Part 37. Arctiscoida
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ARCTISCOIDA.

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Plates I–III.

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Order **ARCTISCOIDA** Schultze (**27**).*

Family **Xenomorphidae** Perty (**18**).

(Water-bears : Tardigrada).

Introduction.

The name **Arctiscoida** is here employed for the group of animals popularly known as Water-bears. Prof. Hay (**7**) showed that the long familiar name **Tardigrada** was preoccupied, and that the earliest known name applied to the family was **Xenomorphidae** Perty (**18**). As the group is of higher than family rank, I have recently suggested (**17**) the adoption of Schultze's name **Arctiscoida** (**27**) as an ordinal name (although it was given as a family name subsequent to Perty's), retaining Perty's **Xenomophidae** for the only family at present in the group.

The word **Arctiscoida** is of suitable form for an ordinal name, and embodies the first generic name, Arctiscon Schrank (**25**), ever applied to a Water-bear.

Historical sketch.—Irish Water-bears appear to have no history. I can learn of no records previous to the commencement of the work of the Clare Island Survey.

Various naturalists employed on the Survey have assisted me by collecting material. In September, 1909, Dr. Penard brought to me some Sphagnum and other mosses, from which I obtained the first Irish Water-bears, *Macrobiotus echinogenitus* and *M. augusti*. The latter species has not been found in any subsequent collections.

In February, 1911, Mr. A. D. Cotton sent mosses from Belclare, among which there were found eight species of Water-bears.

In March, 1911, I spent about a week in the district, and collected thirty-

* Figures in thick type, enclosed in parentheses, refer to the Bibliography at the end.

one species. Mr. G. H. Wailes, who was working the district at the same time, called my attention to any Water-bears which occurred in the material he collected, and thus extended our knowledge of the local distribution. Subsequently Mr. Wailes sent moss from the island of Inishturk, and from a salt-marsh on Clare Island, both of which gave good results, the salt-marsh yielding the type of one of our new species (*Macrobiotus richtersii*).

Lastly, the school-children of Westport collected quantities of moss, which were sent to me by Rev. J. O. Hannay, M.A. The Canadian species *Macrobiotus occidentalis* occurred only in that collection.

Notes on the Species.

Echiniscoides sigismundi (Schultze). (Plate II., figs. 8A–8B.)

Habitat.—Among the sediment washed from sea-weeds, under Achill Bridge; one example.

The Irish example shows some small differences from those figured by Schultze (**28**) and Richters (**24**). Length 230μ, exclusive of fourth legs. Body soft, not plated, with fine pellucid papillae on back and sides. Claws nine on first leg, eight on second and third, seven on fourth. Two pairs of palps near the mouth. Spine at base of head (corresponding to seta *a* of Echiniscus) large, about 25μ long, with a palp at its base. Spine on third leg with thick base. Fourth leg with a very large soft palp near its base. Web joining the claws for nearly half their length. Movements very sluggish.

Echiniscus intermedius Murray. (Plate I, figs. 4A–4B.)

Habitat.—Castlebar, among Cinclidotus from the margin of a little lake near the railway station; several examples.

The Irish animal agrees with the Canadian form of the species in almost all details. The palps near the mouth, and also the papillae bearing the mouth-cirri, are very short and broad. The finding of the species alive permitted fuller study of the parts of the mouth and of the texture of the plates than had been previously possible. The teeth possess "bearers" (fig. 4A), as was first noticed by Herr Thulin, of Lund, Sweden, who recently found the species. It is the only Echiniscus known to have bearers.

The plates bear two kinds of dots,—one kind very small, uniform, and pellucid,—the other larger, irregular, and looking like pits (fig. 4B). The larger dots appear to be superficial; and it is necessary to focus deeper to see the others.

Distribution.—Australia, Hawaii, Canada, Sweden, Ireland

List of Species Collected, with Local Distribution.

	Achill Is.				Clare Is.								
	The Sea.	Moss.	Slievemore.	Tarn on Slievemore.	Moss.	Croaghmore.	Salt Marsh.	Inishturk.	Lonisburgh.	Belclare.	Westport.	Castlebar, lake.	,, moss.
*Echiniscoides sigismundi (*M. Sch.*) (28),	×												
Echiniscus suillus *Ehr.* (4),			×	×				×		×			
*E. intermedius *Murray* (15),												×	×
E. gladiator *Murray* (11),			×										
var. exarmatus *Murray* (13),			×		×	×		×		×			
E. granulatus (*Doy.*) (1),													×
*E. testudo (*Doy.*) (1),												×	
*E. crassus *Richters* (22),												×	
*E. militaris *sp. n.*,												×	
*E. columinis *sp. n.*,			×										
Milnesium tardigradum *Doy.* (1),			×						×		×		×
Macrobiotus hufelandii *C. Sch.* (26),		×	×		×	×		×	×	×	×	×	×
M. echinogenitus *Richters* (21),		×		×					×	×			
M. crenulatus *Richters* (21),			×	×		×							
M. harmsworthi *Murray* (14),		×	×					×			×		
*M. occidentalis *Murray* (15),											×		
M. areolatus *Murray* (15),				×									
*M. richtersii *sp. n.*,							×						
variety with rounded processes,									×				
*M. virgatus *Murray* (15),		×		×									
M. intermedius *Plate* (19),		×			×			×		×			×
M. arcticus *Murray* (14),					×			×	×				
M. hastatus *Murray* (13),		×											
*M. hibernicus *sp. n.*,				×									
M. tuberculatus *Plate* (19),										×			×
M. papillifer *Murray* (11),							×						
M. ornatus *Richters* (20),			×	×	×				×				
*M. scabrosus *sp. n.*,					×								
M. annulatus *Murray* (11),					×							×	
M. lacustris *Duj.* (3),				×									
M. augusti *Murray* (13),									×				
M. schaudinni *Richters* (23),			×								×		
Diphascon chilenense *Plate* (19),						×							
D. scoticum *Murray* (10),			×		×					×			
D. angustatum *Murray* (11),			×							×			

