

VII.—Scottish Rotifers, collected by the Lake Survey (Supplement).  
By James Murray. (With Two Plates.)

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INTRODUCTION.

In June 1906 there was published an account of the Rotifers collected in the Scottish lochs up to that date (7). Many Rotifers had been observed during the survey of the lakes which are not referred to in that paper, as they were not collected actually in lakes. It is with the object of recording these species, and especially of giving an account of some interesting forms previously unknown or imperfectly known, that this supplementary paper is written. These Rotifers were, almost without exception, collected from moss, and, as is always the case in these circumstances, the Bdelloida greatly preponderated over the other orders.

Lists are given of the species found in the various islands visited—North Uist, Orkney, Shetland,—as an assistance to students of distribution, though there is little of special interest in these lists. The list from North Uist contains none but very common species, but in Orkney and Shetland there were a number of rare and interesting species.

Two animals have been found with sufficient frequency on mountain-tops to suggest that they may be specially adapted to the climate of such situations. They are *Callidina cornigera* and *C. plicata*, var. *hirundinella*. Both extend into the most northerly lands—the former to Spitsbergen, the latter to both Spitsbergen and Franz Josef Land.

ROTIFERS OF THE SCOTTISH LOCHS—ADDITIONAL SPECIES.

Since the previous list was issued (7), nine additional species have been observed in our lakes, and one distinct variety :—

*Callidina tridens*, Milne. Loch Tay ; St Mary's Loch.

*C. constricta*, Dig. Frequent.

*C. musculosa*, Milne. Loch Ness.

*Rotifer hapticus*, Gosse. A stout brown animal with stout antenna, common in Loch Ness, seems to answer sufficiently to Gosse's description. The heavy antenna, narrowed towards the base, resembles that of *Callidina armata*, Murray (6). It is placed very far forward on the head in the creeping attitude. It is terminated by what appears to be a single seta, but may be a pencil of setæ. Otherwise the animal has a strong resemblance to *R. macroceros*, Gosse, and I have a suspicion that it is that

species with the antenna partly retracted. Gosse was evidently aware of the close affinity of the two species, as his description aims at discriminating them.

*Synchaeta grandis*, Zach. Castle Semple Loch, Renfrew.

*S. oblonga*, Ehr. Frequent in small lochs and reservoirs.

*Diaschiza eva*, Gosse. Loch Ness.

*Brachionus urceolaris*, Ehr. Lochrutton, Dumfries.

*B. angularis*, Gosse. Several small lochs near Dumfries.

*B. pala*, Ehr., var. *dorcas* (Gosse). Hogganfield Loch, near Glasgow.

#### ROTIFERS FOUND IN PONDS AND DITCHES.

This short list is not a complete account of the Rotifers collected by the Lake Survey in ponds, but only of those pond species which did not also occur in lakes. A large number of species were got in ponds, including the majority of the species recorded for the Scottish lochs. *Callidina natans*, a pond species, has already been recorded (6).

*Floscularia cornuta*, d'Ud. Bog pool on Blantyre Moor, near Glasgow.

#### *Philodina convergens*, sp. n. (Plate I. figs. 1 to 3).

*Specific characters*.—Of moderate size; diameter of corona equal to or slightly exceeding first cervical segment; collar prominent, dorsal folds ending below summit of upper lip; sulcus between discs narrow, bottom convex, central setæ on discs. Rami much constricted at teeth, with prominent spine behind; teeth 2/2. Antenna short. Foot four-jointed. Spurs moderately long, with straight interstice, expanded at base; upper part almost parallel-sided, abruptly acute. Dorsal toes much smaller than ventral.

Length, feeding, 240 to 280  $\mu$ ; creeping, 333  $\mu$ . Colour reddish. Trunk closely longitudinally plicate. Diameter of corona, 50  $\mu$ ; jaw, 25  $\mu$  long; spurs, 22 to 25  $\mu$  long. The rostrum is short, and no long tactile setæ were seen. Length of antenna equal to half the diameter of the first cervical segment.

Pale brown eyes. Stomach walls with yellow globules.

*Habitat*.—In washing of moss from the river Lochy, Killin, January 1906; quarry at Nerston, East Kilbride, February 1906.

In both localities the washing contained many *Gammarus*, and *Gammarus* parasites (at Killin *Phil. hamata*, at Nerston *P. laticeps*), so there is at least a suggestion that this is also a parasite. The corona is usually carried with the discs approximated as in *P. laticornis*, but can be pretty widely extended.

The points which distinguish this from other *Philodinæ* may seem rather slight, but close attention to them will show that it is quite distinct. The spurs, though narrow, are of the same form as in *P. laticeps*, etc., that is, blade-shaped. All the

species of the central group have more gradually tapering spurs. It is nearest *P. laticornis*, from which it is distinguished by the much shorter foot, slender spurs, and oviparous reproduction. The marked constriction of the jaws above the middle, and the posterior spine, are shared by no other species. All have a prominence at the back of the ramus, and in some it might be called a tooth or blunt spine, but none have such a prominent spine. This is only exceeded in size, among species known to me, in an undescribed African *Callidina*.

*Rotifer macrurus*, Schrank. Common in the mud of ponds, and especially so in peaty bog pools.

*Proales werneckei*, Ehr. Parasite in *Vaucheria*, on which it forms galls; roadside ditch, Blantyre Moor, near Glasgow.

*Diglena rosa*, Gosse. Ponds, Pomona, Orkney.

*Rattulus carinatus*, Ehr. Peaty pools, Blantyre Moor.

*R. bicristatus*, Gosse. Pools, Blantyre Moor.

