

AUSTRALASIAN ANTARCTIC EXPEDITION

1911-14

UNDER THE LEADERSHIP OF SIR DOUGLAS MAWSON, D.Sc., B.E.

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VOL. VI. PART 2.

THE CHÆTOGNATHA.

BY
PROFESSOR T. HARVEY JOHNSTON, M.A., D.Sc., C.M.Z.S.,
AND
B. BUCKLAND TAYLOR, F.L.S.

WITH THREE PLATES.

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THE CHÆTOGNATHA

By PROFESSOR T. HARVEY JOHNSTON, M. A., D.Sc., C.M.Z.S., and B. BUCKLAND TAYLOR,
F.L.S., Biology Department, University, Brisbane.

With Three Plates.

INTRODUCTION.

COLLECTIONS of Chætognatha from Antarctic and Subantarctic waters have been examined by Steinhaus (1900), Fowler (1907), Ritter-Zahony (1911), and Jameson (1914). A species, probably *Eukrohnia hamata*, has been referred to by Parker as having been collected to the south of Stewart Island, New Zealand, and other Subantarctic Islands. This occurrence was discussed by Fowler (1907).

We have taken a very wide definition of the words "Antarctic" and "Subantarctic," including thereunder every position south of 40° S. This latitude is a somewhat arbitrary one as far as climate is concerned, more particularly immediately to the south of Australia and Tasmania, the Tasman Sea and New Zealand, where the temperatures are rather higher than they are in corresponding latitudes in most other parts of the Subantarctic region.

MATERIAL COLLECTED.

The collection consisted of (1) material obtained in tow-nets at four stations, from depths ranging from 2 to 400 fathoms; and (2) several specimens found on the beach at Macquarie Island.

The various dates and locations were as follows:—

Date unrecorded.—Maria Island, on the west coast of Tasmania, the most northerly station at which Chætognatha were obtained. Material from 6 fathoms.

18–19th June, 1912.—Twelve hours tow-netting in the vicinity of Macquarie Island, at a depth of 2 fathoms.

21st June, 1912.—In 2 fathoms at Macquarie Island.

March, 1913.—Specimens found on the beach at Macquarie Island.

4th January, 1914.—At 64° 18' S.: 132° 24' E. from 45 fathoms.

10th January, 1914.—At 64° 34' S.: 117° 1' E. Two hauls were made with a closing net, one at 100 fathoms and one at 400 fathoms.

Altogether several hundreds of specimens of Chaetognatha were collected, representing two genera, eight species and one new variety, two of the species being collected from these waters for the first time. One genus, *Heterokrohnia*, and one species of *Sagitta*, *S. maxima*, which have been recorded by Jameson (1914) within the Antarctic circle, off Coats' Land, were not obtained by the Australian Antarctic Expedition.

The appearance of our specimens varied very considerably according to the medium in which they had been kept, those individuals which were preserved in alcohol being totally different to the naked eye from others of the same species which had been preserved in formalin, the latter retaining their shape well and remaining more or less opaque, according to their nature, whereas the alcohol had caused normally firm and turgid species to become rather flaccid and quite transparent, while its effect on normally flaccid species was such as to make the taking of correct measurements a matter of considerable difficulty. The specimens which best showed the contrasting effect of the two media were *S. lyra* and *Eukrohnia hamata*. In the former species, until the heads had been examined under the microscope and various measurements had been made, the contrast between the specimens obtained on the beach at Macquarie Island and preserved in formalin, and a few others preserved in alcohol, was so great that it seemed almost incredible that they belonged to the same species. Those individuals of *E. hamata* which had been kept in formalin were quite darkly coloured and firm, but the alcohol in other cases had made the material quite colourless and flaccid, so that the general appearance of the animal was of no assistance in identification.

SYSTEMATIC ACCOUNT.

SAGITTA HEXAPTERA *d'Orbigny*.

- 1843. *S. mediterranea* Forbes.
- 1844. *S. bipunctata* Krohn.
- 1870. *S. tricuspidata* Kent.
- 1880. *S. magna* Langerhans.
- 1881. *S. longidentata* Grassi.

Several specimens of this form were captured at various stations, some of which arrived dry in a broken tube. However, it was possible to identify all the individuals by means of their characteristic cephalic armature, together with the body proportions. The largest was 33 mm. in length. The jaws and posterior teeth were in excess of the usual number, the jaws of our specimens varying in number from 8 to 11, and the posterior teeth from 5 to 7; the usual number of jaws being 7 or 8 (rarely up to 10), and of posterior teeth from 4 to 6.

Specimens were obtained as follows:—

18th June, 1912, at 2 fathoms, Macquarie Island.

21st June, 1912, at 2 fathoms, Macquarie Island.

