CHAETOGNATHA OF THE GENUS EUKROHNIA VON RITTER-ZÁHONY IN THE MATERIAL OF THE SNELLIUS EXPEDITION

by

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In 1875 K. Möbius described a new species of Chaetognatha under the name *Sagitta hamata.* Hertwig (1880) used the name *Spadella hamata* for it; Strodtmann (1892) called it *Krohnia hamata* and finally Von Ritter-Záhony (1909c) gave it the name *Eukrohnia hamata.*

In this "Research" material Fowler (1905) found a few specimens of *E. hamata* which did not entirely agree with all the characters of Möbius's species; he regarded these specimens a separate variety, which he indicated as *Krohnia hamata* Möbius var. Von Ritter-Záhony (1909c) gave the name *Eukrohnia fowleri* to this form. In the material collected by the "Siboga" Expedition Fowler (1906) found only what he thought to be *Krohnia hamata.* He stated that none of the specimens was actually well preserved, but that as far as could be ascertained there was no reason to doubt their specific identity with Möbius's species. Von Ritter-Zahony (1911c) concluded from the high number of seizing jaws, that Fowler had probably made an incorrect identification and upon re-examination of Fowler's specimens found, besides a few specimens of the true *E. hamata,* mainly *E. fowleri* to be present, though in a very poor condition. As mentioned before (Schilp, 1941, p. 39) the material collected by the Snellius Expedition contains 28 specimens of *Eukrohnia hamata* and 31 of *E. fowleri.* There are three specimens which I then ascribed with some doubt to *E. fowleri,* but which on further examination show to belong most probably to the species *E. richardi* Germain & Joubin, 1916.

Only a few of the 59 specimens of *Eukrohnia* collected by the Snellius Expedition are well preserved, and even in some of those a thorough investigation is made difficult by their opacity.

Eukrohnia hamata (Möbius, 1875) (figs. 1, 2)

The smallest specimen of the present collection measures 7 mm, the largest 22.3 mm. The material of the Siboga Expedition, containing both *E. fowleri* and *E. hamata,* varies from 8 to 26 mm. The two well preserved specimens

of the present species from the Philippines collected by the "Albatross" measured 16 and 16.3 mm (Michael, 1919). The material collected by the "Sealark" varied between 8 and 22 mm (Burfield & Harvey, 1926). The material brought home by the various antarctic and subantarctic expeditions showed a variation in their length ranging from 8.5 to 31 mm, while that from the various arctic and subarctic expeditions ranged between 8 and 45 mm. The largest specimens therefore seem to be restricted to the arctic and subarctic zones.

Table I provides the more important measurements of the present specimens of *E. hamata*. For these measurements I chose the best preserved and least damaged specimens, but as indicated by the many open places in the table, even those specimens are far from complete; which clearly shows the fragility of these deep-sea animals.

The anterior part of the trunk between head and ventral ganglion is flaccid owing to the thinness of the longitudinal muscles and this leads to the fact that many heads are torn from the body. The rest of the body is firmer, the longitudinal muscles in this part being stronger, but still many specimens have become distorted during the hauling of the net. When the animal is examined under a microscope, the pressure of the cover slip often causes it to show a greater maximum width than would be the case if the animal had its natural shape. Therefore the figures for the width of the head, neck and tail septum are given here in addition to the maximum width, since those organs retain their shape better.

I have mainly noted the width of the head with the seizing jaws turned inward, and with the tips directed forward, so that the axis of the jaws is nearly parallel to the long axis of the body. The hammer-shaped heads and those which were folded ventrally along the mid-dorsal line were not measured. In the latter case the left seizing jaws lie against those of the right side as do the teeth; the mouth is then placed deeply in the groove formed by the folded sides of the head. Probably the musculus bicornis is not so strong in the present form as it is in *Sagitta*.

The two smaller specimens have saginated jaws. Specimen no. 1 of table I has all sixteen jaws saginated, each with many teeth; in specimen no. 2 only the two ventral jaws (one on each side) have teeth, only five each. The distance between the tips of two successive saw-teeth is 0.0052 mm.

Most of the 17 specimens were so opaque that the ovaries could not be distinguished. Specimen no. 2 of table I, though only 7 mm long, possesses an ovary measuring 28 per cent of the total length. Specimen no. 11 has an abnormally large number of seizing jaws, even when the very small dorsal jaw is not taken into consideration. It is possible that I made a

TABLE I

Measurements of *Eukrohnia hamata* (Möbius)

