 — 17* — L. Vagula, June 29, 1952 (*D. hyalina pellucida*).

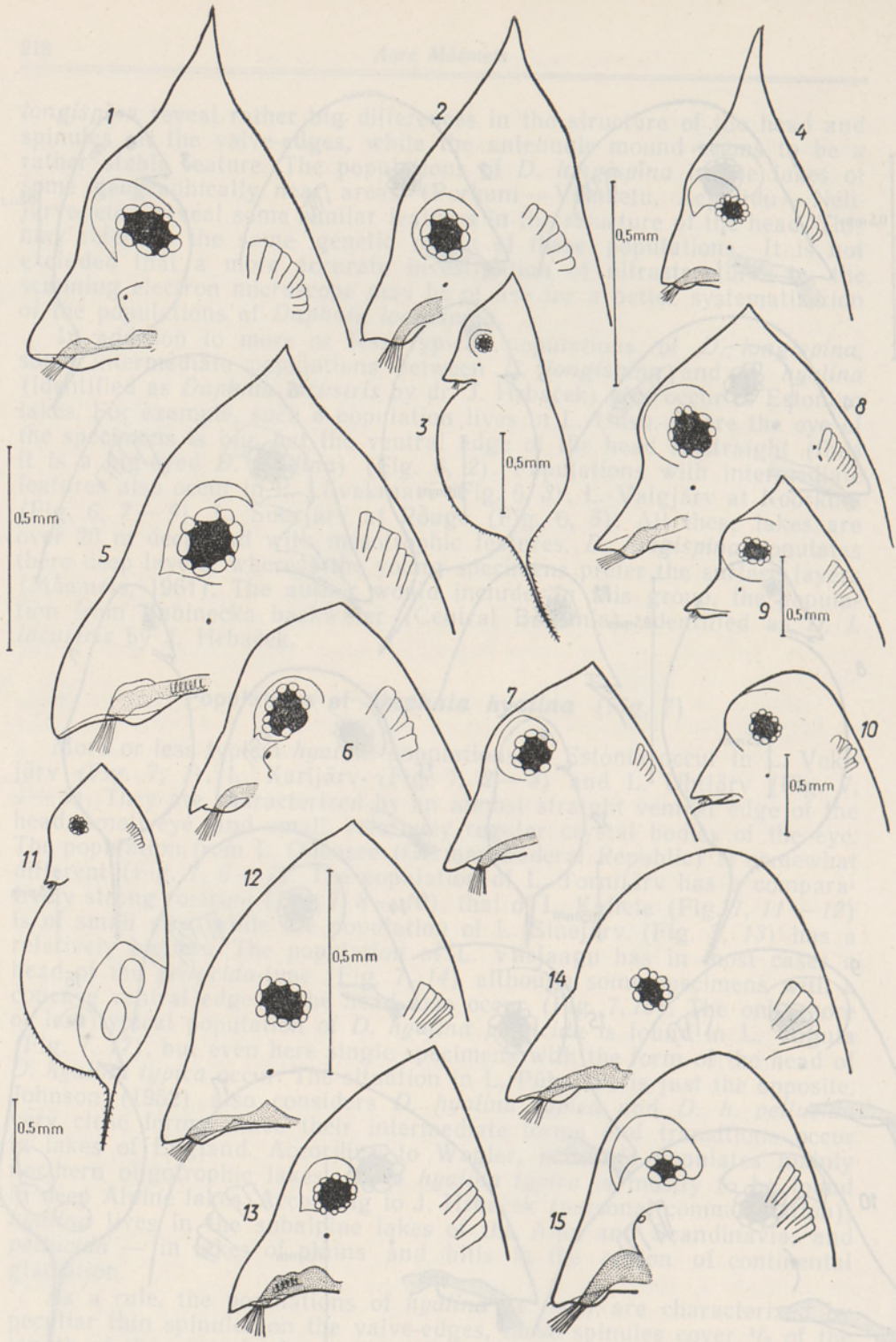

Fig. 8. Heads of *Daphnia galeata* (♀♀): *1* — L. Endla, June 27, 1957; *2—3* — L. Linajärv at Tooma, June 26, 1957; *4* — L. Kalijärv at Jäneda, Aug. 10, 1959; *5—7* — L. Saadjärv, July 3, 1956 (*5*), Nov., 1955 (*6*), Jan. 17, 1956 (*7*); *8* — Bay of Pechora River (Barents-Sea); *9—10* — L. Mustjärv at Kantküla, June 29, 1960; *11—12* — L. Peipsi, July 30, 1962 (*11*), July 22, 1962 (*12*); *13* — L. Vagula, Sept. 8, 1969; *14—15* — L. Tamula, July, 1952.

Fig. 9. Heads of *Daphnia galeata* (♀♀): *1—2* — L. Järise, July 26, 1956; *3—4* — L. Käsmu, July 20, 1953; *5—6* — L. Tõlinõmme, July 6, 1960; *7* — Liivjärv at Kurtna, June 18, 1958; *8* — L. Uljaste, July 1, 1939; *9—10* — L. Purgatsi, Sept. 22, 1956 (10 — juv. ♀); *11* — Bay of Pechora River (Barents-Sea); *12—13* — L. Nikerjärv, Nov. 22, 1962; *14* — L. Kaisma, June 27, 1953; *15—17* — L. Ermistu, June 22, 1953 (*15*), July 18, 1956 (*16—17*), *17* — juv. ♀.