10th January, 1914, at 100 fathoms, from $64^{\circ} 34' S. : 117^{\circ} 1' E.$

10th January, 1914, at 400 fathoms, from $64^{\circ} 34' S. : 117^{\circ} 1' E.$

The species had already been recorded from the Southern Ocean by Fowler (1907) and Jameson (1914).

SAGITTA LYRA *Krohn.*

(Plate II, figs. 1, 2, 3.)

1896. *S. furcata* Steinhaus.

1907. *S. hexaptera* Fowler (non d'Orb.).

1909. *S. gazellæ* Ritter-Zahony.

Of this species there were collected twenty-four individuals, which, as has already been mentioned, owing to different methods of preservation presented very different appearances.

Seven large robust dark-coloured opaque specimens, all over 40 mm. in length were washed up on a sandy beach at Macquarie Island. One specimen, measuring 40 mm., was taken at 100 fathoms; while others were collected from depths of 2 and 45 fathoms, these ranging in length from 18 to 36 mm.

Ritter-Zahony (1909, 1911) stated that the main difference between his species *S. gazellæ* and *S. lyra* lay in the form of the seizing jaws. His figure (fig. 7) is very like that of the jaw of *S. furcata* (Fowler, 1905, pl. 4, fig. 12), a species placed by Michael, Ritter-Zahony and others under *S. lyra*. The base was, however, somewhat different. On the other hand his figure (fig. 8) of the jaw of *S. lyra* resembles that drawn by Fowler (1905, pl. 6, fig. 41) for an undetermined species of *Sagitta*, which was afterwards placed by Ritter-Zahony (1911) as a synonym of *S. lyra*. Ritter-Zahony (1911, p. 8) said that in older specimens of *S. lyra* the jaws became claw-shaped. As will be seen from fig. 3, the tips of our specimens agree with his description of *S. lyra* in this respect, while the shaft of the jaw resembles his own figure of *S. gazellæ* (1911, fig. 7). This to our minds indicates that the differences in the form of the jaws as recorded are of no specific value.

Another point of difference emphasized by him is the shortness of the tail in *S. gazellæ*. In his original description of the species (1909) the tail was stated to be 10 to 14 per cent. of the total length, with one apparently abnormal measurement of 19 per cent. However, in his revision (1911) he gave tail ratios which ranged from 10 to 19 per cent., while in the same paper his measurements for *S. lyra* were 15 to 18 per cent., really nullifying one of his own points of difference between the two.

Michael (1911), in commenting on the likeness of the two species, expressed doubt whether there was sufficient difference to justify the creation of *S. gazellæ*, but stated that as a figure had not been published he let it stand. Since then Ritter-Zahony (1911) redescribed and figured the species, and it was with this redescription that we compared our specimens.

Our measurements for the tail percentages agreed fairly well with those given by Ritter-Zahony for *S. gazellæ*, with the exception of our No. 5, a specimen 36 mm. long, having a tail percentage of 11, while his specimen of *S. gazellæ* of a corresponding length had a tail percentage of 14 to 15. He also gave 15 to 16 per cent. for *S. lyra*, measuring 36 mm. The disparity between his figures and ours was probably due to shrinkage of our specimen, caused by preservation in alcohol. Our dimensions fitted the descriptions of either *S. gazellæ* or *S. lyra*, as given by Ritter-Zahony and Michael, except in the case of the No. 5 mentioned above; the latter was apparently a rather abnormal specimen, the number of its jaws being 13, which was greater than that recorded for either of the species, the maximum being 9 for *S. lyra*, and 10 for *S. gazellæ*.

The ovaries were immature in all our individuals, so comparison of this feature was impossible.

Another distinction between the two mentioned by him was that in *S. lyra* the posterior fin overlapped the anterior (1911, fig. 3), whereas in *S. gazellæ* he stated that the two were continuous in young specimens, becoming separated later (1911, p. 10). This was the only point of difference we could find in regard to the descriptions, and as in the text he stated that the fins were confluent in *S. lyra*, we have felt fully justified in placing *S. gazellæ* as a synonym of *S. lyra*.

Jameson (1914) recorded *S. gazellæ* from the Antarctic, but though he distinguished it from *S. hexaptera*, he did not discuss its likeness to *S. lyra*, to which his description would apply equally well. Some of his specimens were extraordinarily large, one attaining a length of 90 mm.

Measurements, &c., of Selected Specimens.

No.	Length in mm.	Tail %.	Jaws.	Antr. Teeth.	Postr. Teeth.
1	18.5	16	9	3	4
2	19	15.7	11	1	3
3	19	18	8	3	4
4	20	17	9	7	11
5	36	11	13	5	6
6	40	15	9	5-6	5-6
7	40	15.5	8	7	6

Specimens were obtained as follows:—

18–19th June, 1912, at 2 fathoms, Macquarie Island.