No.	Length in mm, tailfin excluded	Width in per cent of total length			Length of tail without tailfin in per cent of total length	Head in per cent of total length		Lateral fin			Ovary		Number of teeth	Number of seizing jaws
		body without lateral fin	neck	trunk-tail septum		length	width	length in per cent of total length	anterior end before †, or on a level with ° ventral ganglion	post. end behind tail-septum in per cent of total body length	length in per cent of total length	width in per cent of total length		
1	7	4.6	2.4	3.5	23	—	—	—	—	—	—	—	———	8-8
2	7	—	—	—	20	8.4	12.5	—	—	—	28	4.7	10-10	8-8
3	8	—	—	—	—	—	—	—	—	—	—	—	8-8	10-9
4	8	—	6.5	—	20	7	11	—	—	—	—	—	9——	8*-8
5	8.5	—	—	9.2	—	—	—	—	—	—	—	—	8-8	9-9
6	9	—	—	—	—	—	—	—	—	—	—	—	10-10	9-9
7	9	—	—	9.3	—	6.8	11.6	—	—	—	—	—	8-8	7-7
8	10	—	—	5.6	24	5.0	9.3	—	—	—	—	—	———	9-9
9	10	13.3	8.3	11.1	22.3	7.7	11.3	60	°	7.7	—	—	12-12	9*-9*
10	10.3	8.2	2.7	5.7	27	5.4	8.1	—	—	—	12.4	2.7	8-10	7-7
11	11	—	—	6.2	21	8.1	—	—	—	—	—	—	20-22	11*-11*
12	12.2	—	—	—	26	6.8	10.2	—	—	—	—	—	17——	8-8
13	13.3	13.6	6.3	9.4	23	7.7	—	62	—	9.4	—	—	19-19	8-8
14	14.2	9.0	—	6.7	22	—	—	—	—	—	—	—	17-17	8-8
15	16.4	11.2	5.1	8.5	23	6.1	8.5	64.9	† 0.7%	10.1	7.7	0.95	23-23	7-8
16	16.5	11	5.4	—	—	5.7	8.8	—	—	—	—	—	24-24	8-8
17	22.3	—	2.4	5.9	27	—	—	—	—	—	18.4	2.4	21——	9-9

* The dorsal jaw still very small.

mistake in the identification of this specimen; unfortunately I can not now check upon this anymore.

In all, I examined 43 seizing jaws of the present species. When examined under a microscope the colour of the shafts of the jaws changes with the intensity of the transmitted light. When looked at through a simple magni-

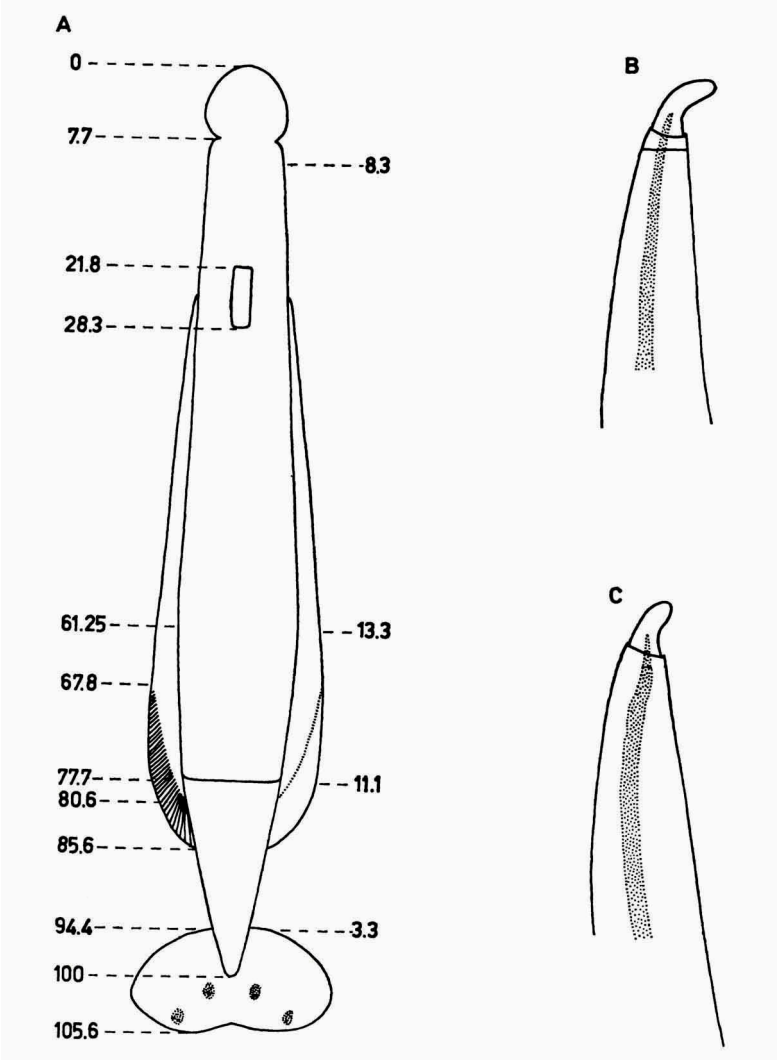

Fig. 1. *Eukrohnia hamata* (Möbius). A, specimen of 10 mm total length (the numbers at the left side indicate the distances of various parts of the body to the apex of the head in percentages of the total length, tailfin excluded; the numbers at the right side indicate the width of various parts of the body in percentages of the total length, tail fin excluded); B, C, two jaws with tips of different shape. B, C, × 108.

fying glass on a dark background the colour of the jaw is brown; examined under a microscope all gradations of clear amber to nearly colourless are found. There is only little difference in the colour of the shafts of the four studied animals. All the points are colourless and sickle-shaped, but there are small differences in shape (fig. 1 B, C). In three of the animals the points are more curved than in a fourth. The bases of the points are oval in all the jaws. In three of the animals the base of the point and the top of the shaft converge upon approaching the edge of the shaft; in the fourth they are nearly parallel. Some of the points are damaged and the longitudinal fibers which build the bulk of the point have become loose. The pulp canal is relatively wide and the pulp does not fill it completely. In some canals it lies in the centre, in others ventrally near the point and nearly centrally in the rest of the canal. In some jaws the pulp is swollen