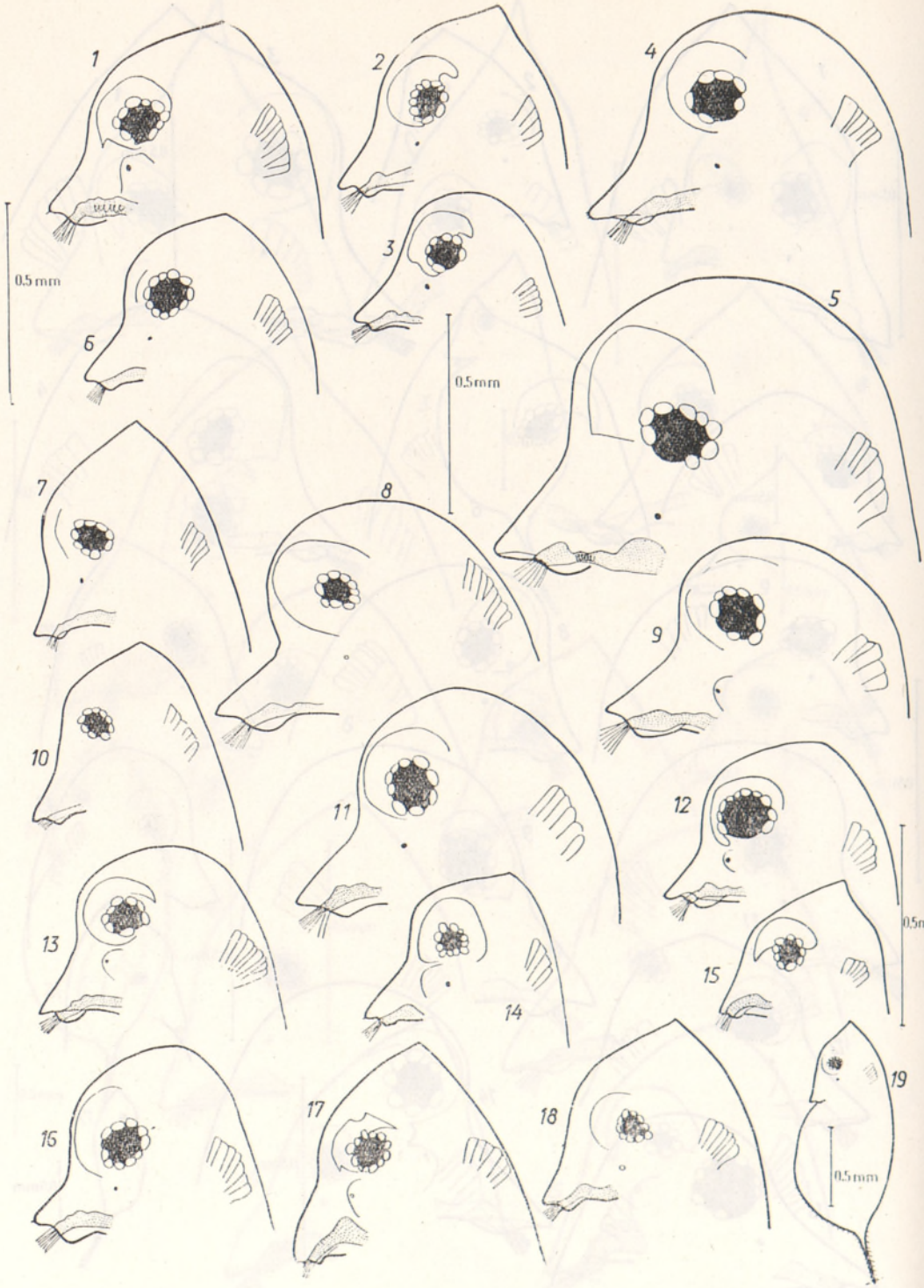

Fig. 10. Heads of *Daphnia galeata* (♀♀): *1* — L. Tootsi, July 13, 1957; *2—3* — L. Tõhela, June 27, 1953; *4* — Slapy reservoir, Central Bohemia, May 18, 1968 (*D. galeata gracilis*, leg. et det. by J. Hrbaček); *5* — Pěšák pond, Lomnice nad Lužniči, Southern Bohemia. Sept. 3, 1969 (*D. galeata gracilis* leg. et det. by J. Hrbaček): *6* — L. Kääriku, July 9, 1954; *7—8* — L. Rummu, July 16, 1953; *9* — L. Ülemiste, June 17, 1957; *10—11* — L. Kahala, July 17, 1953; *12* — L. Sõdaaluse, Aug. 26, 1959; *13* — L. Saarjärv at Misso, June 18, 1952; *14* — L. Hino, June 17, 1952; *15* — L. Pullijärv, June 18, 1952; *16—19* — L. Kisejärv, June 19, 1952.