March, 1913, on the beach, Macquarie Island.

4th January, 1914, at 45 fathoms, from 64° 18' S. : 132° 24' E.

10th January, 1914, at 100 fathoms, from 64° 34' S. : 117° 1' E.

10th January, 1914, at 400 fathoms, from 64° 34' S. : 117° 1' E.

The species had already been recorded from Antarctic or Subantarctic waters by Fowler (1907) as *S. hexaptera*; and by Ritter-Zahony (1909) and Jameson (1914) as *S. gazella*.

SAGITTA MACROCEPHALA *Fowler*.

Only two specimens were obtained (one in a very imperfect condition), and, as will be seen from the accompanying table, they were not normal adult individuals of *S. macrocephala*, but compare closely in their doubtful points with certain of Fowler's specimens obtained from the Bay of Biscay, which shewed a marked decrease in the number of posterior teeth, and regarding which that author stated, "I think they are larval *macrocephala*, but they are very small, and the number of posterior teeth drops rather suddenly." As they were like *S. macrocephala* in appearance, proportional measurements, number and shape of the jaws, and since Fowler's numbers for the teeth in his larval forms corresponded with our own, we have placed them in this species, though with some reserve.

Measurements, &c., of our Specimens.

Length in mm.	Tail % of Length.	Jaws.	Antr. Teeth.	Postr. Teeth.
7	30	9	3	6
9	36	10	3	9

The specimens were obtained on 10th January, 1914, at 100 fathoms from 64° 34' S. : 117° 1' E.

Not hitherto recorded from the Antarctic.

SAGITTA NEGLECTA *Aida*.

1902. *S. septata* Doncaster.

This form was not at all common, only four specimens being captured. The only variation exhibited was the possession of 10 seizing jaws, this being two in excess of the usual number.

The species was regarded by Ritter-Zahony (1911) as a tropical, Indo-Pacific epiplanktonic form, so its occurrence at 100 fathoms in the vicinity of the Antarctic circle was remarkable. However, as we have said above, the only point in which the

specimens did not agree with the descriptions of *S. neglecta*, was in the presence of the two extra jaws. We concluded that the species has a wider range than had hitherto been suspected.

The specimens were obtained on 10th January, 1914, at 100 fathoms from 64° 34' S. : 117° 1' E.

Not hitherto recorded from the Antarctic.

SAGITTA PLANCTONIS *Steinhaus*.

1896. *S. hexaptera* Conant (non d'Orb.).

1905. *S. zetesios* Fowler.

Of this species only four individuals were captured, no variation being exhibited.

The specimens were collected on—

10th January, 1914, at 100 fathoms, from 64° 34' S. : 117° 1' E.

10th January, 1914, at 400 fathoms, from 64° 34' S. : 117° 1' E.

Already recorded from the Antarctic and Subantarctic by Ritter-Zahony (1911); Fowler (1905) as *S. zetesios*; and by Jameson (1914).

SAGITTA SERRATODENTATA *Krohn*.

This species was present in two hauls; on one occasion no other Chaetognatha were captured, while in the other haul only one representative of the species was present. The individuals shewed no variation. They ranged from 6 to 13 mm. in length, and many were sexually mature.

The specimens were collected on—

21st June, 1912, at 2 fathoms, Macquarie Island.

Date unknown, at 6 fathoms, Maria Island, in which haul no other species was represented.

Already recorded from Antarctic and Subantarctic waters by Steinhaus (1900) and Fowler (1905).

• EUKROHNSIA FOWLERI *Ritter-Zahony*.

1905. *Krohnia hamata* var. Fowler.

This species was not commonly represented, only 18 specimens in all being collected, but they were present in five different hauls, at depths ranging from 2 to 100 fathoms. In our individuals from 1 to 3 of the seizing jaws were saginated, and only 2 teeth were present. Fowler (1905, p. 78) found from 3 to 8 of the jaws saginated, and met with 2 to 4 teeth in specimens 6 to 8 mm. long. Michael (1919, p. 240) and Ritter-Zahony (1911, p. 40) mentioned that *E. fowleri* possessed pigmented eyes. This was not the case in any of our specimens, nor did Fowler refer to it in his original description.

The specimens were collected on—

18th June, 1912, at 2 fathoms, Macquarie Island.

21st June, 1912, at 2 fathoms, Macquarie Island.

4th January, 1914, at 45 fathoms, from 64° 18' S. : 132° 24' E.

10th January, 1914, at 100 fathoms, from 64° 34' S. : 117° 1' E.

10th January, 1914, at 400 fathoms, from 64° 34' S. : 117° 1' E.

Already recorded from the Antarctic by Ritter-Zahony (1911).