TABLE II

Measurements (in mm) of some seizing jaws of *Eukrohnia hamata* (Möbius)
The letters of the columns correspond with those given in fig. 2.

	a	b	c	d	e	f	g
1	0.80	—	0.047	0.011	0.52	0.036	60%
2	0.78	0.62	0.047	0.013	0.48	0.03	58%
3	0.76	0.67	0.047	0.013	—	—	—
4	0.76	—	0.047	0.014	0.51	0.026	59%
5	0.76	—	0.045	0.013	0.46	0.033	39%
6	0.73	—	0.052	0.014	0.49	0.023	57%
7	0.73	—	0.044	0.013	0.48	0.03	53%
8	0.71	—	0.045	0.012	—	—	—
9	0.71	0.57	0.049	0.013	0.44	0.025	54%
10	0.68	—	0.057	0.016	0.44	0.023	47%
11	0.68	—	0.054	0.01	—	—	—
12	0.66	—	0.057	0.015	0.41	0.026	54%
13	0.62	—	0.055	0.009	0.48	0.04	47%
14	0.58	—	0.038	0.009	0.43	0.026	56%
15*	0.55	—	0.026	0.0085	0.39	0.017	46%
16*	0.54	—	0.030	0.01	0.37	0.017	58%
17*	0.53	—	0.026	0.008	0.39	0.023	54%
18*	0.52	—	0.023	0.008	0.37	0.02	50%
19	0.47	—	0.031	0.011	0.29	0.013	50%
20	0.44	—	0.035	0.012	0.22	0.023	50%
21	0.42	—	0.048	0.017	0.26	0.01	34%
22*	0.41	—	0.020	0.008	0.31	0.013	54%
23	0.38	—	0.017	0.005	0.28	0.02	52%
24	0.38	—	0.039	0.014	0.2	0.007	28%

* The numbers 15-18 and 22 were situated obliquely on top of each other; therefore the actual width is greater than that given in the table.

beneath the base of the point. In many jaws the pulp canal in the points was either in the middle or a little more dorsal. Below the base of the point the canal often shifts to the dorsum of the shaft and further downward it goes back to the centre.

In the majority of the Chaetognatha the edge of the shaft is concave, but in *Eukrohnia hamata* a small part below the point is convex and straight, or convex, or straight. The following situation was found in 24 jaws. Here follow some data: straight over 0.04 mm; a little convex; at first a little convex and then straight in total over 0.1 mm; straight over 0.05 mm; convex over 0.052 mm; convex over 0.04 mm; straight over 0.065 mm; convex over 0.026 mm and then straight over 0.04 mm; convex over 0.04 mm and then over a short distance straight; convex over 0.078 mm; convex over 0.065 mm.

Table II contains the measurements of 24 jaws arranged according to size. Column a indicates the length of the back of the shaft, column b the length of the edge of the shaft, column c the width of the shaft at the top of the ventral column, column d the width of the shaft at its top, column e

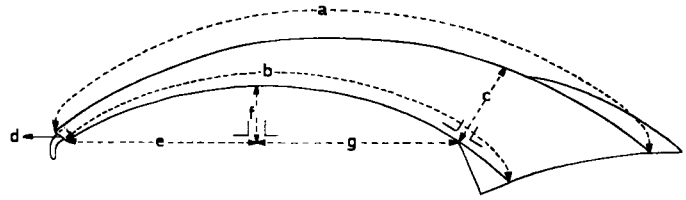

Fig. 2. *Eukrohnia hamata* (Möbius), tip of a jaw with indication of the measurements discussed in the text.

the length of the chord which bears the arc of the edge between the top of the ventral column and the top of the shaft, column f gives the length of the arrow of the same segment and in column g the place of this arrow is given, viz., its distance to the top of the ventral column as a percentage of the length of the chord. These measurements are indicated in fig. 2.

The apical glands in some specimens are very broad. I did not see the dorsal continuations as described by Von Ritter-Záhony (1910d). The eyes lack pigment and often are too damaged to be visible; when visible they are seen lying close together in the anterior half of the head.

The number of teeth increases with age (table I). The smallest number found in this material was 8 and the greatest 24. The vestibular ridge as a rule is well visible, as are the glands and their openings, but no distinct papillae were observed. The corona ciliata is not perceptible. In three individuals I discovered rests of a tissue as in the collarette of many species

of *Sagitta* and in the mantle of *Pterosagitta draco*. In specimen no. 10 they form an elliptical zone on the tailfin just behind the tail end. In specimen no. 12 I saw them on the tail and on a part of the tailfin as a network resembling parenchyma in plants; specimen no. 13 showed some scattered rests. The spongy epithelium in the neck region, described by Von Ritter-Záhony (1910d), is not visible in the animals of this collection, neither are the dorsolateral canals; however, no sections were made. In the majority of the individuals the transverse musculature in the part of the trunk in front of the ventral ganglion is well visible. The longitudinal muscles in that part are not strong. Behind the ventral ganglion the transverse musculature is usually lacking and the longitudinal muscles grow stronger. In specimen no. 9 the ventral ganglion has a length of 0.67 mm and a width of 0.22 mm. The distance from the anterior end of the head to the beginning of the ventral ganglion is 21.5% of the total length. In specimen no. 15 this ganglion is 0.97 mm long and the distance to the anterior end of the head is 22.3% of the total length.