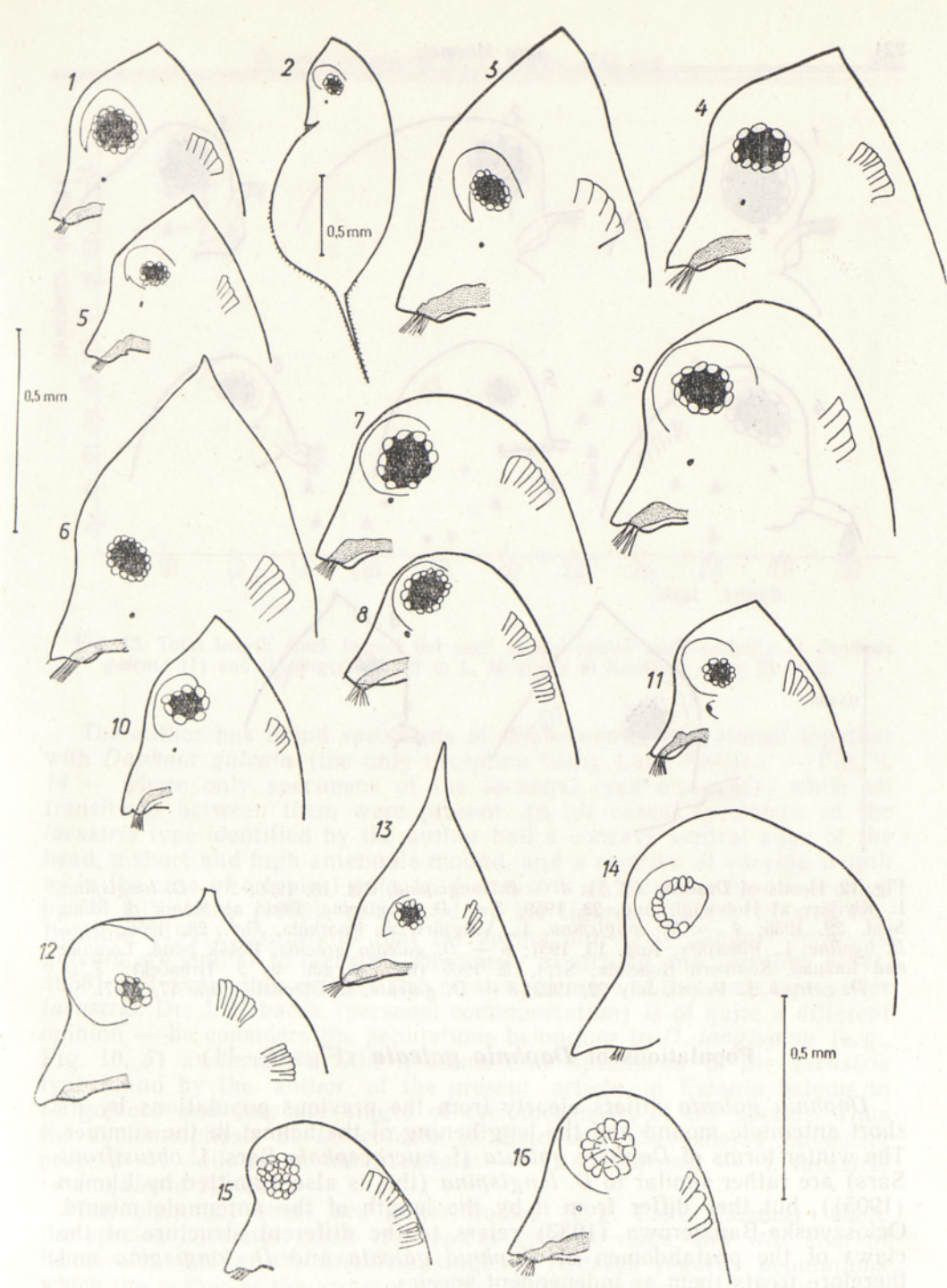

Fig. 11. Heads of *Daphnia* (♀♀): *1—2 — D. galeata,* L. Lohja, July 19, 1953; *3 — D. galeata,* L. Kalli, July 23, 1960; *4 — D. galeata,* L. Mustjärv at Valguta, July 8, 1962; *5 — D. galeata,* L. Luikjärv, Aug. 26, 1959; *6 — D. galeata,* L. Tänavjärv, July 7, 1953; *7—8 — D. galeata* f. *obtusifrons,* L Tänavjärv, March 23, 1957; *9 — D. galeata,* L. Pabra, July 13, 1957; *10 — D. galeata,* L. Savijärv, Aug. 17, 1961; *11 — D. galeata,* L. Tagajärv at Neeruti. Aug. 7, 1962; *12 — D. hyalina lucernensis* (det. by Vereshchagin); *13 — D. cucullata,* L. Tagajärv at Neeruti, Aug. 11, 1957; *14 — D. longispina tenuitesta* (leg. et det. G. O. Sars); *15 — D. longispina* ?, Akmolinsk (leg. G. O. Sars); *16 — D. longispina* ?, Kovda (leg. H. Riikoja).