EUKROHNTA HAMATA *Mœbius*.

(Plate II, fig. 5. Plate III, figs. 8, 12.)

1875. *S. hamata* Mœbius.

1880. *Krohnia hamata* Hertwig.

1880. *Spadella hamata* Hertwig.

1897. *Krohnia foliacea* Aida.

1912. *E. richardi* Germain and Joubin.

This species was far more numerously represented than any other, being collected in every haul except one. There were present in all about 300 individuals, ranging from 7 to 26 mm. in length.

Those of our specimens which were preserved in formalin were of a water-green colour, while those preserved in alcohol were quite colourless. The flask-shaped corona was present on one, and a small collarette on several of our specimens (fig. 8). The anus opened on a small, but distinct, anal papilla (fig. 5).

Germain and Joubin (1912) created a new species, *E. richardi*, distinguishing it from *E. hamata* by—

1. "The water-green colour." This coloration has been found by Michael (1911 p. 267) and ourselves to occur also in undoubted specimens of *E. hamata*.
2. "The elongated triangular head." This depends on the state of contraction.
3. "The more narrowly elongated jaws." Michael (1911, p. 267) quoted this character, and yet stated (p. 268) that the seizing jaws were *more massive* (the italics are ours) than those of *E. hamata*, and that their points were quite dissimilar. On p. 240 of the same paper he gave a key to the species of *Eukrohnia*, in which the seizing jaws of *E. hamata* and *E. fowleri* were stated to be delicate. Our specimens of *E. fowleri* had slender jaws, but all the *E. hamata* individuals had massive jaws with typical *E. hamata* points, *i.e.*, sickle-shaped. The jaws of all our specimens were much more massive than his figure (pl. 37, fig. 27), but the tips were similar, and, though not all were so markedly sickle-shaped, were certainly as much so as that figured by him (1911, pl. 4, fig. 35). On turning to Fowler's paper (1906, pl. 11, fig. 80),

where the jaws of the *E. hamata* collected by the Siboga Expedition were figured, one found three small drawings of the points, one of which was even less curved than in Michael's (1919) drawing of the point of the jaw of *E. richardi* (pl. 37, fig. 26).

4. "The number of teeth." This character was of no specific value in this case, since Germain and Joubin quoted 24 as the number in *E. richardi*, while Ritter-Zahony (1911) gave 4 to 23, and Michael (1919, p. 226) 21 to 25 as the number for *E. hamata*.
5. The maximum width of the body was stated in the text to be 9.3 per cent. of the total length. Including damaged fins, one of our specimens had a width of 9.5 per cent. Michael, who regarded *E. richardi* as a valid species, found certain discrepancies between Germain and Joubin's text and their figures. He gave a table comparing the measurements of his specimens and those of the above-mentioned figures, in which he indicated the width of the figures as 12.2 per cent., but in his text he stated that this percentage was 11.5. Taking into consideration the very damaged condition of our material, there is not a very great difference between Michael's measurements of the drawing and ours, which were taken from undoubted *E. hamata*. We have examined individuals measuring in breadth from 5.7 per cent. of the total length (which was only .1 per cent. greater than the measurement given for *E. hamata* by Michael, 1911, to 9.5 per cent., which was .2 per cent. greater than Germain and Joubin's text figures of *E. richardi*, and 2 per cent. less than Michael's measurement of their drawing, which seemed to us to discredit the separation of the two species on a basis of width.

The distinctions given by Michael (1919) regarding the fins we cannot comment upon, as our specimens were much too damaged to obtain reliable measurements of these structures.

Given the above comparisons, and the fact that Germain and Joubin named the species from one specimen, and that Michael (1919) examined "five specimens, only two of which are well enough preserved to permit certain identification," we consider that we are justified in classing *E. richardi* as a synonym of *E. hamata*.

Neither Michael (1911, p. 52) nor ourselves observed a "bristly ridge" (Ritter-Zahony, 1911) on any of the seizing jaws.

The specimens were collected on—

18th June, 1912, at 2 fathoms, Macquarie Island.

21st June, 1912, at 2 fathoms, Macquarie Island.

4th January, 1914, at 45 fathoms, from 64° 18' S. : 132° 24' E.

10th January, 1914, at 100 fathoms, from 64° 34' S. : 117° 1' E.

10th January, 1914, at 400 fathoms, from 64° 34' S. : 117° 1' E.

Already recorded from the Antarctic and Subantarctic regions by Steinhaus (1900); Fowler (1907) as *Krohnia hamata*; and Jameson (1914) as *K. hamata*.

EUKROHNSIA HAMATA var. ANTARCTICA var. nov.

(Plate II, figs. 4, 6. Plate III, figs. 7, 9, 10, 11.)