*Elosa worrallii*, Lord. Pools, Blantyre Moor.

*Stephanops muticus*, Ehr. Pools, Blantyre Moor.

*Diaschizu exigua*, Gosse. Pond near Mallaig, Inverness-shire.

*Pterodina mucronata*, Gosse. Pond at Nerston, near Glasgow.

#### ROTIFERS FOUND AMONG MOSS.

Moss in any situation is likely to contain abundance of Rotifers. In most situations Bdelloids will predominate, but *Sphagnum* will harbour many other kinds. As a rule the Bdelloids are indifferent to the situation of the moss, and many kinds are found alike in moss which is always moist (*Sphagnum* and mosses in streams, etc.), and in that which is only intermittently moist (on the ground, walls, trees, rocks, etc.).

A few species are exceptions to this rule. *Microdina paradoxa*, for example, will only be found in fresh or running water. The symbiotic species, supposed to be confined to certain hepatics, are quite common in other situations, as among *Sphagnum*.

*Callidina microcephala*, Murray. Ground moss, Fort-Augustus.

#### *Philodina brycei* (Weber) (8).

One of the commonest Bdelloids in Scotland is *P. brycei*, and it is often found in lochs. It is subject to a great deal of variation.

WEBER'S description of *Callidina brycei* (8, p. 347) is in the following terms:—"Le corps est robuste, allongé, de coloration grisâtre ou brunâtre. La peau est rugueuse, sillonnée de forts plis longitudinaux sur les faces dorsale et latérales du corps; par contre, on compte 8 plis transversaux sur la face ventrale. Le bord antérieur du premier segment troncal et le bord postérieur du troisième segment troncal sont armés chacun, dorsalement et latéralement, d'une rangée de courtes épines. L'organe rotatoire est modérément large, à sillon intertrochal étroit. La trompe cylindrique est longue.

L'antenne dorsale est longue et formée de deux articles. Le pied est court, épais. Les éperons courts, coniques sont peu distants l'un de l'autre. Formule dentaire 2/2."

WEBER remarks the resemblance to *Callidina alpium*, Ehr. (which I transfer to *Philodina*). The resemblance is extremely close. Size, colour, general form, skin-folds, —all are alike in the two species. Imagine *P. brycei* deprived of its short central and anterior spines, and we could not, I believe, distinguish it from *P. alpium*.

The type of the species has never occurred in our collections in Scotland, but several varieties are common. The common Scotch form which comes nearest the type differs in having two short spines on the posterior part of the trunk. These appear to be on the preanal segment, but I believe they are really on the fourth central.

The spines on the anterior border of the trunk do not form a regular equal series, as in WEBER's figure. The pair nearest the middle of the back are longest, and form a fork in which the antenna rests when the animal is feeding, precisely as in *Brachionus*, *Anuræa*, etc.

The next pair of spines are very small points. The last pair are laterally placed, or a little inclined to the ventral side. Each of them is usually furcate, one point (the lateral one) being erect, and the other (more ventral) spreading or decurved.

There are some other small spines usually present, which are not referred to by WEBER. On the two lateral skin-folds of each side of the central trunk, on which are the last spines of the transverse dorsal row, there are small spines a little in front of those. Sometimes only one lateral fold has this spine.

This form is generally distributed in Scotland. It is not figured here, but fig. 13, which is of another variety, indicates all the structures referred to, but has an additional transverse row of spines.

*Variety* (fig. 13).—This differs from the form just described in possessing a second transverse row of spines on the central trunk, a little behind the main row. There are four spines in this row. The anterior processes forming the fork for the antenna are very large and are frequently furcate. Almost as common in Scotland as the other, and widely distributed over the world. In Indian examples there may be six or eight spines in the secondary transverse row.

#### *Callidina cornigera*, Bryce (2).

In 1893 Mr BRYCE described this species in the following terms (p. 201):—"Trochal discs apparently without gap, laterally produced into two horn-like but fleshy processes, whose bases are furnished on inner face with cilia, forming part of principle wreath. Antenna very short, one-fourth of neck thickness. . . . *Length*, extended, about  $\frac{1}{10}$ th inch." He noticed further that "the double flap terminating the column tip (lamellæ) was rather more developed than usual," saw the usual skin-folds and conical spines, but failed to make out the dental formula.

These observations were made on a single example, which, though kept alive for

the long period of fourteen days, appears never to have given very good opportunity for study.

The original specimen was found among moss from roadside, near Bognor, Sussex. Some years later another example was found in moss from Buckinghamshire. In 1897 a third example appeared in moss from Spitsbergen. On this occasion Mr BRYCE observed the dental formula  $2/2$ , and gives the measurement of the extended animal as 0.347 mm., but adds nothing further to his original description. In the plate accompanying the description the jaws are figured with two teeth in each.

WEBER (8) found two examples of the species, in very bad condition. His description (p. 349) is almost identical with BRYCE's, and he adds nothing of importance except the dental formula  $2/2$ . He says that the lamellæ are broad.

I can find no other record of the species, which would seem to indicate that it is a rare animal, as such an extraordinary creature would readily attract attention. In March 1904 I first found it in moss from the shore of Loch Ness, near Fort-Augustus, and subsequently it has appeared pretty frequently in Scotland, permitting fuller studies to be made of it.

There will hardly, I think, be any doubt as to the identity of the animal found in Scotland, if the figures here given (Plate II. figs. 20 to 26) are compared with those of BRYCE and WEBER, although I am compelled to differ from Mr BRYCE as to the most important structures of the animal, the horns and the discs. According to BRYCE, the discs have apparently no gap, and are produced into the horns, and the bases of the horns are ciliated, the cilia forming part of the principal wreath.