The neck is conspicuous.

The lateral fin in specimen no. 9 has rays at the outer side extending from 1 mm in front of the trunk-tail septum to 0.28 mm behind it. The last 0.5 mm is rayed throughout. In specimen no. 13 the rays begin 1.7 mm in front of the trunk-tail septum. The end of the lateral fin lies at 1.26 mm behind this septum. In specimen no. 15 the rays begin at 1.44 mm in front of the trunk-tail septum, while the end of the lateral fin is 1.67 mm behind this septum. Only in specimen no. 9 the sensory papillae are clearly visible. They are on the body, on the lateral fin and on the tailfin, being of different size. In most specimens the diameter of these papillae is 0.19 mm and the height 0.044 mm. The mutual distances in longitudinal direction are 0.82, 0.61 and 0.5 mm. On the tailfin the papillae are arranged symmetrically.

Diverticulae of the intestine were not observed. Large drops of oil were seen in the intestine and the coelom of many specimens. In the intestine of one specimen the small animals which had served as food were still clearly visible.

In many animals the ovaries are not visible in consequence of the opacity of the body wall. In specimen no. 1 they are extremely small. The peculiar large ovaries of the small specimen no. 2 have already been referred to above. In specimen no. 10 one of the ovaries was displaced; here both ovaries are well-developed, but the eggs are not visible. In specimen no. 15 the ovaries project outside the body. The cause of this abnormality is unknown to me. The narrow canal leading from the receptaculum seminis ends in a small funnel. The greatest width of the body is in front of and often

TABLE III

Measurements of *Eukrohnia fowleri* Von Ritter-Záhony

No.	Length in mm, tailfin excluded	Width in per cent of total length			Length of the tail without tailfin in per cent of total length	Head in per cent of total length		Lateral fin			Ovary		Number of teeth	Number of seizing jaws
		body without lateral fin	neck	trunk-tail septum		length	width	length in per cent of total length	anterior end before †, ° or on a level with ventral ganglion	post. end behind tail-septum in per cent of total body length	length in per cent of total length	width in per cent of total length		
1	±4.0	10.3	6.9	—	—	11.1	13.9	—	—	—	—	—	4-4	11-11
2	8.5	—	5.5	7.8	20	—	14.8	—	—	—	—	—	6-6	12-12
3	10.5	—	—	—	—	—	—	—	—	—	—	—	7-7	11-11
4	11.5	—	—	—	22	8.7	14.5	—	—	—	—	—	10-10	13*-12
5	13.0	—	—	—	22	—	—	—	—	—	—	—	17-17	12-12
6	13.3	14.8	5.9	13.4	23	8.4	12.8	—	—	—	—	—	16-16	13*-13*
7	13.5	—	6.2	9.1	20.7	—	—	—	—	—	28.8	—	11-11	12-12
8	14.0	—	—	—	—	—	—	—	—	—	—	—	8-8	12-12
9	14.0	14.3	4.8	9.9	21	9.9	13.1	—	—	—	—	—	———	13-13
10	14.4	16.2	—	—	28	—	—	—	—	—	—	—	20——	—
11	14.5	11.9	6.5	8.8	—	7.0	17.0	—	—	—	—	—	12-12	13-13
12	14.7	12.3	5.7	6.8	20	7.6	11.7	65.4	†	7.3	—	—	12-12	12-13
13	15.7	15.4	6.7	9.2	20	8.8	15.6	64.0	†	11.5	6.0	—	15——	13-13
14	16	—	—	—	—	7.3	13.1	—	—	—	—	—	13-13	12-12
15	16.2	—	—	—	—	—	—	—	—	—	—	—	12-12	13-13
16	16.5	11.8	6.7	7.9	21	7.4	13	67	°	11	—	—	18-18	11-11
17	17.0	11.1	—	—	19	8.2	13	—	—	—	—	—	———	12-12
18	18.5	13.2	5.7	10.8	28	6.0	12.0	—	†	15.0	9.0	3.0	17——	12-10
19	18.8	—	—	—	20	—	—	—	—	—	—	—	13-14	13-13
20	19.0	—	—	—	21	—	—	—	—	—	—	—	17-17	12-13
21	20.0	11.9	4.4	8.1	23	—	—	—	—	—	5.6	—	15——	11-12
22	20.5	12	7.3	—	—	7.9	15.7	—	—	—	—	—	17-16	11-11
23	21.5	—	—	—	21	6.7	13.4	—	—	—	—	—	16-16	12-12
24	41.5	7.8	3.5	4.6	22	3.7	6.7	—	—	—	—	—	24-24	12-11

* The dorsal jaw still very small.

near the trunk-tail septum. In specimen no. 1, one of the smallest animals of the collection, the testes are poorly developed. In specimen no. 8 they are on the way of ripening (the ovary is still very small), though I could not discover spermatocytes and spermatozoa in the tail. I did not observe sperm vesicles in any of the animals. In specimen no. 15 there is a faint indication of the area where the sperm cells leave the tail; this area extends over 0.44 mm (starting 0.11 mm in front of and ending 0.33 mm behind the end of the lateral fins).