Nine individuals of this variety were collected, none very well preserved. One had been kept in alcohol, and in consequence was much more transparent and flaccid than the others, while the remaining eight had apparently been allowed to dry slightly at some time and, as a consequence, were rather distorted. Their length ranged from 16.5 to 21 mm.

We have considered these specimens as constituting a variety of *E. hamata* on two grounds:—

1st.—Because of the curious coiling of the ovaries as the individuals progressed towards female maturity. Specimens of *E. hamata* and var. *antarctica* in which the sexual organs were very immature, were indistinguishable in regard to the ovary, but older individuals of both were totally different in this feature, as can be seen by comparing figs. 4 and 5, 9 and 12. The var. *antarctica* was protandrous, the ovaries remaining small and straight, while the tail gradually became filled by the testes and sperm, then, just at the height of male maturity the ovaries began to coil inwards towards the tail septum, first one, then the other (fig. 9), and by the time the male products had been discharged, the ovaries had increased enormously in length and breadth, and lay tightly coiled just in front of the septum (figs. 4 and 10). At this latter stage it was impossible to distinguish the empty testes.

2nd.—Traces of the corona which were observable on one individual (fig. 7) showed that its form was different from that of *E. hamata*, being probably a broad oval lying on the head and neck, as compared with the flask-shaped corona of *E. hamata*.

The vesiculæ seminales were extremely small, and unless filled with sperm, were very difficult to see, as they were quite flat (fig. 11). They were only 6 per cent. of the total length from the posterior end of the tail, and the tail fin reached them.

A row of very pronounced papillæ (fig. 6) lay between two prominences at the extreme anterior end of the head; these, though present, were not so easily observable in *E. hamata*, and as we have not seen any detailed drawings of the head of the latter, we do not know if other observers have already figured them for the species.

The curvature of the jaws, measured according to Michael's formula (1911, p. 23) was 38 per cent.; the tips were inserted in the shaft for 21 per cent. of their length.

The specimens were captured on 10th January, 1914, at 100 fathoms from 64° 34' S. : 117° 1' E.

SPECIES ALREADY RECORDED FROM THE ANTARCTIC, BUT NOT
COLLECTED BY THE AUSTRALIAN ANTARCTIC EXPEDITION.

HETEROKROHNA SP. *Ritter-Zahony*.

Recorded by Ritter-Zahony (1911) from the Antarctic at 2,000 and 3,423 metres;
and by Jameson (1914) at 1,000 fathoms from 68° 25' S. : 27° 10' W.

SAGITTA MAXIMA Conant.

- 1885. Sp. innom., Verrill.
- 1892. *S. hexaptera* Strodttmann.
- 1896. *Spadella maxima* Conant.
- 1896. *S. whartoni* Fowler.
- 1905. Sp. indetermin., Fowler.
- 1906. *S. gigantea* Broch.

This species, which is regarded as valid by Ritter-Zahony, though Michael (1911) considered it a synonym of *S. lyra*, is recorded by Jameson (1914) as having been obtained by the Scottish National Expedition in a net lowered to 1,000 fathoms in 71° 50' S. : 23° 30' W., and at 1,332 fathoms from 48° 00' S. : 9° 50' W.

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EXPLANATION OF PLATES.

(All figures, with the exception of No. 3, were drawn with the aid of the camera lucida.)

PLATE II.

- Fig. 1. *Sagitta lyra*. Head.
 2. *S. lyra*. Jaw.
 3. *S. lyra*. Point of jaw.
 4. *Eukrohnia hamata* var. *antarctica*. Empty ovaries.
 5. *E. hamata*. Region of tail septum.
 6. *E. hamata* var. *antarctica*. Ventral surface of head.

PLATE III.

7. *E. hamata* var. *antarctica*. Head and neck.
 8. *E. hamata*. Head and neck.
 9. *E. hamata* var. *antarctica*. Posterior region.
 10. *E. hamata* var. *antarctica*. Ovaries.
 11. *E. hamata* var. *antarctica*. Seminal vesicles.
 12. *E. hamata*. Posterior region.

PLATE IV.

Chart of the Antarctic showing localities from which Chætognatha have been recorded.

