

XII.—Scottish National Antarctic Expedition: Tardigrada of the South Orkneys.
By James Murray. *Communicated by W. S. BRUCE.* (With Four Plates.)

(MS. received May 11, 1906. Read May 28, 1906. Issued separately August 31, 1906.)

INTRODUCTION.

While engaged in investigating the Tardigrada of the Scottish Lochs, I was desirous of comparing our Tardigrade Fauna with that of other parts of the world, and it occurred to me that the then recently returned Scottish Antarctic Expedition might furnish some suitable material. On applying to Mr R. N. RUDMOSE BROWN, in the absence of Mr BRUCE, I was courteously supplied with various samples of moss which I judged likely to contain Tardigrada.

On examining this moss it was found that Tardigrada were indeed numerous in it, and although not in very great variety, some of the forms were of considerable interest.

The moss had not been collected with a view to the study of its microfauna, but solely as botanical specimens, and was therefore impregnated with some preservative which had killed all the adult animals and most of the eggs. This is unfortunate from the point of view of the present investigation, as I should otherwise have been able to hatch out the Tardigrada and other animals and study their development. A much more complete account of the Tardigrada could in that case have been given.

Besides Water-Bears and their eggs, there were numbers of Bdelloid Rotifers and eggs, Nematodes of at least two species, Rhizopods, and, lastly, very many Mites of at least four species.

The eggs of the Mites seemed to be most impervious to the preservative, and many hatched out, but were very quickly killed by the trace of the naphthaline in the water. The only other animals seen alive were one Bdelloid of the genus *Rotifer*, and a Nematode, which moved feebly for a short time after moistening.

The adult Tardigrada were in very poor condition, most having been long dead, and the flesh all reduced to a formless paste. In this condition, when the specimens were subjected to pressure, all the details of internal structure were lost, and the most useful method of discriminating species rendered of no avail. Even the tough, hard parts of the teeth and pharynx were partially wasted away. The basal portions of the teeth had in most cases merged in the general paste, though the distal parts were intact. The detail had therefore to be studied under moderately low powers, and without exercising much pressure.

A few examples were in that state of rigor so characteristic of Water-Bears, in which the internal parts are in good order, and may be better studied than in active animals,

and may be subjected to pressure, in order the better to study the details. This state has a curious resemblance to rigor mortis. All vital functions appear to be totally suspended; the animal is rigid, and it is impossible to tell whether it is alive or dead. From this apparently lifeless condition a few taps on the coverslip will often rouse it to full activity. No example of the Antarctic Tardigrada revived in this way. The eggs were in better condition, owing to the protection afforded by their shells, but none of them hatched or showed any movement of the contained embryos. The genera *Macrobotus* and *Diphascon* were very abundant, two species of the latter and several of the former being found. Eggs of *Macrobotus* were also plentiful. *Echiniscus*, on the other hand, was very scarce, only some half dozen examples being found, which did not differ conspicuously one from another, though no two were quite identical.

Fifteen forms in all were studied. Though these were clearly distinct, they were not in all cases recognisable. Only two could be identified with any certainty as known species. Three others were so abundant and in such good preservation that they could be pretty fully studied, and are here described. Some of the others are as certainly distinct from any known species, but the examples being imperfect, it is not considered desirable to name them.

All, however, are figured, so that it will be easy to identify them when further opportunities occur to study the fauna of the region.

Three of the eggs figured may belong to three of the species incompletely described. If this duplication has occurred, the number of distinct species observed will be reduced to twelve.

Genus ECHINISCUS.

The genus was very poorly represented, only some half dozen examples being found, all but two being incomplete skins, and in such bad condition that it is impossible to describe them, though some of them have peculiarities which lead me to think they are new species. The two well-preserved examples were identical, and are, I think, of an undescribed species.

No species belonging to the *Arctomys* group (having no setæ or spines except the six on the head) was found. All four forms observed had some dorsal or lateral processes besides those on the head.

Echiniscus meridionalis, n. sp. (Plate I. fig. 1*a* to 1*d*.)

Specific Characters.—Small, plates ten, arrangement normal; three median plates, each plate of the first pair with two setæ, lateral short, dorsal long, each plate of second pair with two short spines, one lateral, one dorsal, a long incurved seta on each of the anal angles (*i.e.* where tail-piece joins lumbar plate); lumbar plate trifoliate, faceted, fringe on last legs of few (about five), very broad spines; inner claws with small decurved

barbs; head setæ long, with expanded base, and separate palp alongside; palp on first leg, none seen on last leg.

Length of one example $164\ \mu$, of the other $200\ \mu$. Fringe absent from the smaller one, obvious on the larger, no other difference. Both appeared as if they might be alive, but in the state of rigor. They did not, however, wake up. The flesh was not wasted as in all the other Tardigrada found, and I was able to mount them. The colour is yellowish, the granules very small.

On account of variability of the processes of *Echiniscus*, and possible changes in the course of development, Professor RICHTERS advises that no species be described as new unless we have evidence of maturity in the presence of skins with eggs, or there are striking peculiarities of some sort. I have shown, further (2), that even after maturity is reached there may be further development of the processes, as well as great increase in size, during successive moults.

As the eggs have not been seen, this species must be distinguished by the various processes, the arrangement of which does not closely approach any described species. It is nearest to *E. merokensis*, Richters (13), but differs in many little points. That species has the lateral setæ after the first paired plates longer than the dorsal, lacks the lateral short spines after the second paired plates, has a straight spine on the outer claws, and is figured as coarsely granular. Still closer is the resemblance to an undescribed species of which Mr BRUCE made a sketch in Franz Josef Land, but that also has the lateral setæ of the first paired plates longer than the dorsal, has lateral setæ instead of short spines at the second paired plates, etc.

The lumbar plate of *E. meridionalis* has five facets, one dorsal, two lateral, and two posterior (forming the tail-piece), and the species figured by Mr BRUCE corresponds in this respect.

Echiniscus, sp. (Plate I. fig. 4.)