The tail tapers gradually towards the beginning of the tailfin. From that point it often narrows more quickly. The measurements of specimen no. 10 are given as an example: the width of the tail from the trunk-tail septum to the beginning of the tailfin diminishes from 0.66 mm to 0.37 mm over a distance of 2.14 mm, while the width of the distal portion of the tail that is surrounded by the tailfin diminishes from 0.37 mm to zero over 0.66 mm; this is a narrowing of respectively 0.136 mm per mm and 0.56 mm per mm. In specimen no. 9 this difference is much smaller, the figures here being 0.4 mm per mm and 0.55 mm per mm.

The tailfin is rayed throughout; its greatest width lies behind the end of the body. In specimens no. 15 and no. 17 it is 3 mm long, being 2.7 mm in specimen no. 13 and 2 mm in specimen no. 9.

Eukrohnia fowleri Von Ritter-Záhony, 1910 (fig. 3)

The smallest specimen from the collection measures ± 4 mm (the end of the tail is damaged); the largest is 41.5 mm long. Table III gives the most important measurements of the present material. As in table I, there are many open places due to incompleteness of the material. Specimen no. 1 of table III has 9 of the 11 jaws at each side saginated; the two dorsal jaws at each side showing no sagination. The number of small teeth on the seizing jaws are given in table IV.

TABLE IV

Number of teeth on the seizing jaws (the jaws are numbered counting from dorsal to ventral)

no.	1	2	3	4	5	6	7	8	9	10	11
left side	0	0	16	18	19	—	22	22	18	16	18
right side	0	0	15	18	21	22	20	—	19	—	18

In the jaws with the smaller number of teeth the distance between the tip of the jaw and the beginning of the row of teeth is a little greater than in the jaws with more teeth. In specimen no. 2 only the ventralmost jaw at each side shows a sagination, which consists of only seven teeth. The sagination zone measures 12.5% of the straight line between the tip and the base of the edge. The distance between the tip and the beginning of the sagination measures 10% of this line.

The colour of the seizing jaws in *Eukrohnia fowleri* is the same as

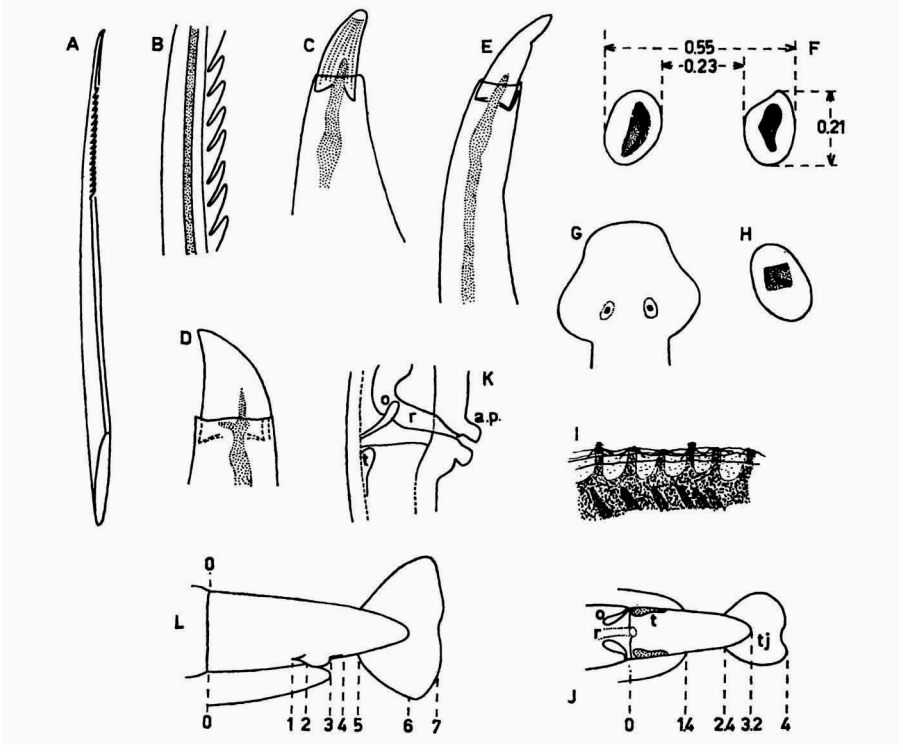

Fig. 3. *Eukrohnia fowleri* Von Ritter-Záhony. A, juvenile jaw; B, detail of same; C, tip of a jaw showing the fibres in the point; D, tip of a jaw showing the ramification of the pulp in the base of the point; E, tip of a jaw with an abnormally bent point; F, two well pigmented eyes of one specimen in situ (measurements in mm); G, head with eyes (length of head 1.2 mm); H, right eye of previous figure, enlarged (length of eye 0.22 mm); I, part of vestibular ridge with glands and tips of teeth showing; J, reproductive organs of a very young specimen in dorsal view (the numbers indicate the distance in mm to the anal opening; o = ovary, r = intestine; t = testis; tj = tailfin); K, same in lateral view (a.p. = anal papilla); L, tail (width of tail fin 3.54 mm; distances from points 1, 2, 3, 4, 5, 6, and 7 to tail septum: 2.3, 2.6, 3.2, 3.5, 4, 5.3, and 6.1 mm, respectively; 1-2, fold of the epidermis; 2-3, a thin-walled vesicle; 3-4, thickening of the epidermis). A, × 135; B, × 625; C-E, × 90.