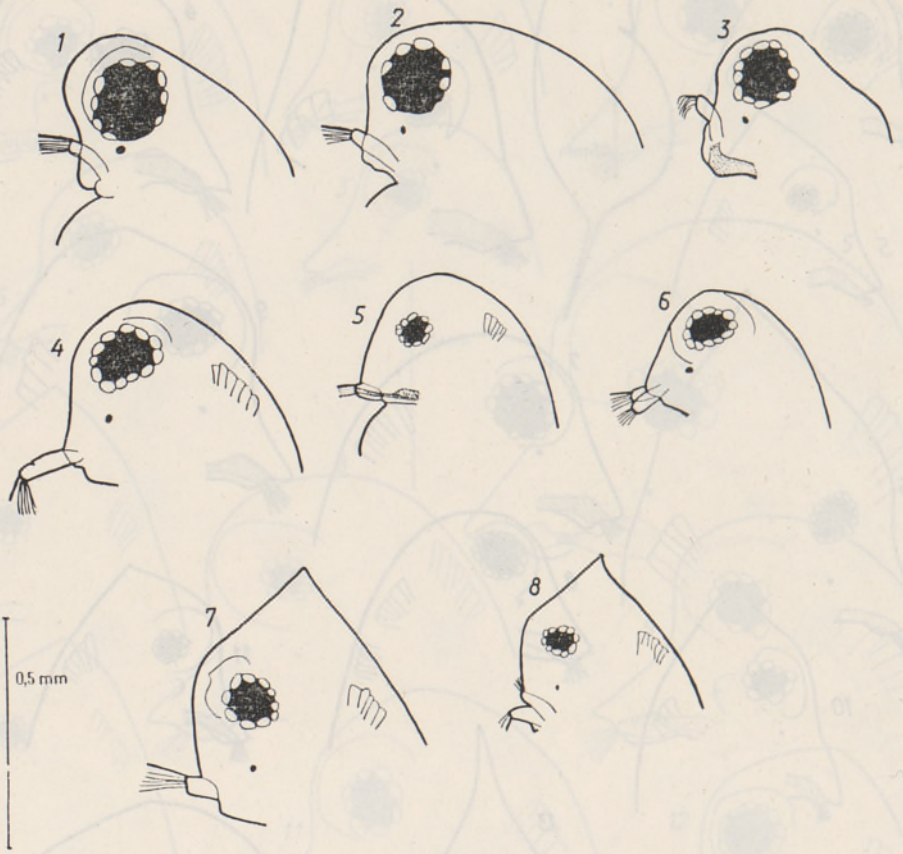

Fig. 12. Heads of *Daphnia* (♂ ♂): *1* — *D. longispina*, Oct. 18, 1956; *2* — *D. longispina*, L. Kivijärv at Holvandi, Aug. 28, 1959; *3* — *D. longispina*, Pond at Manor of Rohu, Sept. 29, 1956; *4* — *D. longispina*, L. Valgjärv at Koorküla, Oct. 23, 1956; *5* — *D. hyalina*, L. Pühajärv, Aug. 13, 1951; *6* — *D. galeata gracilis*, Pěšák pond, Lomnice nad Lužnici, Southern Bohemia, Sept. 3, 1969 (leg. et det. by J. Hrbaček); *7* — *D. galeata*, L. Peipsi, July 22, 1962; *8* — *D. galeata*, L. Ülemiste, June 17, 1957.

Populations of *Daphnia galeata* (Figs. 8—11)

Daphnia galeata differs clearly from the previous populations by its short antennule mound and the lengthening of the helmet in the summer. The winter forms of *Daphnia galeata* (f. *microcephala* Sars, f. *obtusifrons* Sars) are rather similar to *D. longispina* (this is also admitted by Ekman (1905)), but they differ from it by the length of the antennule mound. Ocioszynska-Bankierowa (1933) refers to the different structure of the claws of the postabdomen of *Daphnia galeata* and *D. longispina* and therefore treats them as independent species.

The problem of where *D. hyalina lacustris* Sars belongs, is somewhat debatable. According to Johnson (1952) *lacustris* stands very close to *hyalina*. That author has found specimens with the form of the head of *hyalina* among the populations of *lacustris* and vice versa (according to Lepiksaar (1932) and Riikoja (1944) such a population also occurs in Estonia, in L. Raadi). Nevertheless, Johnson treats these taxons separately and assumes that populations of the *lacustris* type always inhabit small water bodies, while the *hyalina* type lives in big lakes.