Specific Characters.—Of medium size, plates ten, arrangement normal, granules small. Processes,—on each plate of first pair a long dorsal seta, and a small one close beside it, on each plate of second pair a small triangular dorsal tooth, on the lumbar plate a pair of very long curved setæ, each with a short branch about the middle, 3 median plates. The species has no close resemblance to any known species, and the peculiar branch, like the tine of a stag's horn, on the curved lumbar seta, might suggest such a name as "the Stagshorn *Echiniscus*" (*Cervicornis*). As, however, the study is so incomplete, and the head and legs have not been seen, so that we know nothing of the head setæ, fringe, or claws, it would be premature to give the form a name. I know of no species described which has branched setæ, though *E. Duboisi* (8) has serrate spines.

Echiniscus, sp. (Plate I. figs. 2a, 2c.)

Description.—Plates nine, normally placed, two median, finely granular, lumbar plate trifoliate, fringe on fourth legs, inner claws with small decurved barb. Processes,—on each plate of first pair a long dorsal and a long lateral seta, on each plate of second pair a small dorsal, triangular tooth, a pair of long curved setæ on the lumbar plate.

This animal has no very marked peculiarities, and till it is more fully known it cannot be determined whether it is identical with or related to any described species. These *Echiniscus* skins, in poor condition, may have lost some setæ which they possessed in life, and it would therefore be hazardous to attempt to identify them in their present state. No species described precisely agrees with it.

Echiniscus, sp. (Plate I. figs. 3a, 3b.)

Description.—Small, nine plates, two median. Processes,—lateral seta on each plate of first pair, no processes on second pair, pair of long setæ on lumbar plate. Granules of moderate size, interrupted at the line of junction of the tail-piece with the lumbar plate, which is deeply trifoliate. Fringe of broad spines on fourth leg, no barbs seen on any claws. No dorsal processes.

This species also has no conspicuous peculiarity. It is the only *Echiniscus* I have seen in which there is a line free from granules at the base of the tail-piece, though RICHTERS gives this character for several species. I am not inclined to put much value on this feature for specific distinction, as I think it likely it may be an age-mark.

In species of *Echiniscus* destitute of dorsal processes, the lateral processes are usually also absent, except on the head. The possession of lateral setæ, with lack of all dorsal processes and barbs on the claws, and the interruption of the granulation at the base of the tail-piece, sufficiently distinguish this from all previously described species. If the example is young, it may be that the species acquires dorsal processes and barbs at later moults.

The setæ and spines of *Echiniscus* tend to increase in length at each moult, and new ones may appear, while the straight barbs of the outer claws, in those species which possess them, sometimes appear only at a late stage. The decurved spines or barbs of the inner claws, present in the great majority of species, appear, on the other hand, to be of more importance to the larva, and are generally reduced in size in the adult.

Genus MACROBIOTUS.

Animals of this genus were extremely numerous, and several species of both sections were found. In the first section the eggs are laid free and singly, and are covered with processes. Three distinct eggs indicated as many species belonging to this section, but

in only one of these species did I succeed in connecting the egg with the animal which produced it. The others must remain unidentified till the living animals can be studied.

In the other section the smooth oval eggs are deposited several together in the moulted skin, and here again, though several species were seen, only one could be fully studied, and that appears to be a hitherto undescribed species.

In all the species figured it will be noticed that the pharynx is relatively extremely small. The size of the pharynx has been used by authors as a specific character. Of little service at any time, owing to variability, the size of the pharynx is quite valueless in the case of the South Orkneys species. In these, I think, the muscular bulb is greatly contracted.

A. SPINY EGGS, LAID SINGLY, FREE, NOT IN THE MOULTED SKIN.

Macrobiotus furcatus, n. sp. (Plate II. figs. 6a to 6d.)

Specific Characters.—Large, hyaline, in form like *M. hufelandi*, with claws in pairs, which are united half way up as in that species, but with stronger supplementary points. Teeth slightly curved, with a small furca. Pharynx very small, oval or rhomboid, thickenings in each row,—first, short nut next gullet, then three equal rods, about twice as long as broad, then a very obscure small nut. Dark eyes. Eggs spherical, with conical processes, which are dichotomously branched twice or thrice. Length about 600 μ , pharynx of adult 46 μ long.

By far the most abundant Tardigrada collected. The eggs were still more numerous than the adults. By squeezing one fully developed young out of the egg, I was able to establish the identity of structure both of claws and pharynx with the commonest adult *Macrobiotus* in the collections.

This species may be regarded as the South Orkney representative of *M. hufelandi* (14), with which it has affinities in all points of structure. The processes on the egg are most conspicuously different, yet their form is the same, only they are dichotomously divided at the apex. Most of the processes are twice furcate, with slight traces of a third division. Some have a perforation lower down than the first fork. The egg measures 83 μ without the spines, 105 μ over the spines. The pharynx differs in the complete separation of the first two rods, which in *M. hufelandi* are almost joined. The pharynx is relatively much smaller, but it is probably much contracted.

The claws are very similar to those of *M. hufelandi*, but the supplementary points are almost as large as the main claw. I could never see clearly two distinct supplementary points on the same claw, as RICHTERS found to be the case in *M. hufelandi*; but the appearance in optical section (fig. 6c) supports the belief that there are two here also. Owing to diffraction effects the true form of supplementary points on the claws of *Macrobiotus* is difficult to make out.

The processes of the egg have a very remote resemblance to those of *M. granulatus*,

Richters (9), but this does not indicate any affinity whatever, as the entire organisation is different. The processes in that species are divided into several points, but they are not dichotomous.

Macrobiotus echinogenitus, Richters. (Plate IV. figs. 14a and 14b.)

A single egg, the largest seen, might belong to this extremely variable species, but no adult animal at all resembling *M. echinogenitus* in structure was found.

The egg measures 102 μ without the spines, 120 μ over the spines.

The processes are conical, with rounded tops. They are not unlike those figured by Plate as the egg of *M. hufelandi* (5).

It is only on account of the great variability of the egg of *M. echinogenitus*, in size as well as in the form of the processes, that I for the time being include this large egg under that species. I expect to find that the animal which produces this egg is a distinct species.