* Those marked with an asterisk are additions to the Britannic Fauna.

Echiniscus gladiator Murray.

Type.—One example on Slievemore, Achill, between 1,000 and 2,000 feet.

Variety **exarmatus**.—Abundant on Slievemore, from 1,000 feet to the top, and at all elevations on Clare Island; Belclare. Larvae and skins with eggs frequent.

On mountains the variety is usually found on the higher levels and the type lower down. In Ireland the variety was abundant from sea-level to the highest hills, and the type was extremely scarce.

Echiniscus testudo (Doyère). (Plate II., figs. 7A–7B.)

Habitat.—Among aquatic mosses (Cinclidotus) growing on stones at the margin of a small lake near Castlebar railway station.

The Irish example differs from that figured by Doyère in lacking seta *b*; but Doyère says that most of the specimens obtained in Paris were without this seta (which is now called *b*). The plates are more finely dotted than Doyère shows in his figure. The habitat is different, Doyère's animal living among the moss of roofs, etc., and therefore of the kind that dries frequently. But the water-bears do not strictly confine themselves to certain habitats, and an aquatic species may casually occur in moss, and *vice versa*.

Echiniscus crassus Richters. (Plate I., figs. 2A–2C.)

Habitat.—Among Cinclidotus from the margin of a small lake at Castlebar, extremely abundant.

Adults about 400 μ in length, by 200 μ in width. Seta *a* 80 μ, *b* 155 μ, *c* 220 μ, *d* 150 μ; spine over *c* 50 μ, over *d* 60 μ; claws 30 μ; skin of 250 μ long with three eggs of 60 μ by 50 μ. Larva 160 μ long, exclusive of legs; only lateral seta *a* and *d*, *a* 70 μ, *d* 110 μ; over *c* and *d* curved spines of 25 to 30 μ; claws 20 μ. Dots on plates large circles, each surrounded by a hexagon (fig. 2 C), the largest in middle of plates about 6 μ centre to centre. Upper pair of cirri near the mouth, shaped like spear-heads (fig. 2 B). Three median plates. Fringe of large triangular spines, separated at their bases. Small barbs near base of inner claws.

As Professor Richters gave no figure of his species, the larva and some details are here figured. This is, I believe, the first record of the species outside of Iceland.

Distribution.—Iceland, Scotland (not previously recorded), Ireland.

Echiniscus militaris sp. n. (Plate I., figs. 1A–1C.)

Specific characters.—Small, red. Plates nine, two pairs, two median; dots

small discs, uniform, close together. Lateral processes five on each side—*a* and *b* setae of moderate length, *c* and *d* very long setae, *e* a short, thick spike. Dorsal processes three pairs—over *b* a slender seta, over *c* and *d* very large and thick spines. Fringe on fourth leg of large triangular teeth, separated at their bases. Claws large, with small inner barbs.

Length about 200 μ, exclusive of fourth legs. Seta *a* 50 μ, *b* 50 μ, *c* 100 μ, *d* 150 μ. Seta over *b* 30 μ, spine over *c* 50 μ, over *d* 50 μ. Seta *a* has the usual palp at its base. Lateral and dorsal setae at *b* very fine; setae *c* and *d* with thick bases and very fine points. Spines over *c* and *d* straight, or nearly so, very thick and stout, not flattened, but round. Spine *e* also thick and round, sometimes enlarged in middle. The dots are pellucid discs, almost touching at their bases, in regular rows. They did not seem to be either raised above the general surface, or depressed. None of the plates is crossed by plain bands. The lumbar plate is trifoliate, and obscurely faceted.

The claws measure about 25 μ in length. The larva has not been seen. A skin of 180 μ in length contained two eggs of 60 μ by 50 μ.

Habitat.—Castlebar, among Cinclidotus at margin of small lake near the railway station.

E. militaris is distinguished from all other species by having dorsal setae over *b*, by the extraordinary thickness of the spines over *c* and *d*, and by the stout spike at *e*. Only *E. africanus* has setae over *b*, and it has several pairs of them, and is otherwise very different. *E. bellermanni* and *E. creplini* might be supposed to have spines over *b*; but it is difficult to tell exactly what the figures are intended to show, and at any rate they differ widely from *E. militaris*.

Echiniscus columinis sp. n. (Plate I., figs. 3A–3B.)