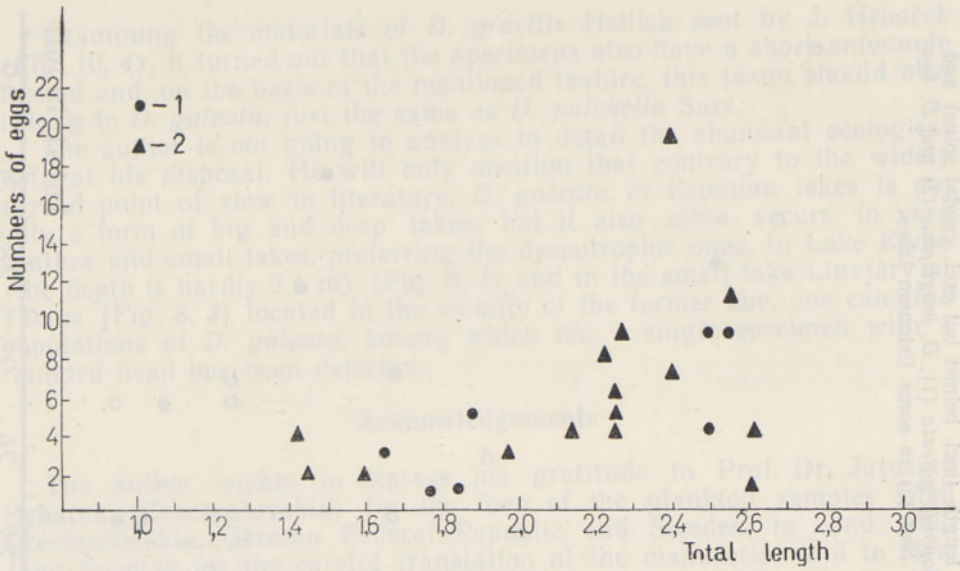

Fig. 13. Total length (incl. helmet but excl. caudal spine) and fecundity of *Daphnia galeata* (1) and *D. longispina* (2) in L. Mustjärv at Kantküla, June 29, 1960.

The author has found specimens of the *lacustris* type almost together with *Daphnia galeata* (the only exception being Lake Kaisma — Fig, 9, *14* — where only specimens of the *lacustris* type occurred), while all transitions between them were present. In all cases, specimens of the *lacustris* type identified by the author had a concave ventral edge of the head, a short and high antennule mound, and a rostrum of varying length as in the case of a typical *galeata*. A *lacustris* of the same type is treated by W. Lilljeborg (1900), as proved by his figures (Tables 15 and 16). Behning (1941) also states that the spring and early summer forms of *galeata* are similar to *lacustris*. Obviously Scourfield and Harding (1941, 1958) and some other authors also mean specimens of the same type under *lacustris*. Dr. J. Hrbaček (personal communication) is of quite a different opinion — he considers the populations belonging to *D. longispina* (e. g., Fig. 10, *5*) as *lacustris*. Still it seems that specimens of the *lacustris* type found by the author of the present article in Estonia belong to *D. galeata* and they are stages of cyclomorphosis of the species. Thus the cyclomorphosis of *D. galeata* in Estonian lakes should obviously proceed as follows: f. *microcephala* → f. *obtusifrons* → f. *lacustris* → f. *galeata typica*.

But obviously there are water bodies (e. g. Lake Kaisma) where the species does not reach the typical *galeata* stage and will stop in its development at the *lacustris* stage. J. Hrbaček regards populations which the author of the present article considers intermediate populations between *D. longispina* and *D. hyalina* (e. g. populations of L. Udsu and L. Valgjärv at Koorküla, the antennule mound of which is long and low — see Fig. 6, *2*, *7—9*) as *lacustris*. Thus it seems that different authors mean different things under *D. hyalina lacustris*. Behning's (1941) assumption that the rostrum of the females of *lacustris* and *galeata* is short does not probably stand. The populations of the lakes Kaisma, Rummu, etc., have long rostra. Another statement by Behning (1941) — that spinules on the top of the rostrum are characteristic of