in *Eukrohnia hamata.* The points are also colourless; they are not sickle-shaped, but resemble the upper half of the bill of a finch. In one jaw of one animal and in three jaws of another animal out of 11 animals examined, the point is longer and more acute than usual and has an abnormally bent tip. The pulp canal is relatively wide and consequently the pulp does not fill the canal completely, but is lying dorsally, centrally or ventrally in the canal and is often alternatingly thin and thick. In the point the pulp canal often lies dorsally. In one point the pulp shows a small ramification in the base. In the majority of the examined jaws the base of the point and the top of the shaft are converging to the back of the shaft and in the minority they run nearly parallel. The points of two very small jaws show still a cap of epithelium, which was torn off by the growing shaft. The base of the point as a rule is hollow and irregular and only in some specimens it is nearly oval. Faint lines that in some points converge to the tip indicate the fibres that form the point. They begin at the base and end at a little distance from the tip. Noteworthy is the phenomenon observed in some points that the upper half is bent backwards, while the surface membrane seems undamaged. The top of some shafts undulates, but in general it forms a straight line. In the upper and middle part of the shaft the pulp canal lies dorsally and not centrally. In the majority of the examined shafts the distance from the pulp canal to the edge of the shaft is larger than the sum of the width of the pulp canal and the distance of the canal to the back of the shaft; this clearly demonstrates the dorsal situation of the pulp canal in these parts. In all jaws the distance from the pulp canal to the edge is greater than to the back of the shaft. In 11 out of 38 examined jaws this distance to the edge is equal to, or greater than, twice the distance to the back. Below the point there often is a constriction or a swelling in the pulp. In 65 out of 86 jaws the edge is concave over its whole length. In the remaining 21, over a very short distance below the top the edge is convex, or straight, or convex and straight. There are animals with all jaws of the same kind, but in some they are different. The weakly convex zone varies in length from 0.026 to 0.04 mm, the straight zone being 0.02 mm. These figures agree with those given for *E. hamata.* In *E. fowleri,* however, the percentage of jaws with a wholly concave edge is much greater than in *E. hamata.* For the rest the number of jaws in *E. fowleri* is greater than in *E. hamata.* Tables V a and b give some measurements of the present species which may be compared with similar measurements of *E. hamata* given in table II. Comparing the figures of columns a, e and f of table V a and b with those of columns a, e and f of table II, one notices that the jaws of the two measured specimens of *Eukhronia fowleri* are almost

TABLE V a

Measurements (in mm) of some jaws in sequence of size of one animal of *Eukrohnia fowleri* Von Ritter-Záhony

	a	b	c	d	e	f	g
1	2.29	—	—	0.016	—	—	—
2	1.50	—	0.103	0.018	1.07	0.09	63-73%
3	1.48	—	0.10	0.017	1.13	0.09	48-68%
4	1.48	—	—	0.017	—	—	—
5	1.37	—	0.103	0.019	—	—	—
6	1.27	—	—	0.021	—	—	—
7	1.18	—	—	0.019	—	—	—
8	0.99	—	0.080	0.021	0.50	0.043	55%

twice as large as those of the measured specimens of *Eukrohnia hamata,* but that the figures of column f are four times as large in the former species. This demonstrates clearly, that the curvature of the jaws of *Eukroh-*

TABLE V b

Measurements (in mm) of some seizing jaws of *Eukrohnia fowleri* Von Ritter-Záhony (after an animal different from that of table Va)

	a	b	c	d	e	f	g	h**
9	1.71	—	0.0969	0.0182	1.083	0.114	52%	0.0338
10	1.653	—	0.1368	0.0169	1.140	0.1596	50%	damaged
11	1.60	—	0.114	0.016	1.14	0.1311	65%	0.0273
12	1.60	—	0.131	0.016	1.17	0.171	50%	damaged
13	1.596	—	0.1026	0.0195	1.0545	0.1026	55%	0.0325
14	1.596	—	0.1026	0.0182	1.083	0.1368	58%	0.0325
15	1.596	—	0.1482	0.0169	1.083	0.1539	50%	0.026
16	1.54	—	0.091	0.017	0.912	0.0969	53%	0.0325
17	1.539	—	0.136	0.022	1.14	0.171	50%	damaged
18	1.539	—	0.097	0.013	1.026	0.114	50%	not measurable
19	1.482	—	0.1311	0.0156	0.983	0.1539	42%*	0.0325
20	1.425	—	0.114	0.013	1.026	0.1482	44%	0.0234
21	1.368	—	0.114	0.014	—	—	—	0.026
22	1.311	—	0.1035	0.0247	0.57	0.117	60%	0.0325
23	1.254	—	0.114	0.013	1.026	0.114	45%	damaged
24	1.254	—	0.0684	0.0104	0.912	0.0892	50%	damaged
25	1.14	—	0.0741	0.0091	0.855	0.114	50%	0.0169
26	0.741	—	0.063	0.0247	0.342	0.023	50%	0.0325

* Over $\frac{7}{19}$ nearly the same arrow.