Specific characters.—Size moderate, colour red. Plates nine, v and vi joined, two median, dots small, uniform, pellucid. Lateral processes five, all fairly long setae. Dorsal processes two—over *c* a long seta, springing nearer the middle line than the posterior angle of the plate; over *d* a short spine. Fringe on the fourth leg; inner claws barbed.

Length about 200 μ, exclusive of fourth legs; seta *a* about 75 μ; *b*, *c*, and *d* 50 to 60 μ each; *e* 125 μ. Dorsal seta over *c* 80 μ. Fringe of small triangular spines. The setae taper gradually from the base. The dots appear to be flat granules, but they sometimes look like pits.

Habitat.—Summit of Slievemore, Achill Island.

There are only a few Echinisci described which have five lateral setae. *E. scrofa* and *E. quadrispinosus* both possess some additional plates between

the ordinary plates, and the spine over *d* is longer. *E. creplini* has three pairs of dorsal spines. *E. oihonnae* usually has *b* and *d* as spines, but sometimes all five are setae. It has spicules at the bases of the setae, and the outer claws are usually barbed.

In distinguishing *E. columinis* from similar species the position of the dorsal seta over *c*, nearer the middle line than in most species, is an important character.

Echiniscus sp. ?

Three forms occurred which appear to be related to *E. columinis*. Two of them are figured.

First.—Lateral setae *a, c, d, e*; over *c* a moderate spine, over *d* a spicule. A spicule on first leg. This form is not figured, as it is exactly like *E. columinis* (Plate I., fig. 3A), but lacks seta *b*. The animal was mature, as an example was found with two eggs in the skin.

Second.—(Plate I, fig 5.) Lateral setae *a, c, d, e*; over *c* and *d* small spicules. This differs from the *first* form described above in having the dorsal process over *c* reduced to a spicule. The setae *c, d*, and *e* sometimes have bulbose bases. Examples with two and three eggs occurred.

Third.—(Plate I., fig. 6.) Lateral setae *a, c, d*; over *c* a moderate spine, over *d* a spicule. Differs from the type of *E. columinis* in lacking setae *b* and *e*, and the reduction of the dorsal process over *c* to a spine.

All these three forms agree with *E. columinis* in having the dorsal processes over *c* nearer the middle line than in most species. They differ from it mainly in the lack of one or two of the lateral setae, and in the varying proportions of the dorsal process over *c*.

Milnesium tardigradum Doy.

All the Irish specimens closely examined had three points on each of the lesser claws of all legs. It is important to note this, as there may be incipient local races distinguished by the number of points. Often the number of points varies from one to three in the same individual, the first leg having one point, the second and third legs two and three, and the fourth leg three.

Macrobiotus crenulatus Richters.

This arctic species was abundant on the two mountains visited, Slievemore and Croaghmore, at elevations of over 1,000 feet.

Distribution.—Spitsbergen, Franz Josef Land, Orkney, Shetland, Ireland.

Macrobiotus occidentalis Murray. (Plate III., fig. 14.)

Habitat.—Westport, several examples.

Irish examples did not show the rectangular plates, floating in clear fluid between two layers of skin, as in Canada. No eggs were found. The species is recognized from the dotted skin, and the characters of pharynx and claws.

It was ascertained that the dots are arranged in pairs, forming longitudinal, and probably also transverse, rows. The larger paired dots appear elliptical or almond-shaped.

Herr Thulin, of Lund, has just found the species and eggs in Sweden.

Distribution.—Australia, Hawaii, Canada, Sweden, Ireland.

Macrobiotus areolatus Murray.

Apparently rare in Ireland, where it is replaced by *M. richtersii.* Only eggs were seen, in a tarn at about 1,000 feet on Slievemore, Achill.

Macrobiotus richtersii sp. n. (Pl. III., figs. 13A–13H.)

Specific characters.—Large, strongly pigmented; no eyes. Teeth thick; gullet very wide; three narrow rods in pharynx, and a small "comma" distant from the last rod. Claws of *hufelandii*-type, joined for half the length of the longer one, which has two supplementary points. Processes of egg conical, truncate, and slightly expanded at apex; egg-surface between the processes areolate.

Length 750 to 1,000μ. Gullet about 16μ in width. Pharynx shortly oval, 80μ in length; first and second rods about four times as long as broad, third five times as long. The pattern on the egg-surface is symmetrical, and consists of obscure polygons, which appear to have originated as regular hexagons, each divided by a partition into two equal pentagons. The processes are faintly papillose; the expansion of the apex varies in amount, and it is bordered by a circlet of papillae. The egg measures 120μ over the processes, 75μ without them.

M. richtersii is closely related to *M. areolatus*, which is distinguished by the pointed processes of the egg, the claws united at the base only, the absence of comma in the pharynx, and the possession of eyes.

Habitat.—Among *Hylocomium squarrosum* from the salt marsh at Kinnacorra, Clare Island, collected by G. H. Wailes, March, 1911.

Though it had not been described, the species was previously known, and had been found in many places—Loch Morar, Scotland (1904); Uganda (N. D. F. Pearce, 1906); Pretoria, Transvaal (Hewitt, 1910).

Prof. Richters has studied the egg, which he found in material from Samoa, and figured it in the "Moosfauna Australiens,"[1] plate 17, fig. 10. It is therefore appropriate that this species should be named in honour of the naturalist who has done so much to extend the knowledge of the Water-bears.