In a previous paper (4) dealing with *M. echinogenitus*, I was led by an error in translation to entirely misrepresent Professor RICHTERS' work on this species and *M. hufelandi*.

In reading his original description (9), I understood Professor RICHTERS to say that the two species were so close that they could only be separated by the totally different form of their eggs, and so omitted to read carefully the remainder of the description, in which he shows that both claws and pharynx are quite different in the two species. The claws of *M. hufelandi* are joined for half their length, those of *M. echinogenitus* form a V, jointed only at the bases. The pharynx of *M. echinogenitus* is variable, presenting three distinct forms, each associated with a different size of egg. If other species, as is likely, have also series of distinct forms of pharynx, the value of this otherwise excellent character for specific distinction is lessened. Everything has yet to be learned as to the cause and meaning of this variation, especially of the remarkable 'simplex' form.

I have seen hatch from a sufficiently typical *hufelandi* egg an animal with a pharynx like one of the forms figured by RICHTERS for *echinogenitus* (13, Plate 16, fig. 16).

The claws appear to be the least variable structures of *Macrobiotus*, and by their form *M. hufelandi* and *M. echinogenitus* can be most readily distinguished.

Macrobiotus, sp.? (Plate IV. figs. 15a to 15c.)

This species we only know from the egg, the very distinct structure of which indicates a good species, but none of them contained a fully developed young, so the identification could not be completed. The processes consist each of a hemispherical base, from the summit of which rises a pair of ovate bodies resembling leaflets, which meet below and diverge above. The egg measures 80 μ without the processes, and 95 μ over them.

The furcate process has some resemblance to that of *M. furcatus*, but the larger base and the definite form of the leaflets leave no doubt that it is distinct. Very few examples were seen.

Macrobotus, sp. ? (Plate IV. fig. 16.)

Known only from the egg, which closely resembles the last (fig. 15), of which it is possibly a variety. The egg is of the same size, and has processes likewise consisting of a hemispherical base and bifid process. The differences are that the basal part is relatively much larger, and that the divisions of the bifid portion are rounded instead of pointed.

Macrobotus, sp. ? (Plate III. figs. 10*a* to 10*b*.)

Description.—Claws of the *hufelandi* type, but, like *M. furcatus*, the supplementary points are stronger, pharynx round, two nearly equal rods in each row, each about three times as long as broad, teeth curved, no bearers seen.

A large smooth-skinned animal, reaching to 520 μ in length. It may be only a variety of *M. furcatus*. The structure of the pharynx is sufficiently distinct, but this is subject to variation in some species at least, as RICHTERS' *M. echinogenitus* (see *Fauna Arctica* (13)). As there are two spiny eggs unaccounted for, the probability is that this is the animal that lays one of those.

One pair of claws is larger than the other, which is unusual with claws of the *hufelandi* form.

Macrobotus, sp. (Plate III. figs. 9*a* to 9*b*.)

Description.—Claws quite like the last, of the *hufelandi* type, but with stronger supplementary points and one pair larger than the other. The pharynx also, like the last (fig. 10*a*), has two rods in each row. The differences are that the pharynx is elliptical instead of round, and the first rod of each row is longer, narrower, curved, and thinned close to the end of the gullet.

B. EGGS SMOOTH, LAID IN THE MOULTED SKIN.

Macrobotus asperus, n. sp. (Plate II. figs. 5*a* to 5*e*.)

Specific Characters.—Large, dark brown. Claws in two similar pairs, joined only near the base, one member of each pair much longer than the other, and with fine supplementary point. Teeth curved, with bearers. Pharynx nearly round, with three short rods in each row of thickenings; rods nearly equal, about twice as long as broad, the first a little shorter. Skin covered on back and sides with somewhat large tubercles, irregularly scattered; ventral side and legs smooth. Eyes dark.

Length up to 600 μ , pharynx (of small example) 50 μ long; claws 24 μ to 34 μ ; those of first legs shortest and of last legs longest.

The granules or tubercles were hemispherical, and appeared of soft texture. Owing to their bad state of preservation, nothing could be inferred from this as to their original condition.

The previously described tubercled species of *Macrobotus* are *M. tuberculatus*, *M. sattleri*, *M. ornatus*, *M. papillifer*, *M. annulatus*, *M. granulatus*, *M. crenulatus*.

M. granulatus and *M. crenulatus* are sufficiently separated by the wrinkled or spiny crescent in front of each pair of claws. *M. tuberculatus*, *M. sattleri*, *M. papillifer* by the large size of the tubercles, which are symmetrically arranged in longitudinal and transverse rows. There remain only *M. annulatus* and *M. ornatus*, which have the tubercles relatively small. *M. annulatus* has the tubercles very regularly spaced, falling into definite transverse annulæ, following the segments, and extending also over the ventral surface.

M. ornatus, var. *verrucosus*, has the thickenings in the pharynx of a different form, that of nearly round nuts. The ill-understood *M. oberhäuseri*, of which such conflicting accounts are given, is sometimes, according to RICHTERS (10), partly papillose. *M. asperus* may be distinguished from it by the structure of the claws. Both pairs are alike, with one of each pair nearly twice as long as the other. *M. oberhäuseri* has the elongate claw on only one pair on each foot. From all of those species there are other differences which it is needless to detail. Fairly abundant when the mosses were first examined, no example has been found recently. The skins which I tried to preserve became quite collapsed, shapeless, and unrecognisable.

Macrobotus, sp. (Plate III. figs. 7a to 7d.)

Description.—Large, very similar in claws and pharynx to *M. asperus*, but skin not granular. One pair of claws is a little larger than the other. The teeth are nearly straight, but abruptly bent near the throat; their bases diverge widely. Four eggs were found in one skin. It reaches 570 μ in length.

Macrobotus? sp.? (Plate III. figs. 8a, 8b.)

Description.—Small, claws of two pairs joined only at base, smaller pair of nearly equal claws, larger pair with one very long claw. Eggs elliptical, laid in the skin.