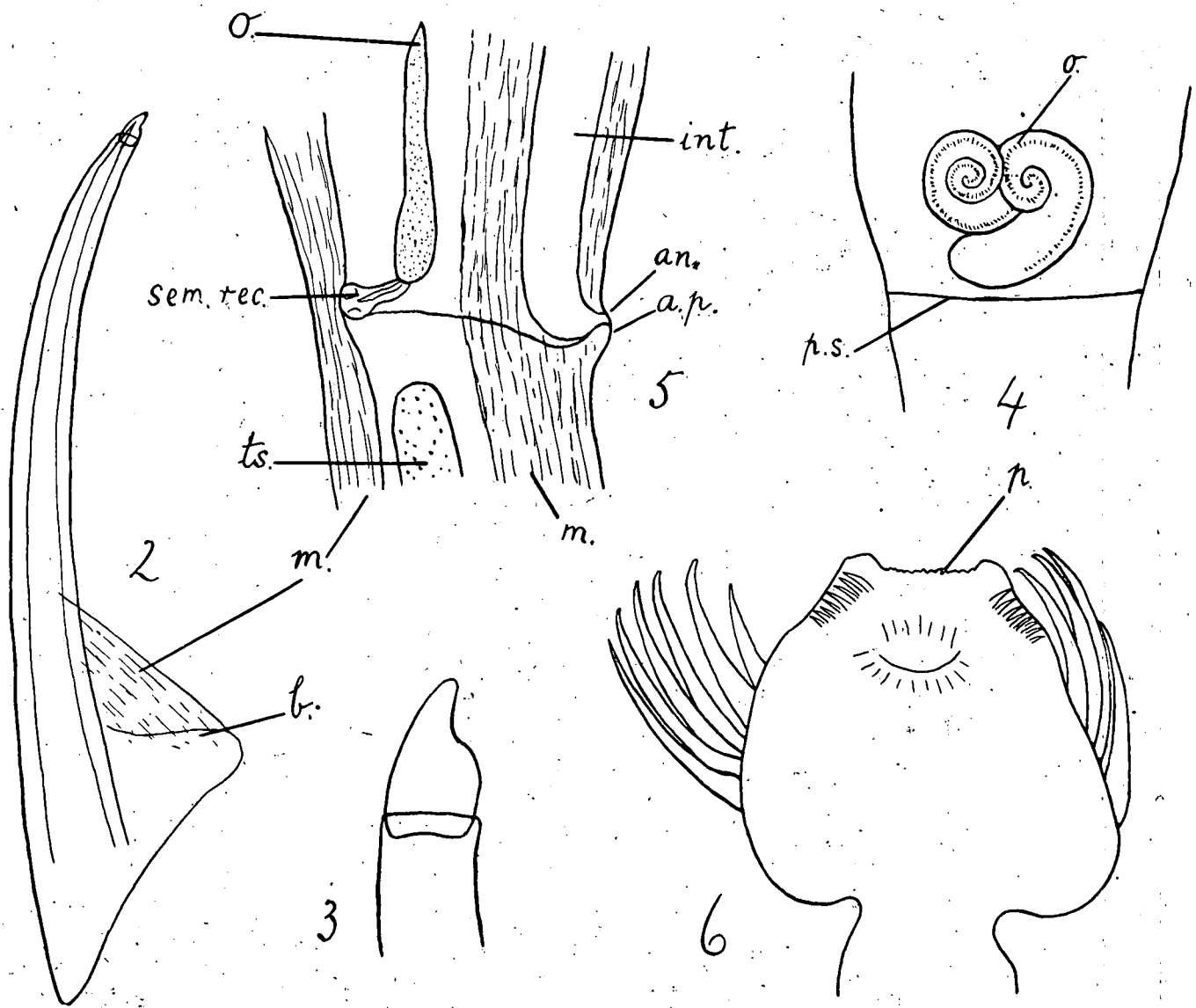
REFERENCES TO LETTERING.

- | | |
|----------------------|---------------------------------|
| an.—anus. | o.—ovary. |
| a.p.—anal papilla. | p.—papillæ. |
| a.f.—anterior fin. | p.f.—posterior fin. |
| b.—edge of base. | p.s.—tail septum. |
| col.—collarrette. | sem. rec.—seminal receptaculum. |
| cor.—corona ciliata. | sem. ves.—seminal vesicle. |
| g.—brain. | t.f.—tail fin. |
| int.—intestine. | ts.—testes. |
| m.—muscle. | |