Variety (figs. 13G–13H).—Processes of the egg shorter, very obtuse, and rounded. Pattern on the shell sometimes exactly as described for the type, sometimes with the polygons further divided by partitions.

Embryo in the egg with the rods of the pharynx short and thick, the length not more than twice the thickness. Adult quite typical. In the embryo, and also in the adult, the middle rod of the pharynx often appears shorter than the other two. This suggested that the animal might be *M. virgatus* Murray, of which the egg is unknown. There are, however, several differences: *M. virgatus* possesses eyes, has no comma, and the claws are much thicker, with larger supplementary points.

Habitat.—Among *Tortula ruralis* growing on the sandy sea-shore at Louisburgh, March, 1911, plentiful.

I have not seen any intermediate forms of eggs between the type and the variety.

M. richtersii is an animal which tends to re-establish faith in the constancy of species of Water-bears. If the adult only were found, it might be identified as one of the forms of *hufelandii* or *harmsworthi*, or some other species; and it would be regarded as one of the puzzling intermediate forms which throw doubt on the validity of species. If the egg only were found, we would suspect close relationship with *M. areolatus*, and no connexion with *hufelandii* and its friends. Really the species is very distinct from both; but we must know both the adult and the egg before we perceive this.

Macrobiotus virgatus Murray.

The occurrence of this recently discovered Canadian species in Ireland is interesting, in view of the fact that two other Canadian Water-bears and a Canadian Bdelloid Rotifer were also found in Ireland. The species is another link between Ireland and the Arctic, as it has been recorded for Franz Josef Land.

Although unfortunately the egg has not yet been discovered, the species has two good marks—the short middle rod in the pharynx, and the very thick claws, thicker than in most species of the *hufelandii*-group.

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[1] Zool. Jahrb. Abt. f. Syst. xxvi, Taf. 17, fig. 10, 1908.

Macrobiotus sp. ? (Plate II., figs. 9A–9B.)

Egg like that of *M. harmsworthi*, with closely set acuminate processes (fig. 9B). Pharynx of young in the egg with two short rods—first twice as long as broad, second quadrate—and no comma; teeth thick; gullet of moderate width; claws not seen.

This might be *M. echinogenitus* Richters *b*; but in that species the pharynx, when so well developed as in the figure, would usually show the comma distinctly.

Macrobiotus hibernicus sp. n. (Plate III., figs. 15A–15C.)

Specific characters.—Size moderate. Claws of Diphascon-type. Gullet slender; pharynx with three short rods. Eggs round or oval, thick-shelled, studded with nail-like rods embedded in a hyaline matrix, the rods arranged in a reticulate pattern.

Egg about 60 μ by 70 μ. The rods have somewhat bulbose bases, are contracted in the middle, and expanded at the end into a broad head like that of a nail. The size of the head varies. The reticulate pattern on the surface is fairly regular, the spaces enclosed nearly circular and about 15 μ in diameter.

The young squeezed out of the egg was 140 μ in length. The gullet is slightly expanded at the end in the pharynx. The rods are nearly equal, about twice as long as broad, and there is a comma. The claws were too small to allow details to be accurately seen. The Diphascon character does not appear to be very pronounced, the pairs being nearly equal, with the long claw of one pair somewhat produced. This shows an approach to the type of *hufelandii*; but it is not safe to take the characters of the claws from the young in the egg, as their development may be incomplete. The teeth and pharynx are fully developed earlier than the claws. Eyes were not seen.

The size of the adult cannot be given, as, although they may have been present in the material, the identity of any adult with the egg could not be proven.

Closely related to *M. arcticus* and *M. hastatus*. Although the observations are incomplete and the adult is unknown, the reticulate pattern on the egg and the three rods in the pharynx sufficiently distinguish *M. hibernicus* from these species. Both of them have only two rods in the pharynx, and the rods on the egg are more numerous and closer together, not forming a reticulation.

Judging by what is known of the related species, it may be expected that

the adult will have the rods in the pharynx relatively longer, and the claws more decidedly of the Diphascon type.

Habitat.—Among moss from the margin of a tarn on Slievemore, Achill Island, at an elevation of about 1,000 feet; only a few examples.

Macrobiotus papillifer Murray. (Plate II., figs. 10A–10C.)

Variety.—Papillae in number and position as in the type, but arising from large hemispherical or conical bases. There are six papillae in a transverse row on each segment and pseudo-segment; and they cover the whole surface of the segments, touching at their bases. The last three apparent segments have only four papillae on each. There is a large papilla at the base of each fourth leg. Pharynx with three short rods, and no comma. Claws unequal, united near the base only, diverging at about a right angle. Length 200 μ.

The large size of the dorsal and lateral processes, which occupy the whole surface, gives the animal an appearance very different from that of the type; and it may prove to be a distinct species. It agrees in pharynx and claws.

The variety has been seen in Scotland, but never recorded.

Habitat.—Salt-marsh, Clare Island; among Sphagnum, Blantyre Moor, Scotland.

Macrobiotus ornatus Richters.

All the three forms described by Richters (*spinifer, spinosissimus,* and *verrucosus*) occurred in Ireland.