I find that the discs are normal and separate, but close together, and the horns spring from folds of skin somewhat to the dorsal side of the discs (technically part of the collar, I believe). The horns are nowhere ciliate.

These differences between Mr BRYCE's observations and mine seem greater on paper than they are in reality. Compare the figures, and see what a slight difference in interpretation is involved.

A full description of the animal, as observed in Scotland, is added.

*General form.*—Slender, more like WEBER's figure than BRYCE's, broadest in central trunk, well-marked neck, slightly expanded head, much contracted in posterior trunk (4th central), foot generally hidden. Trunk closely longitudinally plicate. In its movements the animal contorts its body a good deal, changing form greatly, expanding one segment and drawing in another.

*Discs.*—Elliptical, touching at inner margin, slightly inclined forward.

*Horns.*—Long, white, with broad bases and narrow, soft, blunt tips, curved forward from base to apex, and elbowed where the narrow part begins, sometimes angled again, or incurved close to the apex. One horn is generally longer than the other, and in the creeping attitude the tip of the longer one usually protrudes, sometimes both.

There is no doubt that the function of the horns is tactile. The animal is exceedingly sensitive and timid. The horns are employed before beginning to feed, and

their action is very like that of fingers. Arrived before some flocculent material, the head is unfolded in a hesitating manner, the horns (or fingers) make a tapping motion forward among the food-material, after which the beast either withdraws into its trunk hurriedly, or goes on quietly feeding. The fingers seem to be moved by special muscles, and act as if articulated at the bend, though nothing of this was actually seen.

*Rostrum*.—The basal joint is large, the apical joint very small and short.

*Lamellæ*.—These exhibit the highest development of the Bdelloid lamellæ known. They are very large, and widely divergent laterally, resembling a pair of butterfly's wings. Unlike those of most Bdelloids, which remain passively motionless when extended, the lamellæ of *C. cornigera* are waved about in the water with a very graceful motion. This action has suggested that they are organs of smell.

*Rostral cilia*.—The brush of cilia is well developed, but none of the other processes of the tip were seen.

*Antenna*.—This is very short. In the creeping attitude it looks like a little button (fig. 22), or may be quite retracted. It can be extended to about one-quarter the diameter of the neck.

*Stomach*.—Walls much convoluted, food moulded into pellets. Though neither BRYCE nor WEBER mentions this, their figures seem to indicate that they observed it.

*Intestine*.—Rarely easy to observe in a pellet-maker, it was here conspicuous and filled with pellets.

*Jaws*.—Teeth  $2\frac{1}{2}$ . Lateral margin lightly convex, angled to anterior margin; posterior margin abruptly bent, forming a little point (fig. 25).

*Foot*.—Joints, four. Spurs small, acuminate, curved, close at bases. Toes, three, short, blunt.

*Yolk-mass*.—Eight relatively large nuclei.

*Egg*.—Small, thin-shelled, shortly oval.

*Habitat*.—Among moss, most commonly *Sphagnum*, from near sea-level to nearly 4000 feet. Shores of Loch Ness, several places; Ben Lawers; East Kilbride, near Glasgow; Orkney, summit of Ward Hill, in Hoy, about 1500 feet.

Length, creeping, 250  $\mu$ . This is the same size as Mr BRYCE's first example, but that from Spitsbergen was much larger.

*Callidina minuta*, sp. n. (Plate I. figs. 11, 12).

*Specific characters*.—Very small. Very short, with broad trunk. Corona less than neck, much less than collar. Central trunk broadly elliptical, first segment anterior to central trunk bearing some small spines on lateral skin-folds. Posterior part of trunk nodose. Foot short; spurs short, acuminate, meeting at bases. Teeth about  $5\frac{1}{4}$  ( $5\frac{1}{5}$ ,  $4\frac{1}{3}$ ). Food moulded into pellets.

In form this curious little animal is an exact miniature of *C. pulchra*, Murray (6). The only differences in detail which can be pointed out are that the first cervical does

not project so prominently outward in *C. minuta*, and the little lateral spines on the anterior trunk segments. The skin was not stippled, but little importance can be given to that character.

In size it does, however, differ greatly, measuring only  $77\ \mu$  in length when feeding, or little more than one-third that of *C. pulchra*. While size alone cannot be made a primary specific character, in this case the difference between the related species is so great that it gives greater weight to the other small differences.

No Bdelloid which I have seen hatched is to such a degree smaller than the adult. In common with many other Rotifers, the young, when hatched, is hardly inferior in length to the parent, and very soon attains to all the adult proportions. The pellets of food which filled both stomach and intestine showed that the last example of *C. minuta* had been feeding for a considerable time. The pellets are relatively large, measuring 6–7  $\mu$ .

The discs are inclined backward, and have central setæ. The spurs measure 9  $\mu$  from tip to tip.

The length of the antenna is equal to one-third of the diameter of the neck.

*Habitat*.—Among *Sphagnum*, Blantyre Moor, 1902. In ground moss, Nerston, near Glasgow, March 1905.

On the first occasion of finding it, my acquaintance with Bdelloids was very limited, and after a time I lost faith in the observation, and came to suppose that there had been a mistake as to the power of the microscope used. The second occurrence of the animal, years later, after a good deal of experience among Bdelloids, confirmed the earlier record.

*Callidina circinata*, sp. n. (Plate I. figs. 4 to 10).