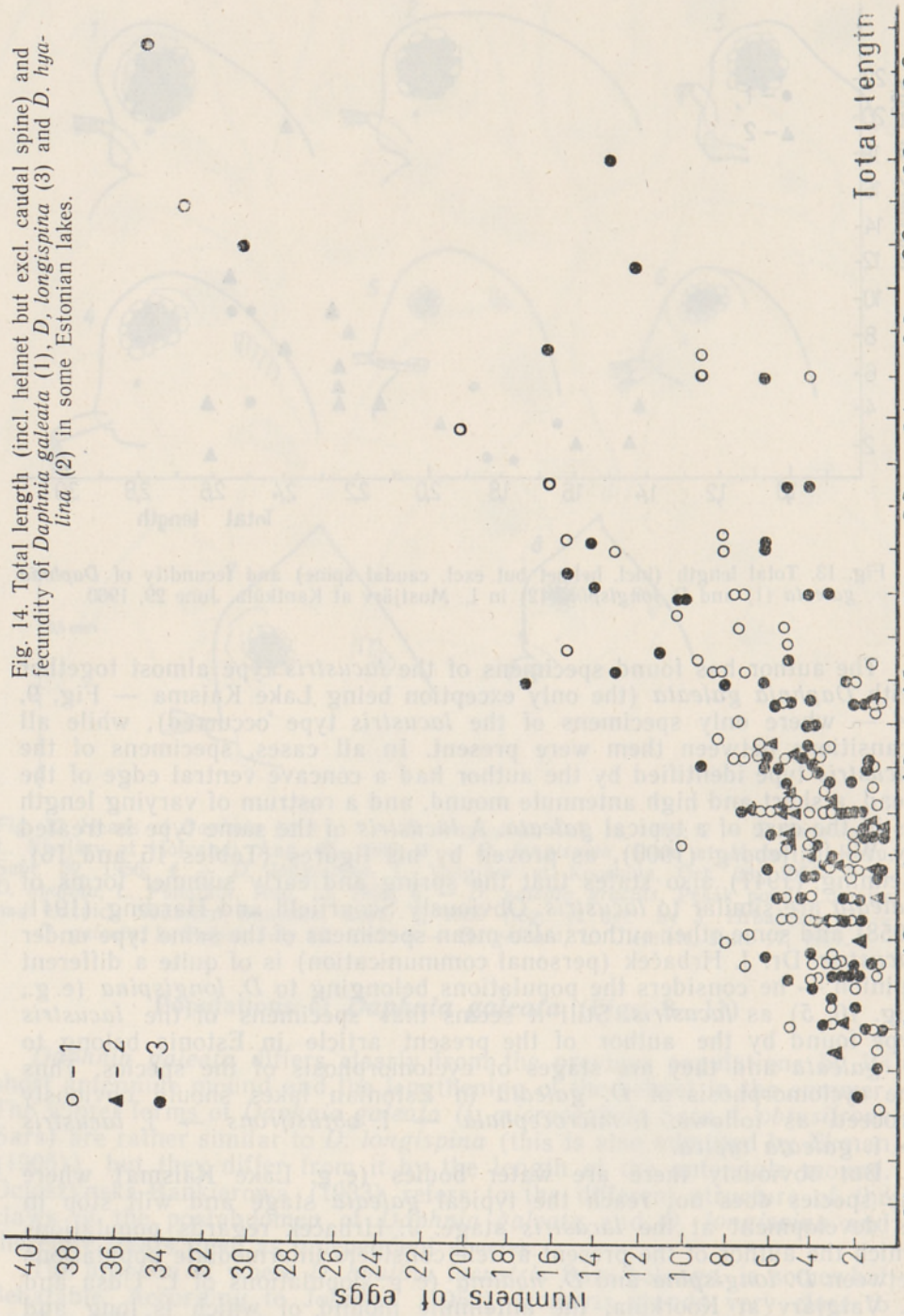

Fig. 14. Total length (incl. helmet but excl. caudal spine) and fecundity of *Daphnia galeata* (1), *D. longispina* (3) and *D. hyalina* (2) in some Estonian lakes.

lacustris — is not correct, either. As a fact, some populations of *galeata* and *longispina* also have such spinules. According to Johnson (1952), *lacustris* is characterized by a reticulation of the valves but, as a fact, some populations of *longispina* (e. g., in L. Mustjärv at Kantküla) are characterized by the same feature, as well.