Var. **verrucosus.** (Plate II., fig. 12A to 12C.) As Professor Richters identified my first drawing of *M. scabrosus* as this variety, it is here figured and described in order to point out the differences. Var. *verrucosus* is exactly like the other varieties of *M. ornatus*, except that the spines are greatly reduced or lacking. All these varieties are smaller than *M. scabrosus*; the papillae are in regular rows across the segments; there are no eyes; and the claws are Y's with short stem, rather than V's. The spines of the spiny varieties spring from the transverse ridges, and in the var. *verrucosus* these ridges are still represented by lines.

Macrobiotus scabrosus sp. n. (Plate II., figs. 11A, 11B.)

Specific characters.—Small, papillose; papillae unequal and irregular; gullet narrow, pharynx with two short rods; dark eyes; claws V-shaped, united at base only, pairs equal, claws of each pair unequal.

Length about 250 μ. The slender gullet ends with conspicuous apophyses, and the two rods of the pharynx are little longer than broad. There is no

comma. The back, sides and the basal parts of the legs are papillose. The papillae are scattered irregularly, not arranged in transverse rows, and some are very large. Some have the appearance of being the product of secretion; but if so, they are strongly fixed, and do not come off under rough usage. The claws diverge but moderately.

Habitat.—Among moss from the sea-shore, Clare Island.

This animal was recorded in 1905 (**11**) for Scotland as var. *verrucosus* of *M. ornatus* Richters; but I have since seen reason to doubt the identity with Richters' species. The differences are—the larger size, the possession of eyes, the irregularity of the papillae, and the relatively larger claws of different form.

All the forms of *M. ornatus*, including *verrucosus*, occurred in W. Ireland. All were smaller, without eyes, with papillae in regular transverse rows, and very small claws. The claws are partly united, forming little Y's, with the arms unequal.

Richters' name has not been adopted for the new species, because it is believed we are dealing with a different animal, and that there is a verrucose variety of *M. ornatus*.

Distribution.—Only known in Scotland and Ireland.

Macrobiotus augusti Murray.

Although it has a fairly wide range, since it has been noted for the Arctic, Scotland, Ireland, and Australia, *M. augusti* seems to be rare, or extremely local. In Scotland it occurs in one patch of bog, and not in any of the numerous similar bogs in the same neighbourhood. Similarly, in Ireland, where the whole country seems suitable for it, it only occurred once.

M. schaudinni Richters. (Plate III., figs. 16A, 16B.)

As Richters gave no figure with his description of this species, it is here figured. It is a fairly large animal, and possesses eyes, three short rods in the pharynx, and claws of the Diphascon-type. There are some differences from Richters' animal, but they are too slight to justify its separation in the meantime.

Irish examples have not the rods very obviously increasing in size from first to third, and very often there is no comma.

Though only recently described from Spitsbergen material, the animal has long been known in Scotland, and has just been recorded for that country (**16**). It was abundant in some localities in W. Ireland, though it did not appear to be generally distributed.

SUMMARY.

The Clare Island Survey has collected thirty-three species of Water-bears, besides some distinct varieties which may eventually be elevated to the rank of species.

The examination of the Irish Water-bear fauna will be instructive in so far as it brings to light some correspondence with the faunas of other countries, as well as peculiarities of its own.

It is natural to compare the Irish Arctiscoida first with those of Scotland, as the countries are so near, and so similar in physical features and climate. Scotland has fifty species of Water-bears, and Ireland has thirty-three. Scotland has been worked for a longer time and over a wider area. As the Irish list was compiled in one small corner of the island, the number of species may be considered very fair as a beginning.

The amount of difference between these two adjacent countries is considerable. There are twenty-two species common to the two countries, leaving twenty-eight Scottish species which are unknown in Ireland, and eleven Irish species which have not been recorded for Scotland. The difference is reduced by the recording here of three species previously known in Scotland, but not recognized as distinct.

Among the eleven species not found in the Scottish list there are five which are described as new species. *Macrobiotus richtersii* and *M. scabrosus* are here recorded for Scotland, so that there are only three species which at present appear to be peculiar to Ireland (*Echiniscus militaris*, *E. columinis*, and *Macrobiotus hibernicus*).

Arctic Species in Ireland.—It was expected that some Arctic species might appear on the Irish mountains, as they are known to occur in Scotland. Sixteen species, or nearly half of the Irish list, are common to Ireland and the Arctic Region; but the majority of these are cosmopolitan species. The following half-dozen species are at present limited in their known range to the north temperate and Arctic regions:—*Echiniscus crassus*, *Macrobiotus crenulatus*, *M. virgatus*, *M. arcticus* (also in the Antarctic), *M. schaudinni*, *Diphascon angustatum*.

Canadian Species in Ireland.—An interesting feature of the Irish list is the occurrence of three Water-bears which were recently discovered in Canada, and which were hitherto unknown in Europe:—*Echiniscus intermedius*, *Macrobiotus occidentalis*, and *M. virgatus*. The two first have now been found in Sweden by Herr Thulin, though I am not aware that the records have been published. *E. intermedius* is also on record for Australia and Hawaii; but it is very likely that the three forms will be eventually recognized as distinct

species. With the Canadian Water-bears there was associated in Ireland a Canadian Bdelloid Rotifer. This fact strengthens the idea that this "Atlantic" distribution may be due to some real community of conditions.