As this species is only known from skins containing eggs, the description cannot be completed. The claws are of what I take to be the *oberhäuseri* pattern, not, as originally described (1), quite separate, but joined at the base. This arrangement resembles the *Diphascon* claw, as I understand it, but the mode of union of the two

claws is not quite the same. In all species of *Diphasccon* known to me the long claw appears, when seen from the side, to spring from the middle of the shorter claw. This animal may be a *Diphasccon*.

Genus DIPHASCON (5).

Two species only were distinguished, and both were identified as known species, though they possessed some little peculiarities.

The genus rests on slight and doubtfully stable characters. The elongated, flexible portion of the gullet, intervening between the teeth stays and the pharynx, is the sole character on which Plate (5) founded the genus. None of the recognised species of *Diphasccon* have ever, so far as I am aware, been found without this flexible portion, though *D. angustatum* has this portion very short and only slightly flexible. None of the six species known to me would, if deprived of the flexible gullet, be rendered identical with any species of *Macrobotus*.

Some species of *Macrobotus*, on the other hand, exceptionally develop the flexible gullet. I have seen *M. macronyx* and *M. ornatus* in this condition.

In view of this one character, then, the species of *Diphasccon* would be only those in which there is normally a long flexible gullet, which *Macrobotus* might exceptionally have. In that case the genus would have to be abandoned, as was necessary with *Doyeria*.

All the species of *Diphasccon* have one very elongate claw on each foot. This is also a characteristic of *M. oberhäuseri*. The long claw and one short claw of that species are said to be quite separate and independent. I have seen no species in this condition.

In *Diphasccon* the pair of short claws are united at the base. The pair to which the elongate claw belongs are also joined, but not at the base. Seen from the side, under pressure (Plate IV. fig. 17), the long claw seems to be joined to the back of the short one half way up the latter. If this structure of claws proves to be distinct from that of *M. oberhäuseri*, it may be possible to retain the genus on this character.

Diphasccon chilense. Plate (5). (Plate IV. figs. 12a to 12c.)

Specific Characters.—Small, short, broad; one pair of claws equal, the other with one longer claw, having small supplementary point. Teeth small, curved, with bearers, gullet slender, pharynx round, rods five in each row, short, scarcely separate.

Size, up to 240 μ long. The number of nuts in the pharynx is subject to variation, but they are always sub-equal, short, roundish, and touching, or nearly so. It is relatively the broadest of the genus (except *D. bullatum* (3)). The S. Orkney examples are much contracted, and this affects the breadth more than the length, so that they appear narrower than usual.

Diphascon alpinum, Murray (4). (Plate IV. figs. 11a to 11c.)

Specific Characters.—Long, narrow, whitish or hyaline; one pair of claws, short and very thick, with conspicuous short supplementary point on one claw, the other pair with one very long claw, having a fine supplementary point. Teeth short, curved, with bearers; gullet very long, slender, pharynx shortly oval, three rods and a short nut in each row. The rods increase both in length and thickness from the first to the third, which is about three times as long as broad.

The S. Orkney examples are much larger than the Scotch ones, reaching 360 μ in length. The only other difference is the fourth small nut in the rows of pharyngeal thickenings. This little nut at the end of the row is in many species of Tardigrada very obscure, very doubtfully of the same structure as the other rods, and at any rate of too uncertain a character to be regarded as of any specific value.

NOTES.

Taking a general view of the preceding somewhat meagre list of Tardigrada, the most striking feature of it is its very slight correspondence with the Tardigrada fauna of other parts of the world. It differs not only from the fauna of the temperate regions, which we know best, and from that of the arctic region, which has been pretty well studied, but from that of the only other part of the antarctic region which has been studied (12); indeed it differs more from the last than from the others.

Every one of those regions has a number of peculiar local species, mingled with others which are widely distributed.

Only two of the S. Orkney water-bears have been identified, and a third doubtfully. We cannot, however, suppose that we have anything like a complete, or even a fair, knowledge of the Tardigrada of the South Orkneys. The fifteen forms enumerated were obtained practically from one large tuft of moss. A second minute scrap yielded only a few examples, which were of species plentiful in the larger sample. If mosses from a variety of situations could be examined in the fresh condition, it is likely that others of the widely distributed kinds would be found, as well as perhaps still other local species.

The Tardigrada would appear to be best adapted to live in temperate or cold regions. They are very numerous in Scotland; in Spitzbergen they are also plentiful and the largest known species are found; while in the only parts of the southern hemisphere which have been studied, the Tardigrada are a conspicuous element in the moss-fauna.

A large series of samples of moss from India has been recently examined for Tardigrada, and though some of them came from elevations of 7000 to 8000 feet, near Darjeeling, and there were a few peculiar species, they were, on the whole, very scarce.

No doubt, with fuller information as to the many species here referred to as "doubtful," several could be referred to known species, though several others are almost certainly

distinct. In the case of *Macrobotus* which lay spiny eggs, the presence of a known species is generally first indicated by the eggs. It is notable that in the S. Orkney moss no single example of such unmistakable eggs as those of *M. hufelandi*, *M. intermedius*, and *M. echinogenitus* (type) was seen.

The South Orkneys are situated outside the Antarctic Circle, but within the ordinary limits of drift ice. I have found only one record of a Tardigrada from within the Antarctic Circle, viz. *Macrobotus antarcticus*, found by Professor RICHTERS in moss from the Gaussberg.

In the collections made by the German South-Polar Expedition on various islands in the Southern Ocean, Professor RICHTERS has found altogether eleven species, viz. *Macrobotus hufelandi*, Sch., *M. oberhäuseri*, Doy., *M. tetradactylus*, Greeff, *M. intermedius*, Plate, *M. sattleri*, Richters, *M. echinogenitus*, Richters, *M. vanhoeffeni*, Richters, *M. antarcticus*, Richters, *Echiniscus arctomys*, Ehr., *E. kerguelensis*, Richters, *E. sp.?* (not yet named). To this list I understand Professor RICHTERS will make some additions in a more detailed memoir to be published at an early date. EHRENBERG recorded a *Macrobotus* from St Paul Island as doubtfully *M. hufelandi*.