** Under h the length of the points in mm.

nia fowleri is stronger than that of *Eukrohnia hamata.* Comparing the figures of columns c and d one notices that the width of the jaws of *E. fowleri* is not greater relatively than of *E. hamata.* The heads of *Eukrohnia fowleri* are relatively more robust than those of *E. hamata;* the same is true for the width of the body.

The apical gland of *E. fowleri* is well developed. In 17 animals the eyes are not visible; in three they are distinct but without pigment and in three specimens the pigment is well visible. However, there is a difference in the shape of the pigmented parts of the eyes. In *E. fowleri* the eyes are placed farther back on the head than in *E. hamata.* In one specimen the eyes are placed 0.1 mm behind the brain. The eyes themselves are 0.18 mm long. In another specimen the distance between the eyes is 0.23 mm; the length and width of the eyes being 0.21 and 0.16 mm respectively. In a third specimen the length of the eyes is 0.22 mm and the width 0.18 mm. The anterior end of the eyes lies 0.8 mm from the beginning of the head, the posterior end lies 0.2 mm from the posterior end of the head. The distance separating the eyes is 0.22 mm.

The number of teeth does not differ much from that of *Eukrohnia hamata,* but in specimens of the same length the number is greater in *E. hamata* than in *E. fowleri.* The shape and the place of the teeth are the same in both species. The vestibular ridge is not conspicuous. It lies at the ventral side of the head behind the teeth, which, when directed backward, cover it. In some cases I could distinguish small papillae on the top of which the glands open. In some of these openings plugs of secretion were visible. The excretory ducts are well visible through the epidermis.

The corona ciliata was not observed, neither were a collarette or dorsolateral canals.

TABLE VI

Measurements (in mm) of length and position of the ventral ganglion in five specimens of *Eukrohnia fowleri* Von Ritter-Záhony

specimen no.	total length	length ventral ganglion	distance between anterior margin of head and distal end of ventral ganglion
11	14.5	1	—
12	14.7	1.05	3.5
13	15.7	0.83	5.7
16	16.5	0.9	3.6
22	20.5	1.4	5.2

The neck is conspicuous. The transverse musculature was visible in eight animals. In one case this musculature extended clearly beyond the ventral ganglion. Table VI provides the measurements of the ventral ganglion in five animals.

The longitudinal muscles become gradually stronger posteriorly. The lateral fields between the dorsal and ventral bands of these muscles are wide. Only in some specimens the lateral fins are well visible over the whole length of the body. The dense fin-rays are confined to the back of the