*Specific characters*.—Small. Head nearly square, with corona slightly exceeding the collar, and very prominent dewlap overhanging first neck-segment. Upper lip of very unusual form—sulcus between discs deep, bounded by two large processes connected with the collar (the arrangement will be better understood from fig. 5 than from any description). Antenna short, dorso-lateral processes large, widely spreading laterally. Foot short, three-jointed. Spurs large, long, nearly parallel-sided, incurved, acute, interspace large, flat. Toes symbiotic (joined to form a perforate disc). Teeth, 3/3 or 2 + 1/1 + 2. Length when feeding, 213  $\mu$ ; diameter of trunk, 71  $\mu$ ; of corona 60  $\mu$ ; tip to tip of spurs, 30  $\mu$ .

*Habitat*.—Among moss growing on dry wall at Nerston, East Kilbride, October 1906. Plentiful.

This species affords another of those puzzles in distribution which are especially familiar to students of the Rotifera. The moss on the wall was growing in little detached cushions. One of these was casually pulled in passing, and was washed on reaching home. When the strange species was found so abundant in it, the wall was visited again, and surrounding tufts pulled, but none of the Rotifers found.

The long spurs, more or less curved towards one another, resemble callipers. The flame-cells are narrow and spindle-shaped. The rostrum is short and broad. The dorso-lateral processes of the neck are conspicuous in the creeping attitude (fig. 6). Length of antenna about equal to half diameter of neck.

The possession of a "symbiotic" foot, *i.e.* one ending in a perforate adhesive disc, distinguishes *C. circinata* from the great majority of *Callidinæ*. Of the small group having a foot of this type, all have a greater number of teeth, except only *C. symbiotica* and *C. armata*, and both of these species have short spurs of quite a different shape, so that the species cannot be confused with any known species.

*Callidina plicata*, Bryce (1).

Described by BRYCE in 1892. The most important distinguishing character is the expanded, hood-like, posterior trunk-segment.

One of the very commonest Bdelloids in Scotland, *C. plicata* is the centre of a large series of forms, some of which have the processes of the posterior trunk-segment greatly produced, while others have them reduced or entirely absent. The latter would not be recognised as *C. plicata*, but long study of other characters of the type, and of a series of forms in which the processes were progressively reduced, convinced me that those without the processes were also of this species.

*Description of C. plicata* (type) (fig. 14).

*General form* narrow, elongate, widest in central trunk. Neck and anterior trunk well extended in usual feeding attitude. Trunk closely plicate, the central dorsal pair running out on to the rump, as pointed out by BRYCE; but the rump is marked off from the central trunk by a very deep transverse furrow, so that the longitudinal folds on the rump might more properly be regarded as distinct from those of the central trunk.

The transverse furrow is much further forward than the lateral constriction separating rump and central trunk, but I believe both belong to the same line of separation of segments.

*Head*.—From the neck the head gradually expands upward, the corona being the widest part. The collar is distinct, but not very prominent. The discs bear central setæ, springing from small papillæ.

*Upper lip*.—Though to some extent variable, the upper lip is one of the best characteristics of the species. There are two convex processes, meeting in the middle line, much as in *C. habita* (3). Between them is usually a smaller convexity, not belonging to the lip. The processes are connected with the collar by a ridge, as usual. From the outer edge of the processes two fine lines pass downward towards the rostrum, converging towards the middle line, giving the lip the appearance of a keystone set into the head. This form of lip I have seen in no other species.

*Rostrum*.—Short and broad, and bearing two lamellæ, which in dorsal view seem far separated, as in some symbiotic *Callidinæ*. The restlessness of the animal when not



feeding has prevented a fuller study of the rostral processes; but I have thought at times I could detect long setæ, or pencils of setæ, projecting laterally from the lamellæ, as in *C. ehrenbergi*, Janson (4).

*Vibratile tags*.—These are of the usual narrow form. I have not been able to count more than four pairs.

*Alimentary canal*.—The jaws, stomach, and intestine are normal. There are two teeth in each jaw, and the usual fine striæ. The food is not moulded into pellets.

*Rump*.—The preanal and anal segments, which form the rump, are but slightly separated; but the second constriction mentioned by BRYCE doubtless marks the separation, and the hood with its processes will then belong to the anal segment. The two lobes which project from the end of the anal segment are thin hyaline flanges.

*Foot* of four joints, short. Spurs rather long for a *Callidina* of the central group, narrow, tapering, slightly acuminate, obtuse, close together at base, but small interspace showing in some positions. Toes very short, difficult to see, as the last portion of the step is very rapidly made.

#### *Variations of C. plicata.*

*Head*.—The processes of the upper lip, which usually meet in the middle line (fig. 14), are sometimes separated by a small but deep sulcus. A *ligule* is very commonly present, in examples otherwise typical (see dotted line between the discs in fig. 15). In its greatest development this is a drop-shaped body, apparently just touching the head, a little to the ventral side of pedicels.

*Foot*.—The first foot-joint sometimes has a boss, which may be centrally placed, as in most species having this process, or at the posterior edge of the segment, as in *C. symbiotica*. In an Indian form, not otherwise peculiar, this becomes a transverse ridge, with a sharp edge.

*Rump*.—BRYCE does not refer to the processes on the posterior margin of the hood, but his figure shows them.

Their commonest form is shown (in fig. 14). A form in which they are quite obsolete is figured (fig. 19). The posterior part of the hood is divided into three plane surfaces, a central one and two lateral flaps.

The processes are, on the other hand, often produced much more than in that figured (fig. 14), and become in some forms very prominent. They are still, however, quite rigid outgrowths of the skin, and do not appear to be articulated at the base.

A form in which the development of these processes is carried still further is regarded as being a stable variety, and is described below.