The meagre materials available for the study of the Tardigrada of the Southern Ocean are still sufficient to indicate a Tardigrada fauna comparable for variety with that of the arctic regions, though the species yet known are not quite so numerous.

LITERATURE CITED.

- (1) DOYÈRE, *Ann. d. Sci. Nat.*, ii. Ser., 1839, T. 14, p. 286.
- (2) MURRAY, JAMES, "Tardigrada of the Scottish Lochs," *Trans. Roy. Soc. Edin.*, vol. xli., 1905, pp. 677-698.
- (3) " " "Tardigrada of the Forth Valley," *Ann. Scot. Nat. Hist.*, 1905, p. 160.
- (4) " " "Scottish Alpine Tardigrada," *Ann. Scot. Nat. Hist.*, 1906, p. 25.
- (5) PLATE, L. II., "Naturgeschichte der Tardigraden," *Zool. Jahrb.*, Bd. iii., *Morph. Abt.*, 1888, pp. 487-550.
- (6) RICHTERS, F., *Ber. Senckenbg. Natf. Ges.*, 1900, p. 40.
- (7) " " "Fauna der Umgebung von Frankfurt-a-M.," *Ber. Senckenbg. Natf. Ges.*, 1902, pp. 8-13.
- (8) " " "Neue Moosbewohner," *Ber. Senckenbg. Natf. Ges.*, 1902, pp. 23, 24.
- (9) " " "Nordische Tardigraden," *Zool. Ang.*, Bd. 27, 1903, p. 168.
- (10) " " "Eier der Tardigraden," *Ber. Senckenbg. Natf. Ges.*, 1904, p. 59.
- (11) " " "Verbreitung der Tardigraden," *Zool. Ang.*, Bd. 28, 1904, p. 347.
- (12) " " "Vorläufiger Bericht über die Antarktische Moosfauna."
- (13) " " "Fauna Arctica," Bd. iii., 1904, pp. 495-508.
- (14) SCHULTZE, C. A. S., "Macrobotus hufelandi," *Isis of Oken*, 1834, p. 708.

EXPLANATION OF PLATES.

PLATE I.

1. *Echiniscus meridionalis*, n. sp.
a, lateral view.
b, dorsal view.
c, last leg, with fringe.
d, outer and inner claw of last leg.

2. *Echiniscus*, sp. ?
a, dorsal view.

b, outer and inner claw of last leg.

3. *Echiniscus*, sp. ?
a, dorsal view.
b, outer and inner claw.

4. *Echiniscus*, sp. !

PLATE II.

5. *Macrobiotus asperus*, n. sp.
a, lateral view.
b, dorsal view.
c, claws, seen from front.
d, claws, seen from side.
e, teeth and pharynx.

6. *Macrobiotus furcatus*, n. sp.
a, dorsal view.
b, teeth and pharynx, under pressure.
c, claws.
d, furca of tooth.

PLATE III.

7. *Macrobiotus*, sp. ?
a, dorsal view.
b, teeth and pharynx.
c, claws.
d, larger pair of claws.

8. *Macrobiotus*, sp. ?
a, skin with three eggs.

b, claws of 4th leg.

9. *Macrobiotus*, sp. !
a, gullet and pharynx.
b, claws.

10. *Macrobiotus*, sp. !
a, teeth and pharynx.
b, claws.

PLATE IV.

11. *Diphascum alpinum*, Murray.
a, dorsal view.
b, teeth and pharynx.
c, the shorter pair of claws.
d, claws of 4th leg.
e, longer pair of claws.

12. *Diphascum chilense*, Plate.
a, dorsal view.
b, teeth and pharynx.
c, claws.

13. *Macrobiotus furcatus*, n. sp., egg.
a, complete egg.
b, three of the furcate processes, from the side.
c, two processes, seen from above.

14. *Macrobiotus echinogenitus*, Richters ?

a, the egg.
b, one process.

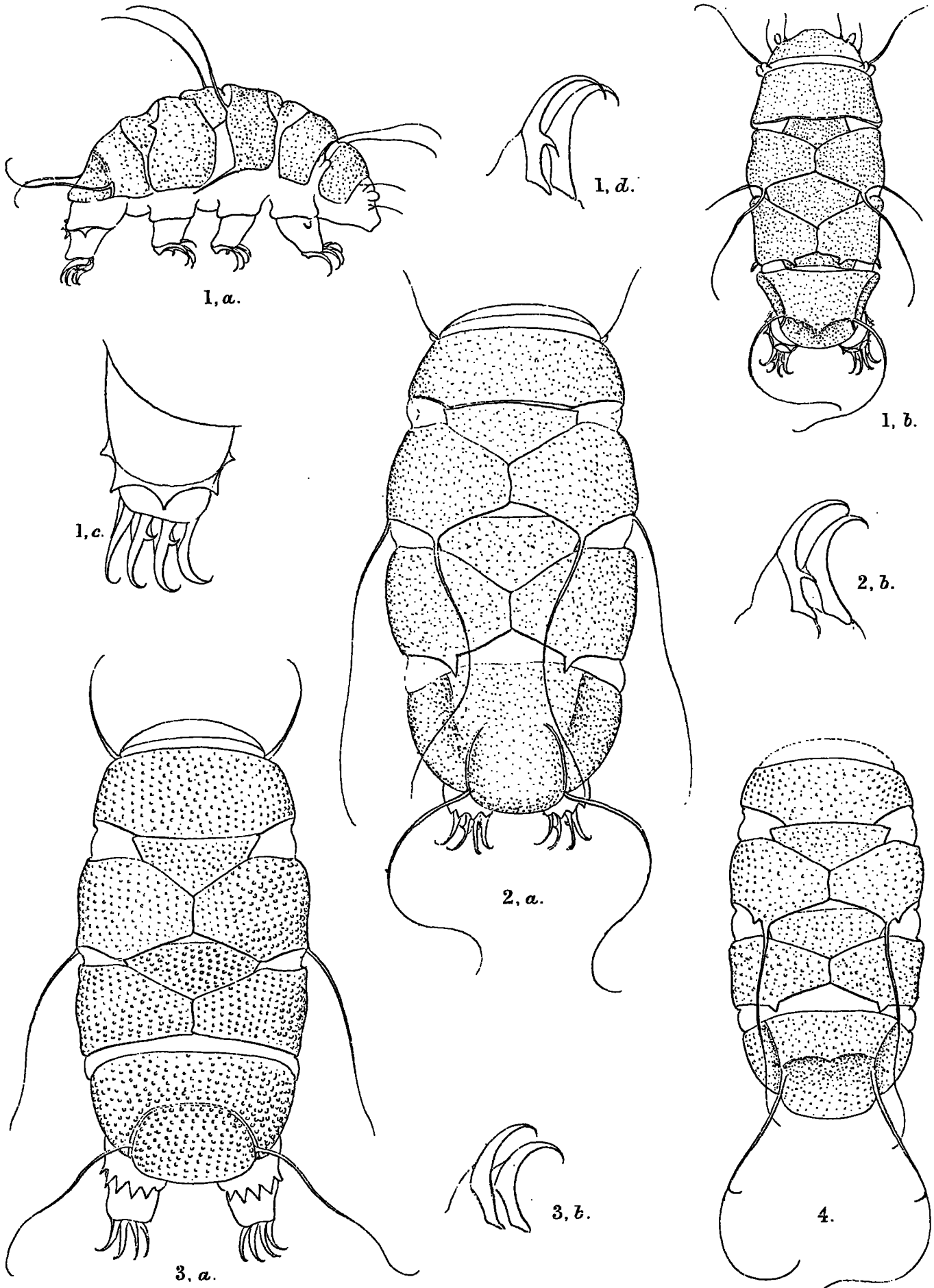
15. *Macrobiotus*, sp. ! egg.