Marine species.—Echiniscoides sigismundi is the first marine Water-bear to be recorded for the British Isles, and the Irish form has some peculiarities not previously noted.

Rare and local species.—About one-half of the Irish species are cosmopolitan or widely distributed. The others are more or less limited in their range. Some of these have been already noticed under the Arctic, Canadian, and Marine species. Others show various peculiarities in distribution. *E. gladiator* is in the British Isles, Canada, and New Zealand, but the variety *exarmatus* only in Britain and New Zealand; *M. harmsworthi* in Europe, Australasia, and the Arctic; *M. hastatus* in Britain and Switzerland, *M. papillifer* in Britain and Australasia *M. annulatus* in Britain, New Zealand, and the Arctic; *M. schaudinni* and *Diphascon angustatum* in Britain and the Arctic.

No doubt further work in other countries will greatly modify our ideas of distribution, but some species (such as *M. augusti* and *M. hastatus*) appear to be, from some unknown cause, extremely restricted in their range, as among hundreds of apparently suitable locations they will be found only in one here and there, or even in a single spot.

Conclusion.—As the thirty-three species of Water-bears were all collected in a small part of one county, it cannot be supposed that the list is fairly representative of the whole of Ireland. When other parts of the country, offering varying conditions, come to be studied, it would not be surprising if the list were easily doubled. As there appear to be no earlier records of Irish Water-bears, all thirty-three species are new for Ireland. As indicated in the table on p. 3, there are eleven species which are new records for the British Isles, making the Britannic list up to sixty-one species. [See Murray (**16**) in Bibliography.]

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There is no bibliography relating to Irish Arctiscoida; but as this is the first paper dealing with this group in Ireland, references are given to the works in which the student will find further information about Water-bears in general, and especially about the species here recorded.

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EXPLANATION OF PLATES.

PLATE I.

Fig.
1A. *Echiniscus militaris* sp. n.
1B. The same: outer and inner claws, the latter with barb.
1C. The same: part of the surface-markings.
2A. *Echiniscus crassus* Richters: larva.
2B. The same: head of adult.
2C. The same: part of the surface-markings.
3A. *Echiniscus columinis* sp. n.
3B. The same: outer and inner claws, the latter with barb.
4A. *Echiniscus intermedius* Murray: head of adult, showing the "bearers" of the teeth, etc.
4B. The same: surface texture, of two sorts of dots.
5. *Echiniscus*, probably a form of *E. columinis*.
6. *Echiniscus*, probably another form of *E. columinis*.

Plate II.

Fig.

7A. *Echiniscus testudo* Doy., variety.

7B. The same: claw.

8A. *Echiniscoides sigismundi* (M. Sch.).

8B. The same: claws, showing the web.

9A. *Macrobiotus* sp.?: teeth and pharynx.

9B. The same: one process of the egg.

10A. *Macrobiotus papillifer* Murray: variety with very large papillae.

10B. The same: teeth and pharynx.

10C. The same: claws.

11A. *Macrobiotus scabrosus* sp. n.

11B. The same: claws.

12A. *Macrobiotus ornatus* var. *verrucosus* Richters: skin with egg.

12B. The same: teeth and pharynx.

12C. The same: claws.

Plate III.

13A. *Macrobiotus richtersii* sp. n.

13B. The same: teeth and pharynx of adult.

13C. The same: teeth and pharynx of young in the egg.

13D. The same: claws.

13E. The same: egg.

13F. The same: one process of the egg.

13G. The same: variety of the egg.

13H. The same: one process of the egg.

14. *Macrobiotus occidentalis* Murray, showing the surface-markings in pairs.