*C. plicata*, Bryce, var. *hirundinella*, var. nov. (Plate II. figs. 16 to 18).

*Distinctive characters*.—The processes on the anal segment are produced into long ligular bands with rounded ends. They normally diverge widely, but they are distinctly articulated at the base, and can be approximated, or even crossed over one

another (fig. 18). These tail-like processes suggest a resemblance to those of the swallow-tail butterfly. They are sometimes considerably longer than the foot. I have seen no evidence that they are movable at will, but they certainly yield readily at the base and assume many different positions. The position in which they are crossed does not seem one likely to be produced automatically by the movements of the skin to which they are attached.

*Habitat*.—Among ground moss. Frequent, especially on mountain-tops. Fort-Augustus; Ben Lawers (cairn on summit); North Uist; summit of Ward Hill in Orkney, and of Ronas Hill in Shetland.

*Rotifer quadrioculatus*, Murray. Moorland, Fort-Augustus.

*Arthroglana lutkeni*, Berg. Moorland, Pomona, Orkney.

*Stephanops microdactylus*, Murray. Blantyre Moor; Ballagioch Hill, near Glasgow.

*Cathypna unguolata*, Gosse. Mainland of Shetland.

*Brachionus bakeri*, Ehr. Summit of Ronas Hill, Shetland.

#### ROTIFERS FOUND IN THE SEA.

Though the Rotifers are pre-eminently a fresh-water group of animals, a considerable number of marine species are now known. Besides those which are exclusively marine, many species live indifferently in fresh or salt water. Seaweed was gathered on the west coast of Scotland, kept tightly packed in a tin box for a week, then washed in fresh water. A great many living Rotifers were then found which seemed active and healthy in the fresh water.

The Lake Survey did not make a special study of the marine species, but occasionally, when opportunity offered, the nets were used in the sea, or seaweed was washed.

*Synchaeta* is a specially marine genus, or at least has a number of exclusively marine species. In the harbour at Mallaig we found one species extremely abundant, and in the brackish loch of Stenness there were several species; but we could not venture to name these without submitting them to a specialist. We have found only one Rotifer in the sea which has never occurred in fresh water.

*Rattulus dubius* (Lauterborn) (5). In Morar Bay, West Inverness. Got by washing seaweeds.

*Furcularia reinhardti*, Ehr. This common lake species was also frequent in the sea at Morar. The salt-water form was larger than the other, but I could see no other difference.

*Philodina*. Two species occurred in the washings of seaweed from Lochinver, West Sutherland. They could not be identified. (*P. flaviceps*, Bryce, was got by Mr WM. EVANS in the sea near Edinburgh.)

*Colurus*, sp. In the washings of seaweed, one of the species occurring most regularly is a large *Colurus*, which I will not attempt to name, in the present chaotic state of the genus.

*Pterodina*, sp. Lochinver.

## ROTIFERS OF NORTH UIST.

The Rotifers enumerated in the following short list were collected in the early summer of 1904, while the lochs of the island were being surveyed. As the whole district surveyed is one great wet moor, most of the Rotifers were got from bog or moor mosses, chiefly *Sphagnum* and *Hypnum* of various species.

One interesting collection was made from a tuft of *Fontinalis* growing in a mill-stream, within reach of the tides, so that the animals living in the axils of the leaves must be able to endure alternately fresh and salt water. The species found here were *Philodina flaviceps*, and all four species of *Euchlanis* on the list. *P. flaviceps* has since been found actually in the sea, by Mr WM. EVANS.

<i>Philodina rugosa</i> , Bryce.	<i>Adineta barbata</i> , Janson.
„ <i>nemoralis</i> , Bryce.	<i>Ascomorpha ecaudis</i> , Perty.
„ <i>flaviceps</i> , Bryce.	<i>Microcodon clavus</i> , Ehr.
„ <i>macrostyla</i> , Ehr., and variety <i>tuberculata</i> (Gosse).	<i>Copeus cerberus</i> , Gosse.
<i>Callidina aspera</i> , Bryce.	<i>Proales petromyzon</i> , Ehr.
„ <i>lata</i> , Bryce.	<i>Furcularia longiseta</i> , Ehr.
„ <i>angusticollis</i> , Murray.	<i>Rattulus longiseta</i> , Schrank.
„ <i>symbiotica</i> , Zel.	<i>Diurella tigris</i> , Müll.
„ <i>tetraodon</i> , Ehr.	<i>Diaschiza gibba</i> , Ehr.
„ <i>russeola</i> , Zel.	<i>Dinocharis tetractis</i> , Ehr.
„ <i>plicata</i> , Bryce, and variety <i>hirundinella</i> .	<i>Stephanops muticus</i> , Ehr.
„ <i>papillosa</i> , Thompson.	<i>Euchlanis lyra</i> , Huds.
„ <i>multispinosa</i> , Thompson.	„ <i>oropha</i> , Gosse.
„ <i>quadricornifera</i> , Milne.	„ <i>deflexa</i> , Gosse.
<i>Rotifer tardus</i> , Ehr.	„ <i>triquetra</i> , Ehr.
„ <i>macrurus</i> , Schrank.	<i>Monostyla lunaris</i> , Ehr.
„ <i>citrinus</i> , Ehr.	„ <i>cornuta</i> , Ehr.
<i>Adineta vaga</i> , Davis.	<i>Colurus obtusus</i> , Gosse.
	<i>Anuræa serrulata</i> , Ehr.