Examining the materials of *D. gracilis* Hellich sent by J. Hrbaček (Fig. 10, *4*), it turned out that the specimens also have a short antennule mound and, on the basis of the mentioned feature, this taxon should also belong to *D. galeata*, just the same as *D. pulchella* Sars.

The author is not going to analyze in detail the abundant ecological data at his disposal. He will only mention that contrary to the widely spread point of view in literature, *D. galeata* in Estonian lakes is not only a form of big and deep lakes, but it also often occurs in very shallow and small lakes, preferring the dyseutrophic ones. In Lake Endla (the depth is hardly 2.4 m) (Fig. 8, *1*) and in the small lake Linajärv at Tooma (Fig. 8, *2*) located in the vicinity of the former one, one can find populations of *D. galeata*, among which not a single specimen with a rounded head has been detected.

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The author wishes to express his gratitude to Prof. Dr. Jaroslav Hrbaček (Czechoslovakia) for the loan of the plankton samples from Czechoslovakia, German Federal Republic and Sweden, to cand. phil. Jaan Soontak for the careful translation of the manuscript and to Mrs. Aino Kallejärv for the preparation of the illustrations.

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Aare MÄEMETS

DAPHNIA LONGISPINA O. F. MÜLLER 1785 JA *DAPHNIA GALEATA* G. O. SARS 1864 (*CRUSTACEA, CLADOCERA*) KUI ISESEISVAD LIIGID. I

Resümee

Kõnealuste liikide süstemaatikas valitseb tänapäevani segadus. *Daphnia longispina* ja *D. galeata* täiskasvanud isaste ja emaste üheaegne koosesinemine samas biotoobis Kantküla Mustjärves (Rakvere raj.), hübriidide ja vahevormide puudumine ning morfoloogilised erinevused lubavad väita, et tegemist on iseseisvate liikidega. Umbes sajast veekogust pärinevate isendite analüüs näitas, et morfoloogilistest tunnustest sobib nende liikide eristamiseks kõige paremini antennulate kinnitusvalli ehitus (*D. longispina*'l on kinnitusvall pikk ja madal, *D. galeata*'l lühike ja kõrge). Iseseisev liik on nähtavasti ka *D. hyalina*, ehkki selle liigi eristamine ainuüksi morfoloogiliste tunnuste alusel on raske.

Kuigi *D. longispina* populatsioonide isendite morfoloogiline ehitus on väga varieeruv, võib lähestikku paiknevate järvede populatsioonidesse kuuluvate isendite puhul leida sarnaseid jooni.

Eesti NSV Teaduste Akadeemia
Zooloogia ja Botaanika Instituut

Toimetusse saabunud
27. III 1975

Аарe МЯЭМЕТС

DAPHNIA LONGISPINA O. F. MÜLLER 1785 И *DAPHNIA GALEATA* G. O. SARS 1864 (*CRUSTACEA, CLADOCERA*) КАК САМОСТОЯТЕЛЬНЫЕ ВИДЫ. I

Резюме

До настоящего времени в систематике этих видов господствуют большие разногласия. Одновременное сосуществование взрослых самцов и самок видов *Daphnia longispina* и *D. galeata* в одном и том же биотопе в оз. Мустъярв (Кантькюла, Раквереский р-н), отсутствие гибридов и переходных форм и морфологические различия показывают, что мы имеем дело с самостоятельными видами. Как показывают материалы по 100 водоемам, среди морфологических признаков самым характерным является строение закрепительного вала антеннул: у вида *Daphnia longispina* этот вал длинный и низкий, у вида *D. galeata* — короткий и высокий. Самостоятельным видом, по всей вероятности, является и *Daphnia hyalina*, хотя с помощью одних только морфологических признаков определение этого таксона трудно (вал антеннул длинный и низкий).

Несмотря на большое разнообразие в морфологии вида *Daphnia longispina*, имеются некоторые общие морфологические признаки у особей этого вида, находящихся в географически близких озерах.

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