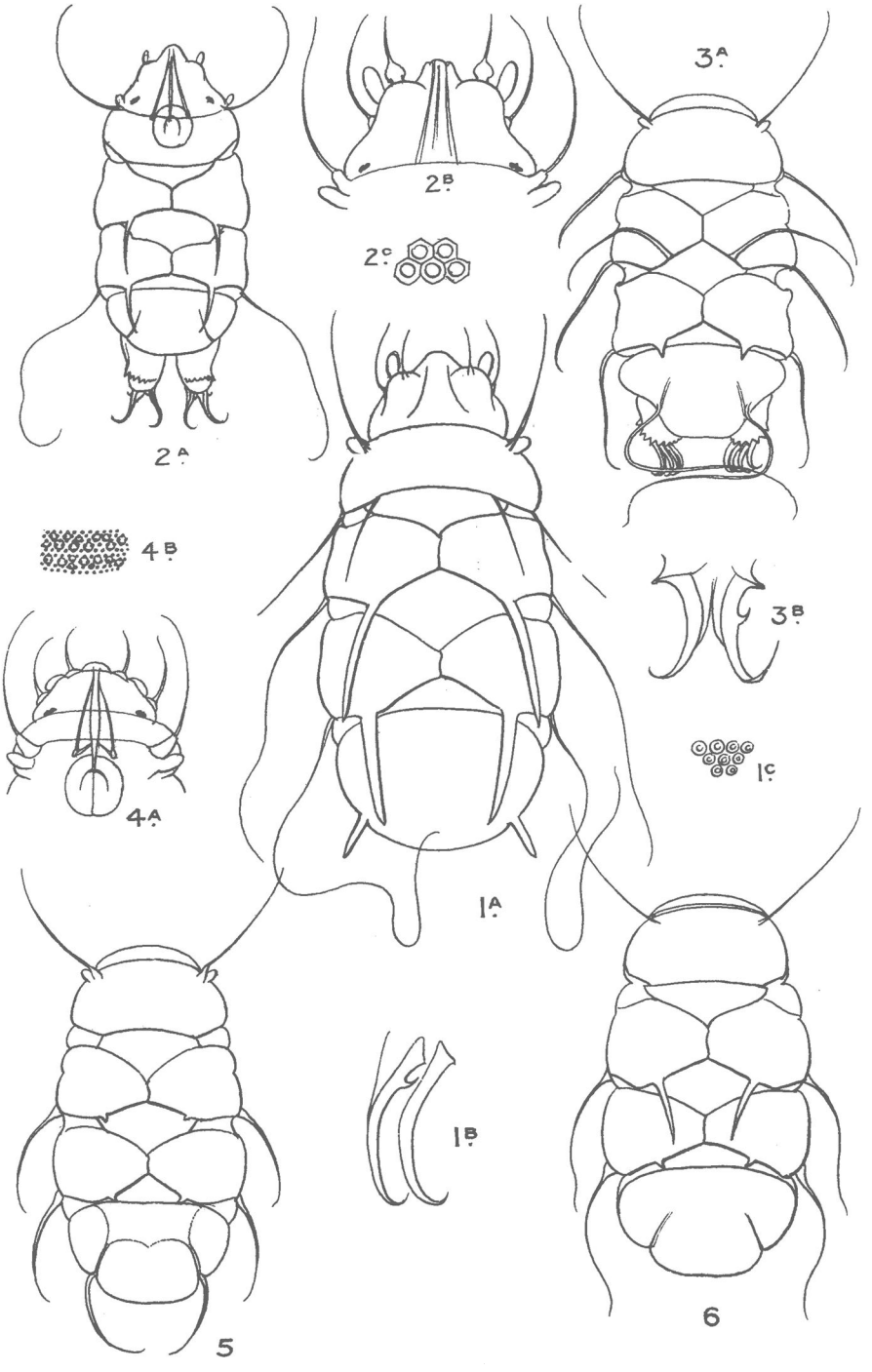
15A. *Macrobiotus hibernicus* sp. n. The egg.

15B. The same: teeth and pharynx of young in the egg.

15C. The same: the claws of the young, probably incompletely developed

16A. *Macrobiotus schaudinni* Richters.

16B. The same: claws.



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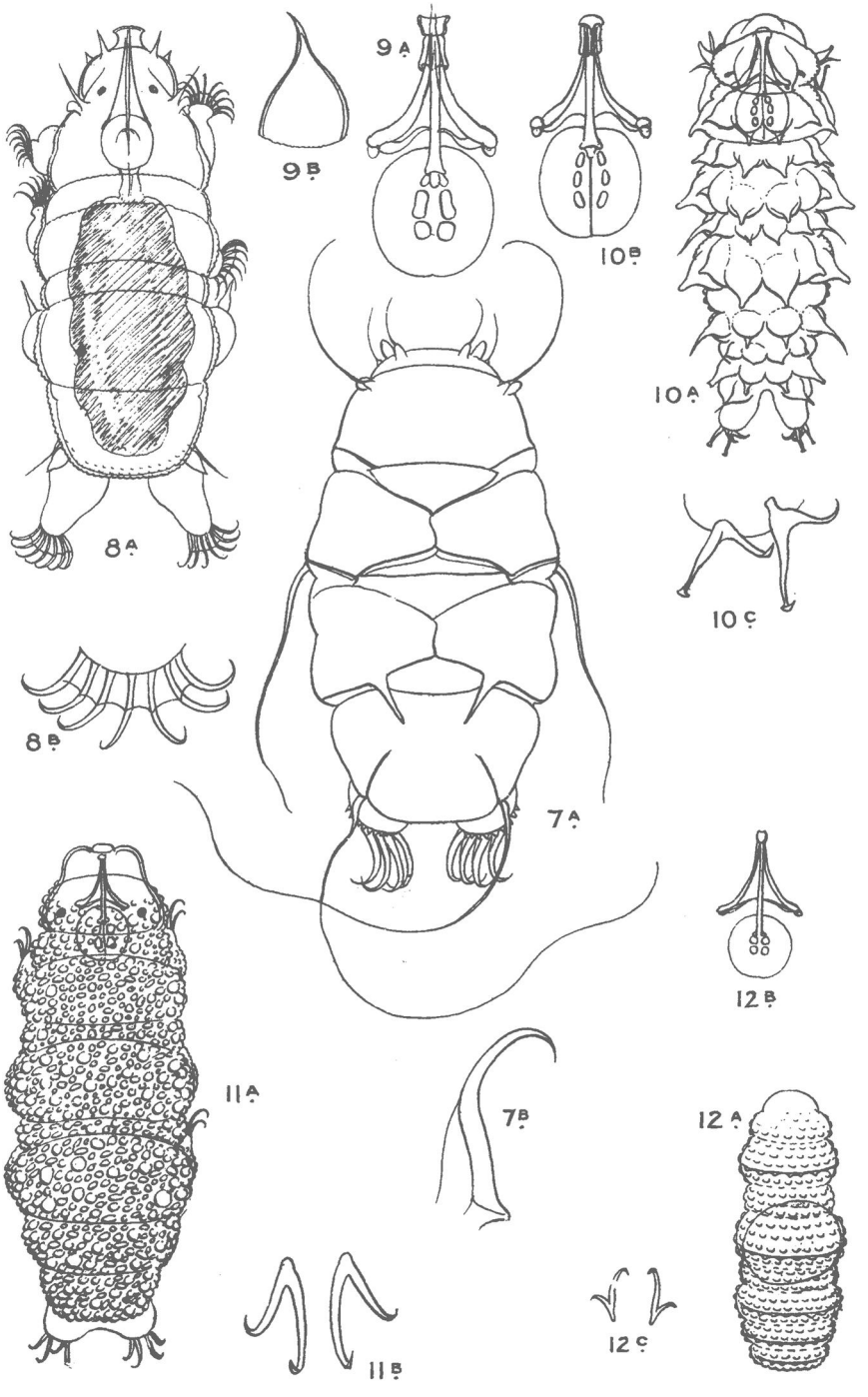