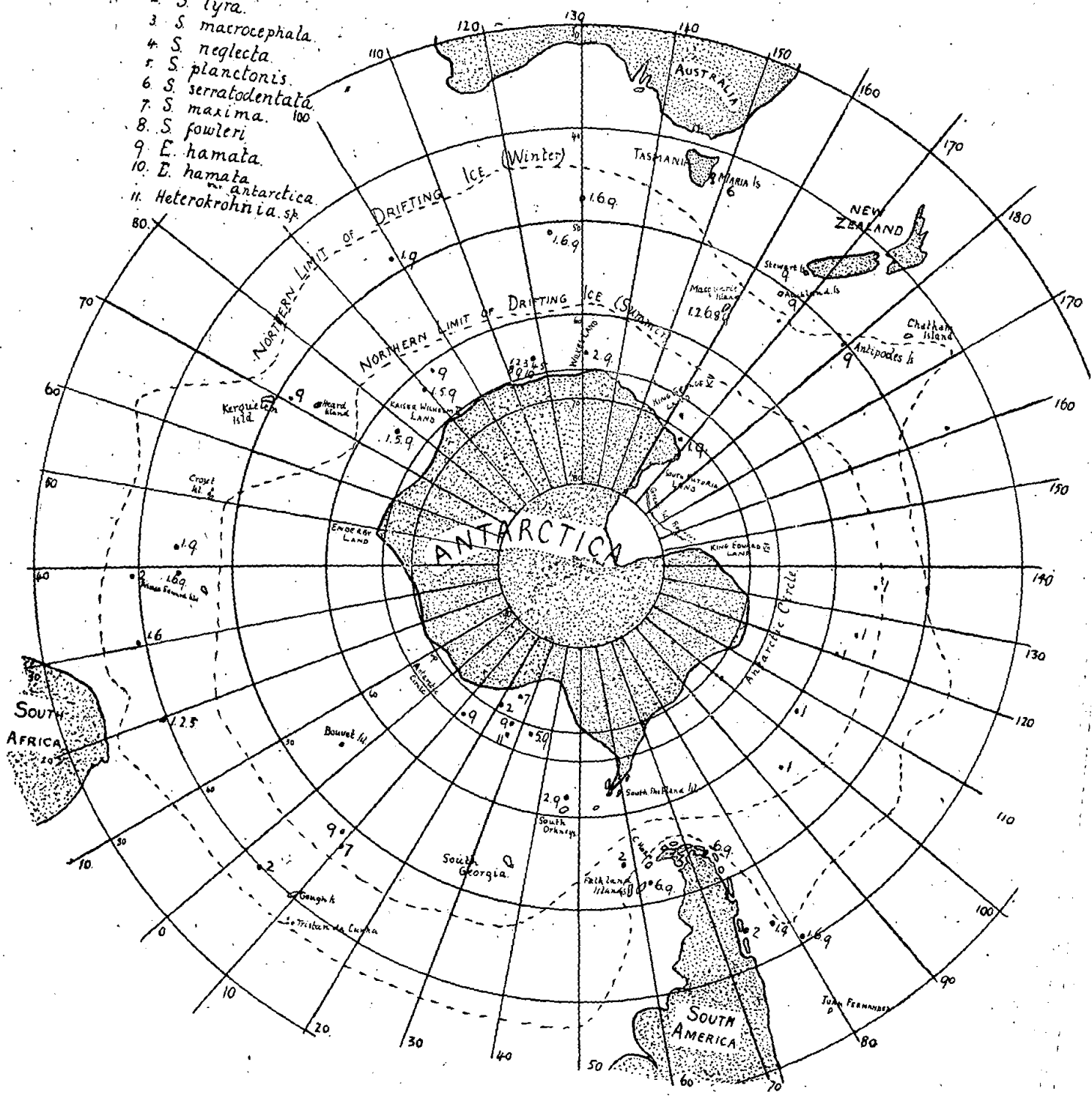
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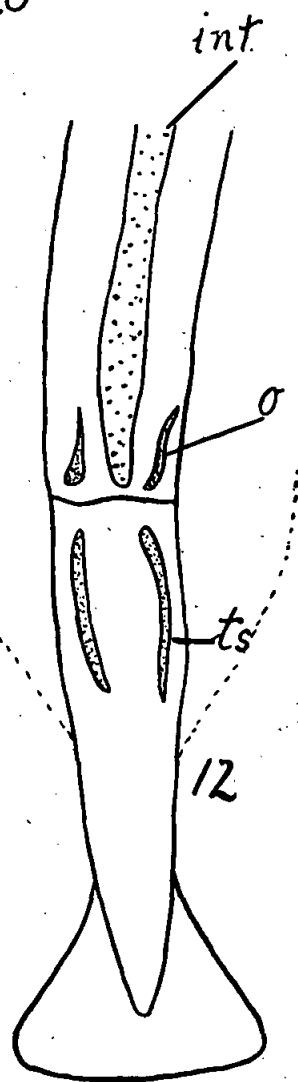
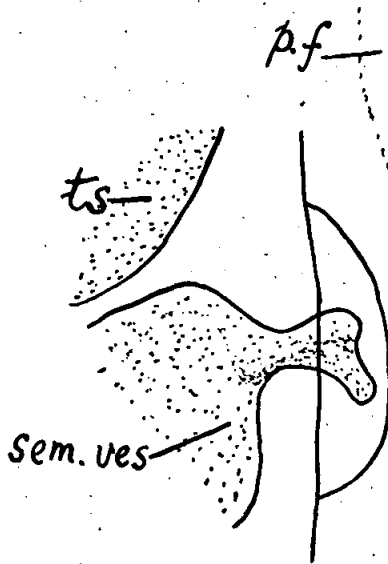
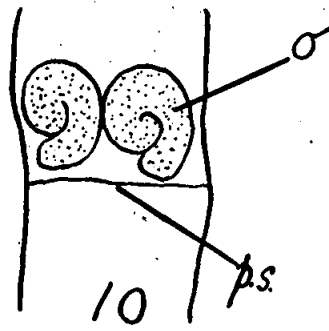
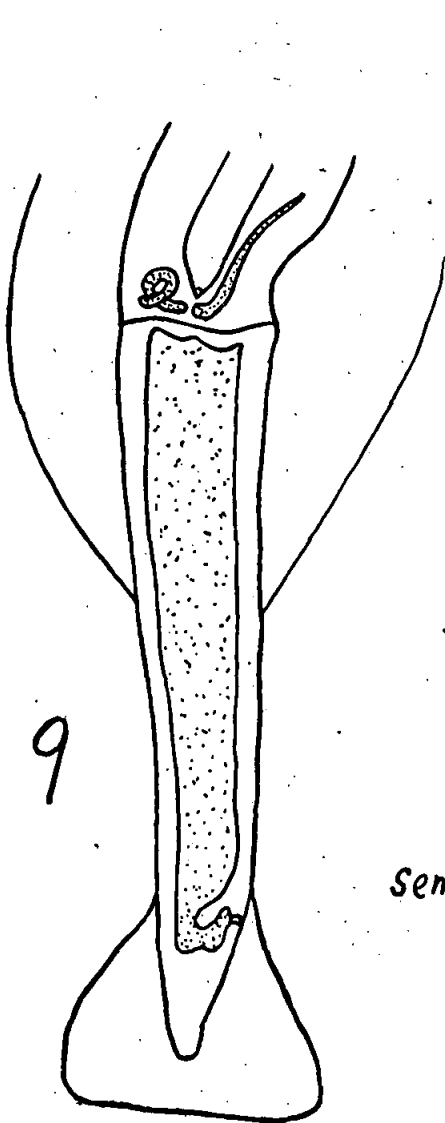
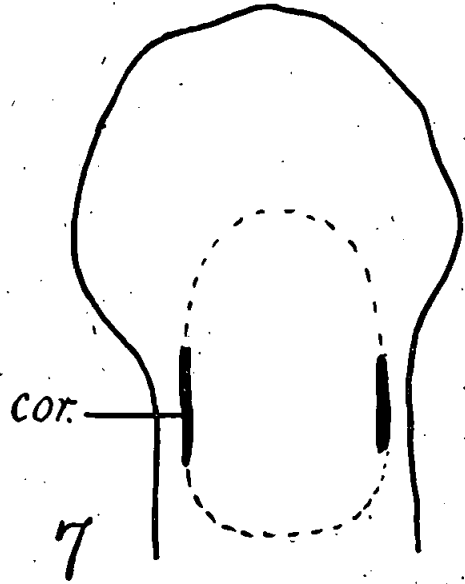
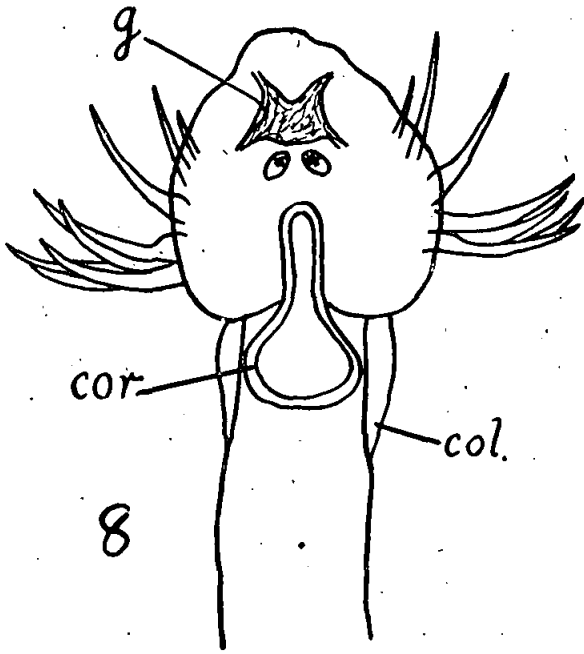
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[3 PLATES.]



- 1. *S. hexaptera*.
- 2. *S. lyra*.
- 3. *S. macrocephala*.
- 4. *S. neglecta*.
- 5. *S. planctonis*.
- 6. *S. serratodentata*.
- 7. *S. maxima*.
- 8. *S. fowleri*.
- 9. *E. hamata*.
- 10. *E. hamata antarctica*.
- 11. *Heterokrohnia* sp.





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