a, the egg.
b, a process, lateral view.
c, a process, seen from above.

16. *Macrobiotus*, sp. ? egg, process.

17. *Diphascum*, long pair of claws of an undescribed species.

MURRAY: TARDIGRADA OF THE SOUTH ORKNEYS. — PLATE I.

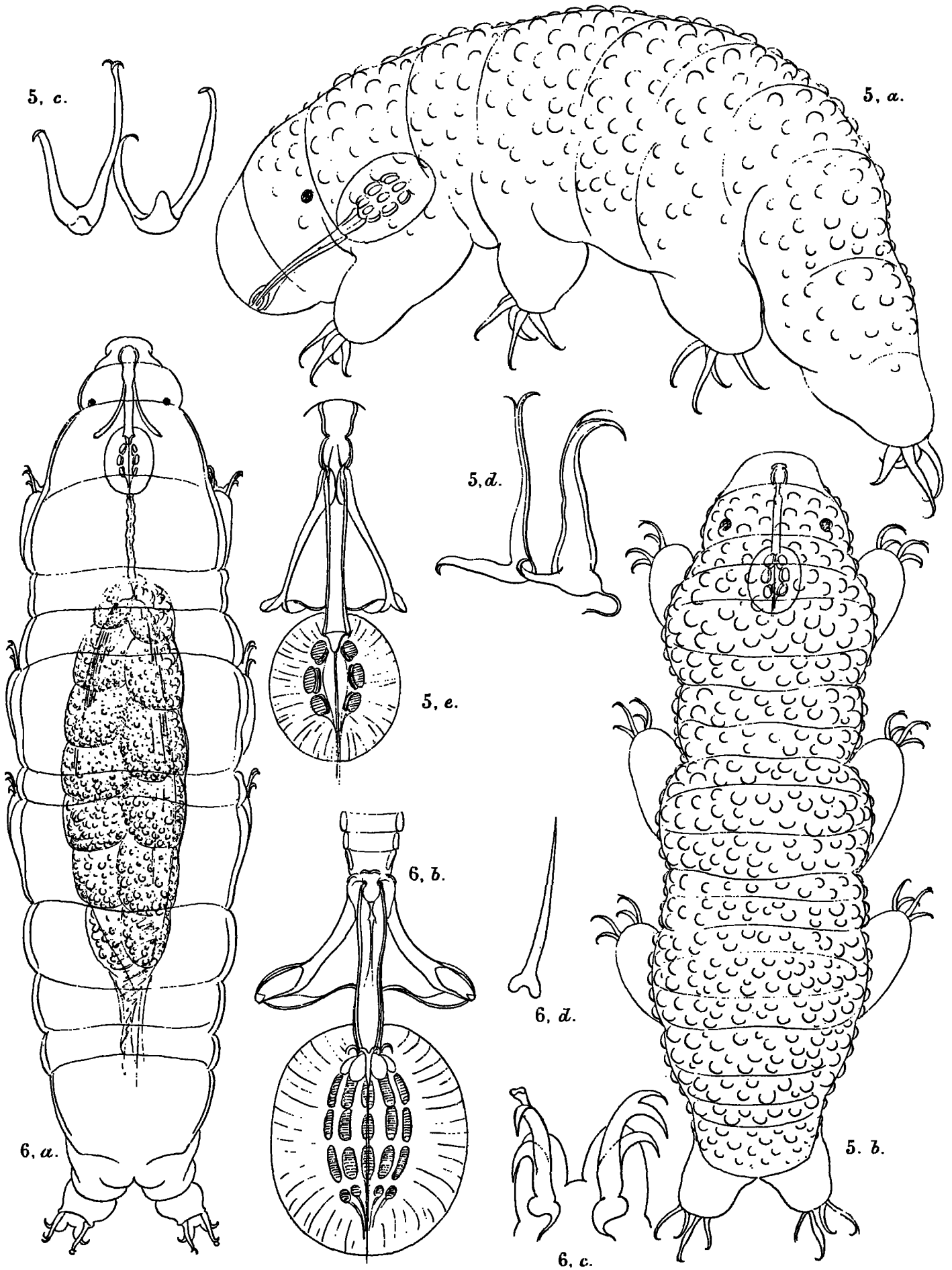


1. ECHINISCUS MERIDIONALIS, n. sp.

2, 3, 4, ECHINISCUS, sp. ?