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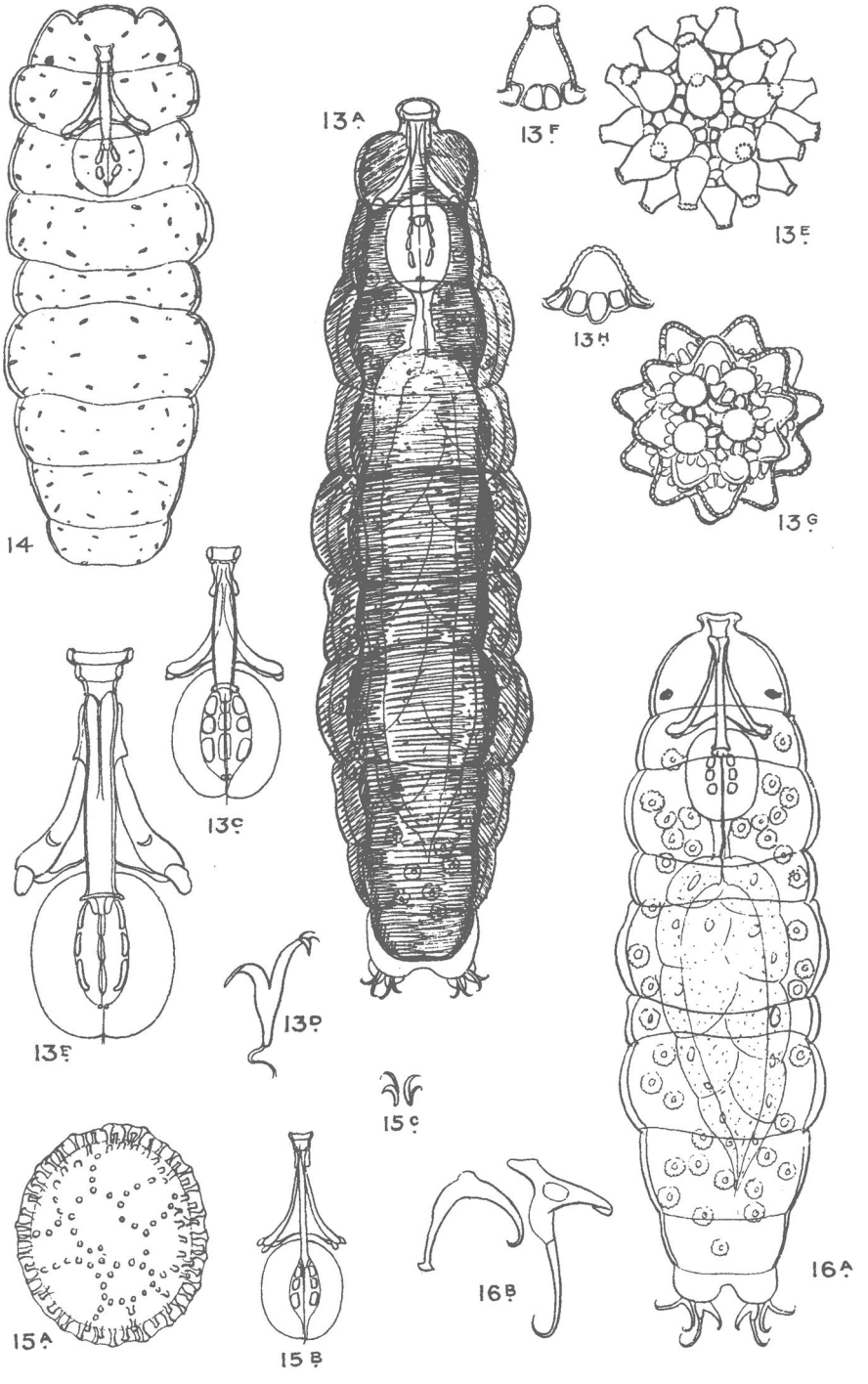

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