## ROTIFERA OF ORKNEY AND SHETLAND.

As I am aware of no published account of the Rotifers of these islands, a list of some of those found by the Lake Survey is here given, though there is nothing of special interest in the list. We found several species which are very local in their distribution, some of them only previously known from one or two spots on the mainland of Scotland. Though the majority of Rotifers are considered to be cosmopolitan in their distribution, the same species appearing under similar conditions everywhere, the portion of the earth's surface which has been carefully examined is too limited to permit us to suppose that this is demonstrated, and so local lists have their uses.

*Arthroglæna lutkeni*, Berg., occurred in Orkney, and *Brachionus bakeri*, Ehr., in Shetland, both for the first time in my experience. The lists from Orkney and Shetland are given in parallel columns, though the information thus given is of little value, owing to the inadequacy of the work done. As usual, the great majority of the species found are Bdelloids. Forty-four species and three varieties are noted for Shetland, thirty-two

species and one variety for Orkney. Twenty-three species and one variety are common to the two groups.

The two highest hills in the islands, Ward Hill in Hoy and Ronas Hill in Shetland, were specially examined. Both are about 1500 feet in height, and thus combine high latitude and considerable elevation. Saxavord Hill, in Unst, nearly 1000 feet high, and close to the northernmost point of the British Islands, was also carefully studied.

	Orkney.	Shetland.
<i>Philodina aculeata</i> , Ehr. . . . .	. . . . .	Ronas Hill, Mainland.
„ <i>macrostyla</i> , Ehr. . . . .	. . . . .	Mainland ; Yell.
var. <i>tuberculata</i> (Gosse). . . . .	. . . . .	Mainland ; Yell.
„ <i>acuticornis</i> , Murray . . . . .	. . . . .	Ronas Hill ; Yell.
„ <i>brevipes</i> , Murray . . . . .	Ward Hill, Hoy. . . . .	Ronas Hill.
„ <i>flaviceps</i> , Bryce . . . . .	. . . . .	Yell.
„ <i>nemoralis</i> , Bryce . . . . .	Hoy ; Rousay . . . . .	Unst.
„ <i>rugosa</i> , Bryce . . . . .	Ward Hill, Hoy. . . . .	Ronas Hill ; Yell.
„ <i>alpium</i> (Ehr.) . . . . .	. . . . .	Saxavord, Unst.
„ <i>brycei</i> (Weber). . . . .	Rousay . . . . .	Mainland.
„ <i>humerosa</i> , Murray . . . . .	. . . . .	Mainland.
<i>Callidina aspera</i> , Bryce . . . . .	Rousay . . . . .	Mainland ; Yell ; Unst.
„ <i>ræperi</i> (Milne) . . . . .	. . . . .	Mainland.
„ <i>angusticollis</i> , Murray . . . . .	. . . . .	Saxavord, Unst.
„ <i>lata</i> , Bryce . . . . .	. . . . .	Ronas Hill.
„ <i>pulchra</i> , Murray . . . . .	Pomona. . . . .	...
„ <i>constricta</i> , Duj. . . . .	Ward Hill, Hoy. . . . .	...
„ <i>tridens</i> (Milne) . . . . .	Pomona. . . . .	...
„ <i>leitgebii</i> , Zel. . . . .	Hoy ; Rousay . . . . .	Saxavord, Unst.
„ <i>cornigera</i> , Bryce . . . . .	Ward Hill, Hoy. . . . .	...
„ <i>plicata</i> , Bryce . . . . .	Hoy ; Rousay . . . . .	Mainland ; Yell ; Unst.
var. <i>hirundinella</i> , var. nov. . . . .	Ward Hill, Hoy. . . . .	Ronas Hill.
„ <i>habita</i> , Bryce . . . . .	Ward Hill, Hoy . . . . .	Mainland.
„ <i>quadrirorifera</i> (Milne) . . . . .	Pomona ; Rousay . . . . .	Mainland ; Yell ; Unst.
„ <i>ehrenbergii</i> , Janson . . . . .	Pomona . . . . .	Yell ; Unst.
„ <i>papillosa</i> , Thompson . . . . .	Hoy ; Pomona ; Rousay . . . . .	Mainland.
„ <i>musculosa</i> (Milne) . . . . .	Pomona . . . . .	Mainland.
„ <i>symbiotica</i> , Zel. . . . .	Pomona . . . . .	Ronas Hill.
„ <i>armata</i> , Murray . . . . .	Pomona. . . . .	...
„ <i>tetraodon</i> , Ehr. . . . .	Pomona . . . . .	Ronas Hill.
„ <i>incrassata</i> , Murray . . . . .	Rousay . . . . .	Mainland.
„ <i>scarlatina</i> , Ehr. . . . .	Ward Hill, Hoy . . . . .	Ronas Hill.
„ <i>russeoli</i> , Zel. . . . .	Ward Hill, Hoy . . . . .	Mainland ; Unst.
<i>Rotifer vulgaris</i> , Schrank . . . . .	. . . . .	Yell ; Unst.
„ <i>macrurus</i> , Schrank . . . . .	. . . . .	Ronas Hill.
„ <i>citrinus</i> , Ehr. . . . .	. . . . .	Saxavord, Unst.
„ <i>longirostris</i> (Janson) . . . . .	Ward Hill, Hoy . . . . .	Mainland ; Unst.
<i>Adineta vaga</i> (Davis) . . . . .	Pomona . . . . .	Mainland.
var. <i>major</i> , Bryce . . . . .	. . . . .	Mainland.
„ <i>barbata</i> , Janson . . . . .	Ward Hill, Hoy . . . . .	Mainland ; Unst.
„ <i>gracilis</i> , Janson . . . . .	Pomona . . . . .	Mainland.
„ <i>tuberculosa</i> , Janson . . . . .	. . . . .	Ronas Hill.
<i>Notommata toruloso</i> (Duj.) . . . . .	. . . . .	Mainland.
<i>Diglena rosa</i> , Gosse . . . . .	Pomona. . . . .	...
„ <i>ferox</i> , Western . . . . .	. . . . .	Mainland.
<i>Arthroglana lutkeni</i> , Berg. . . . .	Pomona. . . . .	...
<i>Stephanops stylatus</i> , Milne . . . . .	Pomona. . . . .	...
„ <i>tenellus</i> , Bryce . . . . .	Pomona . . . . .	Mainland.