Printed by James Macmillan & Co. Edinburgh.

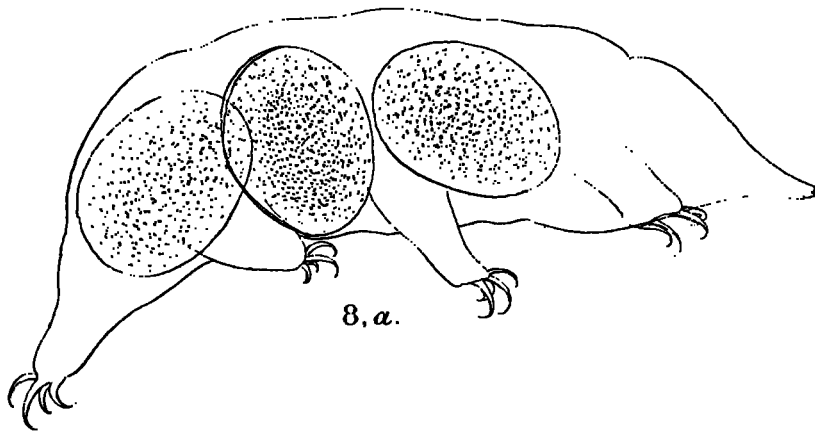
MURRAY: TARDIGRADA OF THE SOUTH ORKNEYS. — PLATE II.



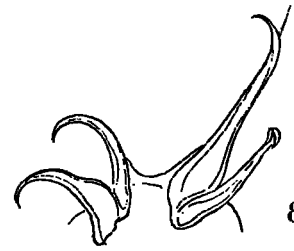
5, MACROBIOTUS ASPERUS, n. sp.

6, MACROBIOTUS FURCATUS, n. sp.

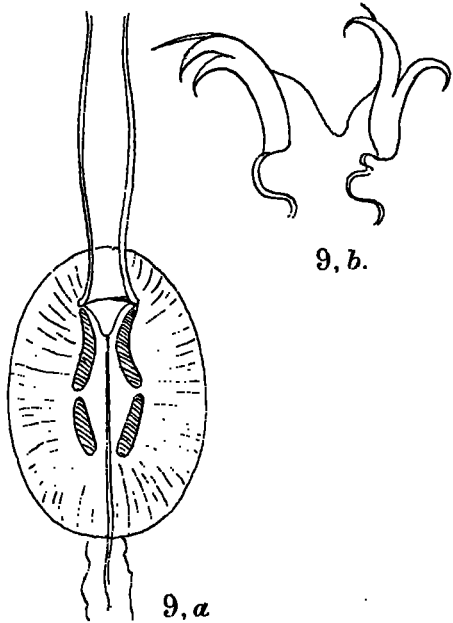
MURRAY: TARDIGRADA OF THE SOUTH ORKNEYS. — PLATE III.



8. a.



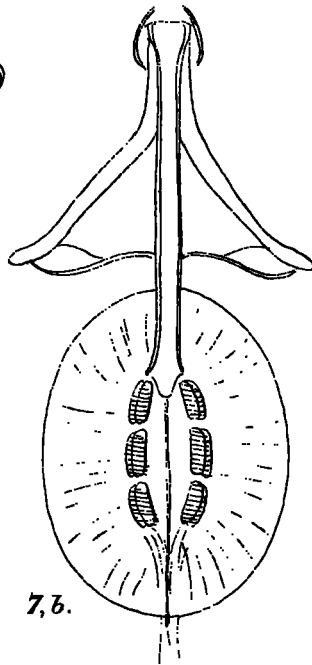
8. b.



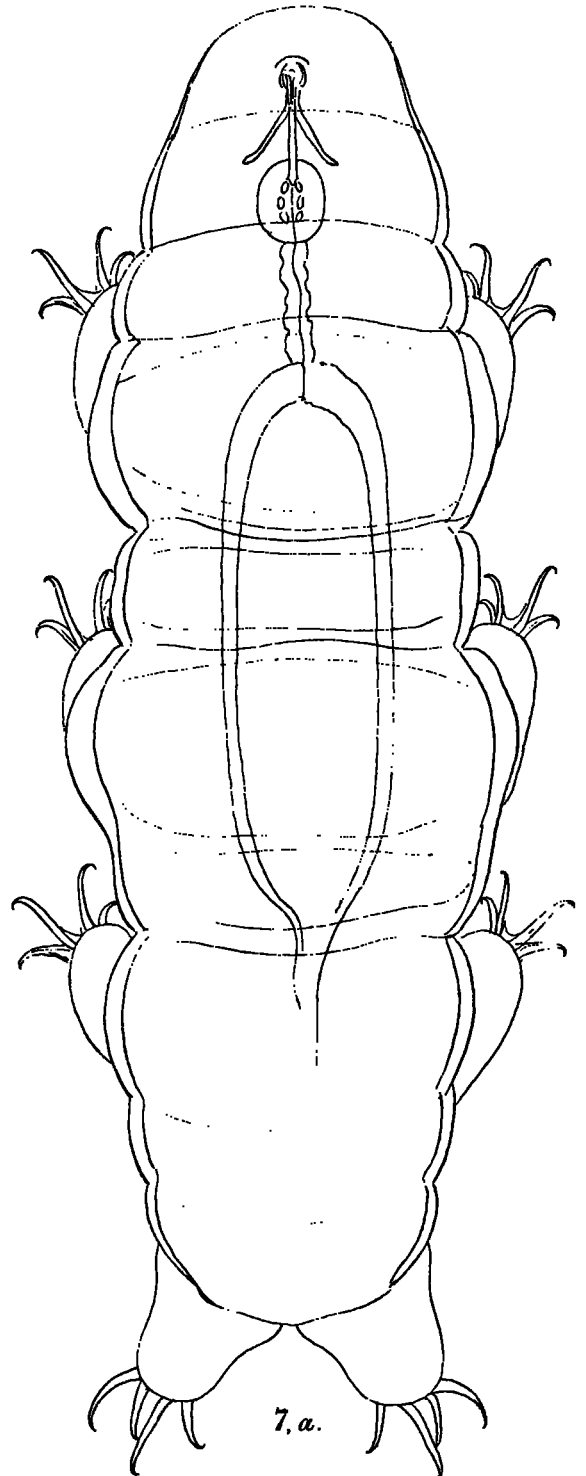
9. a.