	Orkney.	Shetland.
<i>Diaschiza eva</i> , Gosse . . . . .	Ward Hill, Hoy . . . . .	Mainland.
<i>Monostyla lunaris</i> , Ehr. . . . .	Rousay. . . . .	Ronas Hill.
" <i>cornuta</i> , Ehr. . . . .		...
<i>Distyla flexilis</i> , Gosse . . . . .		Mainland.
<i>Cuthypna unguolata</i> , Gosse . . . . .		Mainland.
<i>Colurus obtusus</i> , Gosse . . . . .		Mainland.
<i>Metopidia acuminata</i> , Ehr. . . . .		Ronas Hill.
<i>Brachionus bakeri</i> , Ehr. . . . .		Ronas Hill.

## LITERATURE.

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## EXPLANATION OF PLATES.

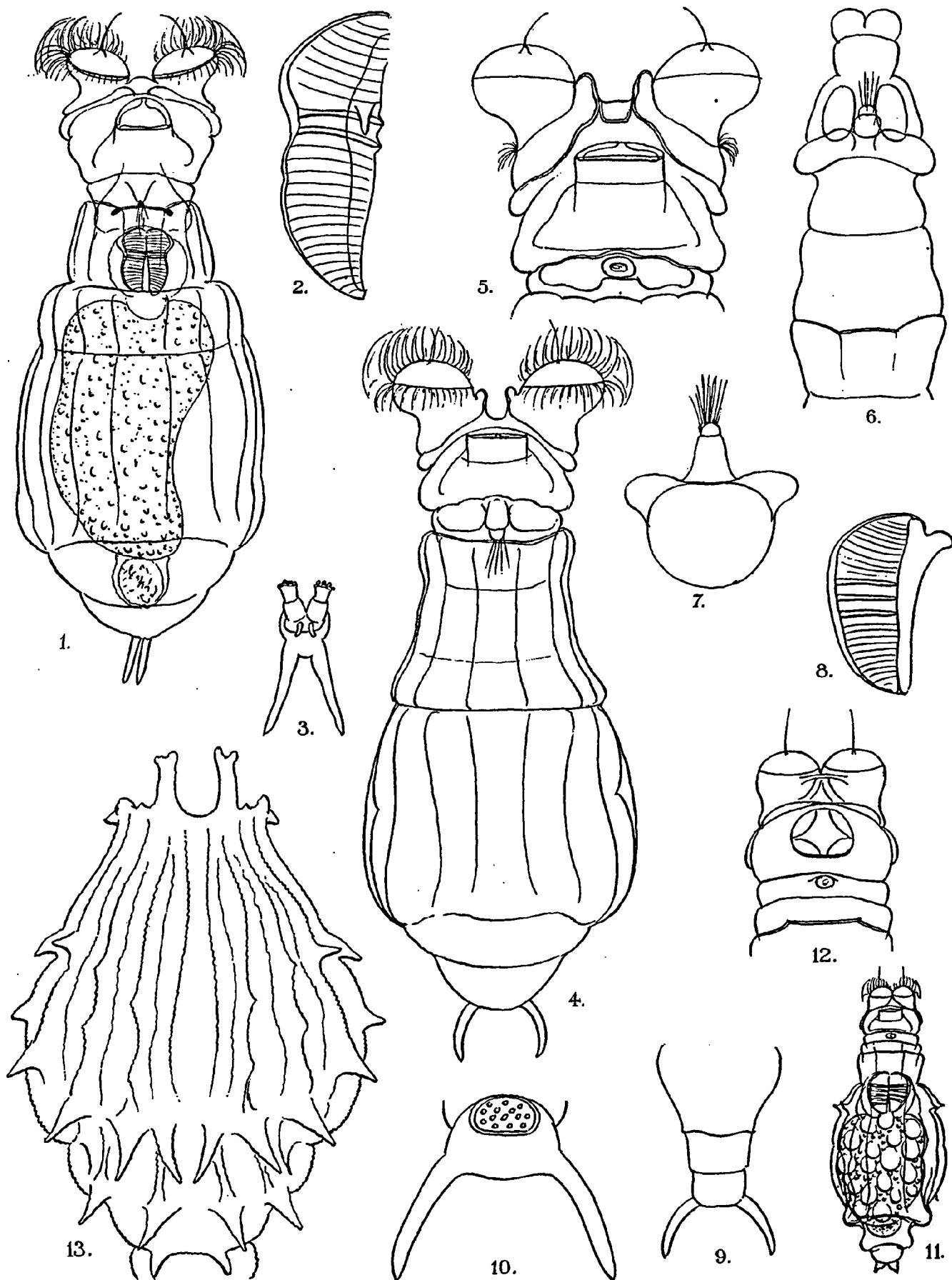
In order to indicate relative sizes of different species, all the drawings of complete animals are made to one scale, except that of *C. minuta*. To show sufficient detail, this had to be drawn nearly twice as large as the others.

## PLATE I.

- |  |   |
|--|---|
| 1. <i>Philodina convergens</i> , sp. n., dorsal view, feeding. | 7. <i>Callidina circinata</i> , section of neck and antenna |
| 2. " " jaw, seen from behind.                                  | 8. " " jaw.   |
| 3. " " spurs and toes.   | 9. " " foot.  |
| 4. <i>Callidina circinata</i> , sp. n., dorsal view, feeding.  | 10. " " spurs and perforate disc.                           |
| 5. " " head, more highly magnified.                            | 11. <i>Callidina minuta</i> , sp. n., dorsal view, feeding. |
| 6. " " head and neck, when creeping.                           | 12. " " head more highly magnified.                         |
|  | 13. <i>Philodina brycei</i> , Weber, variety.               |

## PLATE II.

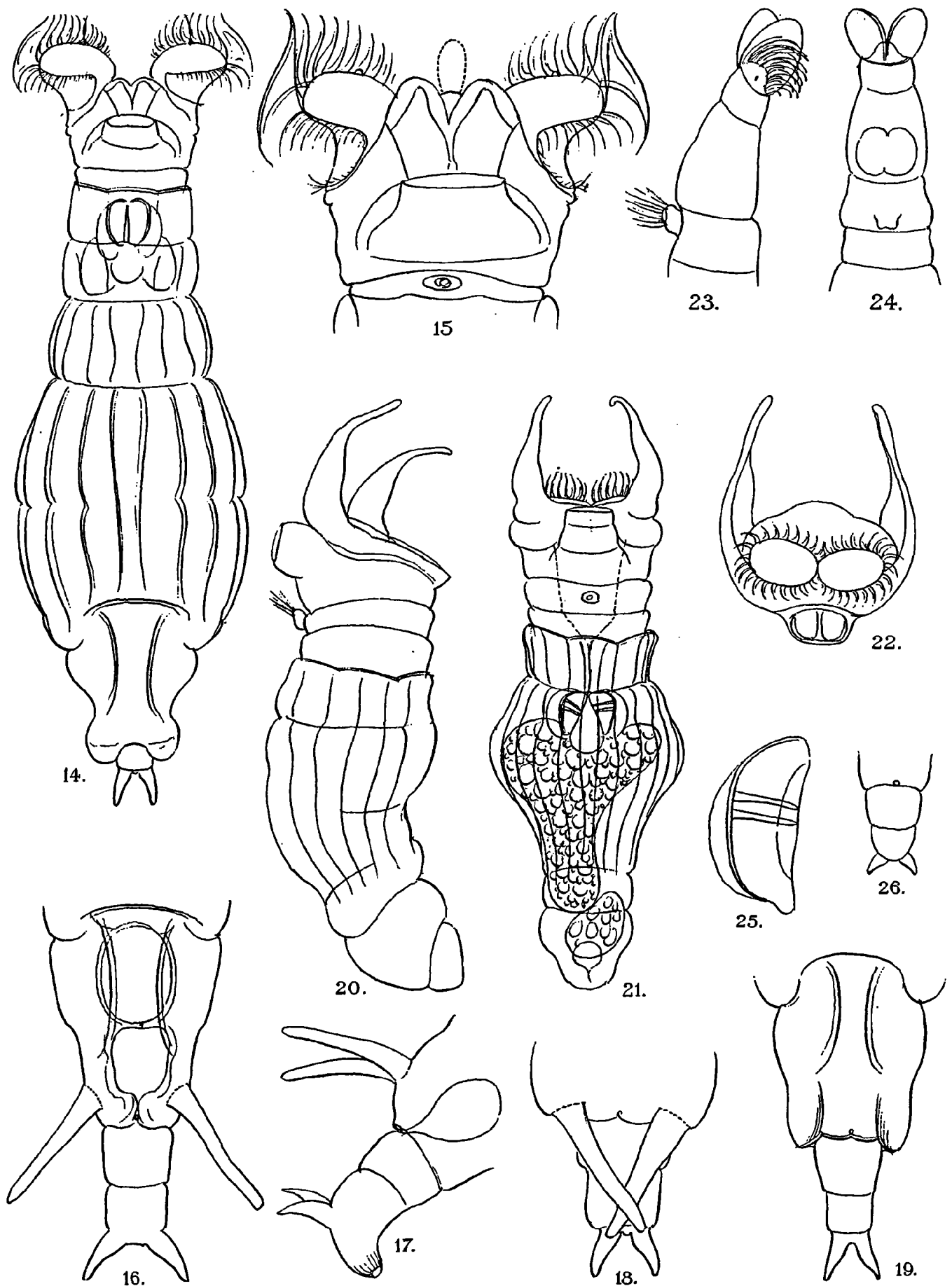
- |   |   |
|---|---|
| 14. <i>Callidina plicata</i> , Bryce, type, feeding.                            | 20. <i>Callidina cornigera</i> , Bryce, side view, feeding. |
| 15. " " head, on larger scale.  | 21. " " dorsal view, feeding.                               |
| 16. " " var. <i>hirundinella</i> , var. nov., rump and foot, showing processes. | 22. " " head, seen from above.                              |
| 17. " " var. <i>hirundinella</i> , side view of foot.                           | 23. " " side view of rostrum, lamellæ, and antenna.         |
| 18. " " var. <i>hirundinella</i> , showing processes crossed.                   | 24. " " dorsal view of rostrum and lamellæ.                 |
| 19. " " foot of variety without flanges on hood.                                | 25. " " jaw.  |
|   | 26. " " foot.   |



J. Murray, del. ad. nat.

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## MURRAY: SCOTTISH ROTIFERS. — PLATE II.



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