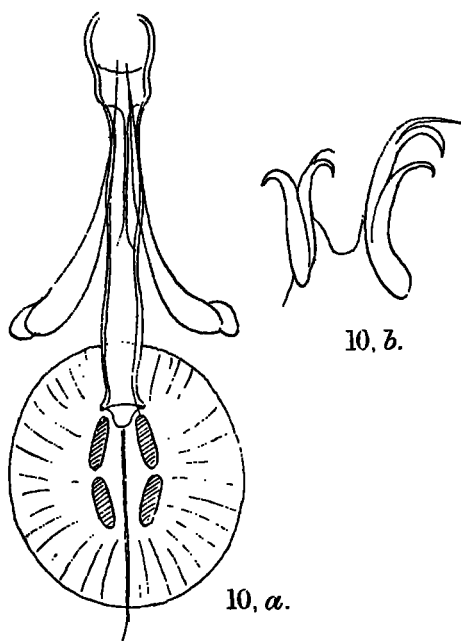
9. b.



7. b.



7. a.



10. a.



10. b.

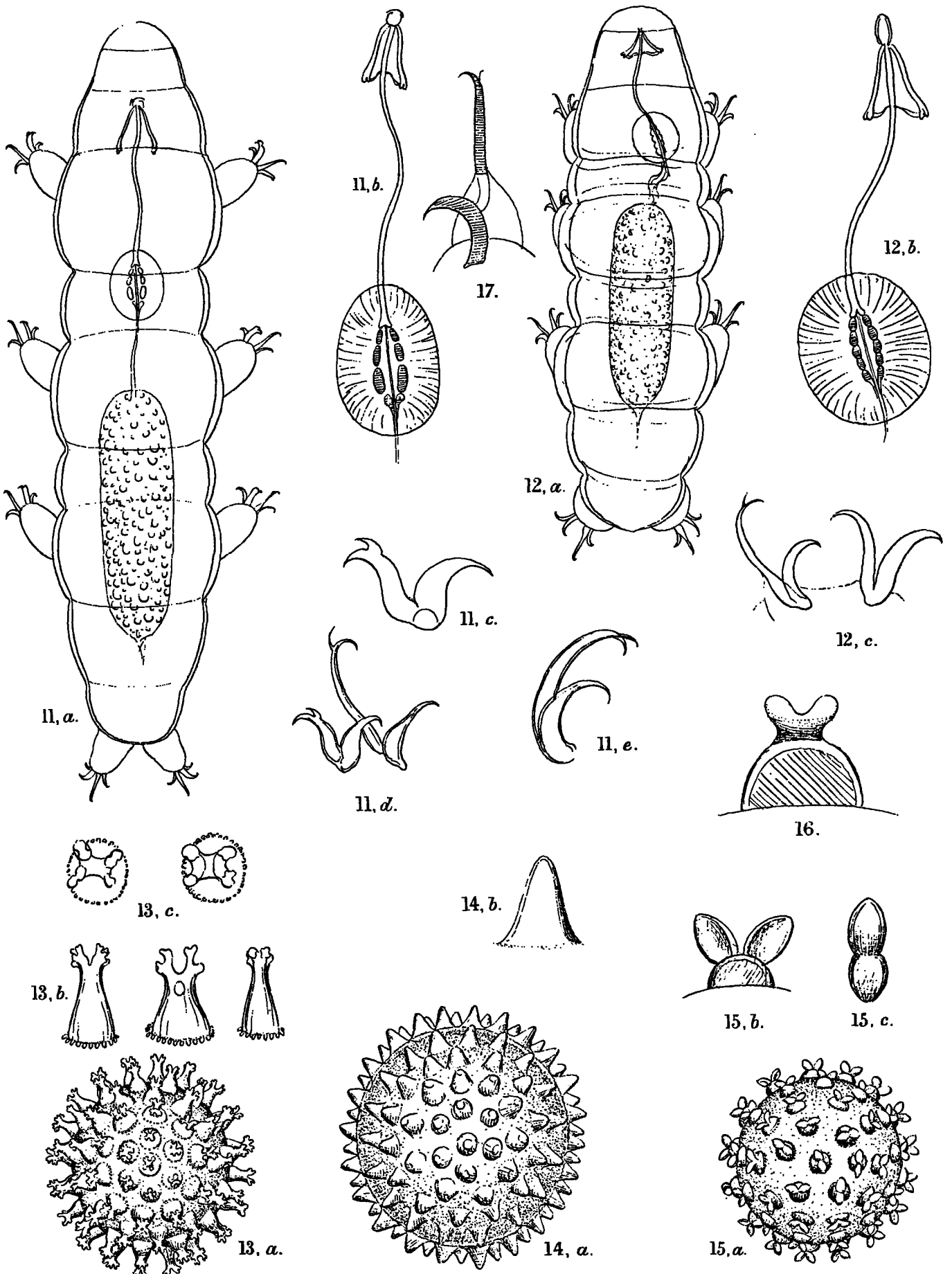


7. c.



7. d.

MURRAY: TARDIGRADA OF THE SOUTH ORKNEYS. — PLATE IV.



M^r Forlano & Krantz, Lith. Edin^r

11, DIPHASCON ALPINUM, Murray. 12, D. CHILENENSE, Plate. 13, MACROBIOTUS FURCATUS, n. sp.
14, M. ECHINOGENITUS, Richters ? 15.16. MACROBIOTUS, sp. ? 17, DIPHASCON, sp.