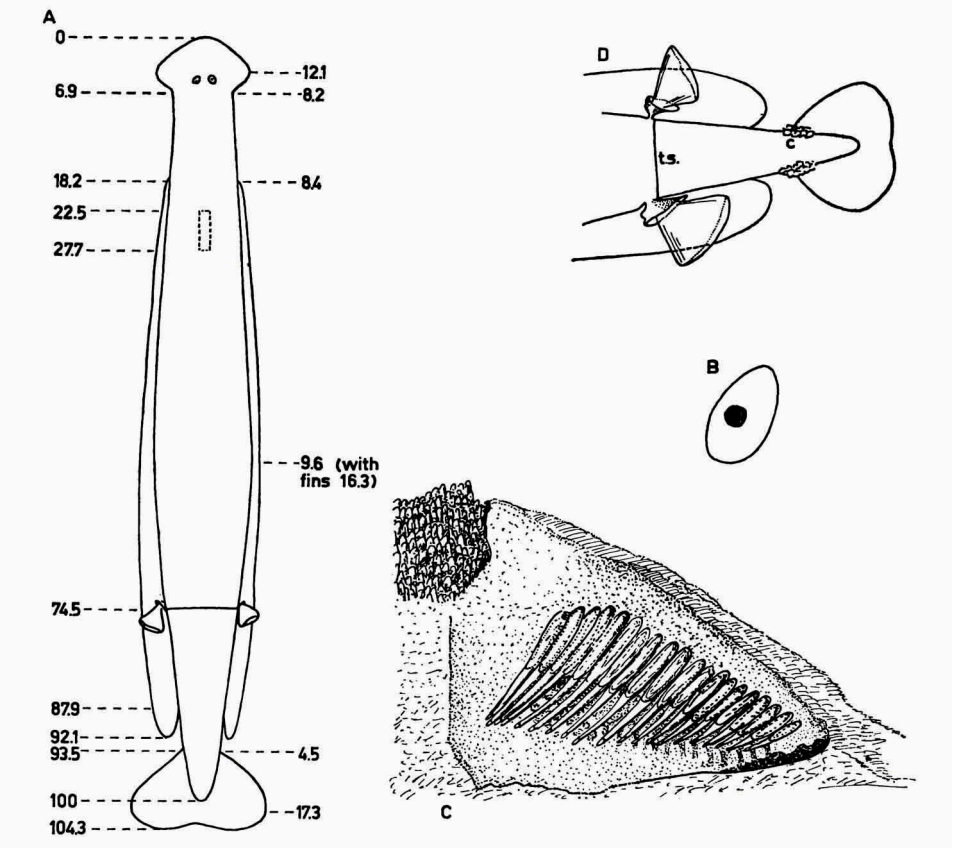

Fig. 4. *Eukrohnia richardi* Germain & Joubin. A, specimen of 23.1 mm total length (the numbers on the left side indicate the distances of various parts of the body to the apex of the head in percentages of the total length, tailfin excluded; the numbers at the right side indicate the width of various parts of the body in percentages of the total length, tailfin excluded); B, left eye of specimen figured in fig. A (length of eye 0.31 mm, width 0.17 mm; width of pigment spot 0.06 mm; distance of pigment spot to anterior margin of eye 0.14 mm; same to posterior margin of eye 0.11 mm); C, anterior ventral left side of the head with apical gland, vestibular ridge, glands and teeth; D, part of trunk and tail (c. = bladder-like cells; t.s. = trunk-septum).

fin. Near the trunk-tail septum the rays are visible only in the outer part of the fin, but in its posterior part the fin is rayed throughout. Sometimes the rays are damaged.

Intestinal diverticulae were not observed. Oil droplets were present in some specimens.

Anal papillae were present. The number of ovaries that could be measured was so small that a comparison with those of *E. hamata* proved not possible. The receptaculum seminis is distinctly bag-shaped and the funnel-shaped outer opening of the excretory duct was visible in one case. Eggs were not present. One specimen (no. 18) had spermatocytes and sperm cells in the tail; at the end of the lateral fins there are thin-walled and tender organs that resemble the sperm vesicles of *Sagitta*. In another specimen there is a distinct thickening on the corresponding place. The tail is less acuminate than in *E. hamata*. The tailfin is provided all over with densely placed rays.

Eukrohnia richardi Germain & Joubin, 1916 (fig. 4)

As mentioned above, Germain & Joubin (1916) described a new species under the name of *Eukrohnia richardi*. In his Philippine material Michael (1919) found this species represented by five specimens, only two of which were well enough preserved to permit of a certain identification. He was not certain whether or not this species is valid. Burfield & Harvey (1926) referred seven specimens of the "Sealark" collection to this species and declared that, althoug the number of specimens at their disposal was small, it would appear that the species was valid.

Three specimens of the "Snellius" material show the characters described by the previous authors to be typical for the species. One specimen has lost its head; the second lost its head during examination of the material, while the third was only slightly damaged. Table VII gives some measurements of the latter two specimens. The body of the first specimen (which because of its incompleteness is not included in table VII) measures 19.5 mm; the width of the trunk (without the lateral fin) is 2.8 mm; the length of the tail 5.6 mm.

The colour of the jaws is like that of the two other *Eukrohnia* species. An apical gland is present. The eyes have pigment, they are oval and their long axes converge to the front of the head. The pigmented part is small. The distance from the front of the head to the eyes is 1.1 mm and that from the eyes to the back of the head 0.4 mm. The distance between the two eyes is 0.6 mm.

The teeth and jaws are similar to those of *Eukrohnia fowleri*. The vesti-

TABLE VII

Measurements of *Eukrohnia richardi* Germain & Joubin

No.	Length in mm, tailfin excluded	Width in per cent of total length			Length of the tail without tailfin in per cent of total length	Head in per cent of total length		Lateral fin			Number of teeth	Number of seizing jaws
		body without lateral fin	neck	trunk-tail septum		length	width	length in per cent of total length	anterior end before †, ventral ganglion	post. end behind tail-septum in per cent of total body length		
2	21	9.7	—	—	26	6.3	11	—	—	—	20-20	13*-12*
3	23.1	13	8.2	9.6	25.5	6.7	12.3	74	†	17.7	——	12-12

* The dorsal jaw still very small.

bular ridge is well visible and possesses glands as in the two other species.

The corona ciliata, the dorsolateral canals and the intestinal diverticulae are not visible, neither is the collarette. The neck is conspicuous. The transverse musculature extends from the head to beyond the ventral ganglion. The longitudinal muscles are feeble in the anterior part of the trunk. The lateral fields between the dorsal and ventral muscles are broad. In the best preserved specimen the lateral fins begin 1 mm before the ventral ganglion (4.3% of the total length of the animal). In the posterior part of the fin the rays are conspicuous. Near the septum they make an angle of $\pm$ 45° with the body wall; at the end of the fin this angle is $\pm$ 10°. In the other parts of the lateral fins the rays are very thin and do not always reach the body. In some parts the rays are wanting. The tips of the fins reach farther backward than their bases. The ovaries are visible in one specimen; they are not long. Sperm vesicles are not present. In all three animals large membranous funnels are present in the funnel-shaped end of the receptaculum seminis above the lateral fins. The iridescent colours of these funnels show them to be very thin. They reach beyond the outer border of the lateral fins. Figs. 4 A and D give an idea of the shape and place of these organs.

The three animals agree with the account given by Burfield & Harvey of this species in having rather swollen cells of the type seen in a well-developed collarette of *Pterosagitta draco* (Krohn). In one of the animals these cells are placed near the base of the tailfin and in some other parts of the body, but not on the head or neck. In the second specimen they

were only found on the sides of the tail near the base of the tailfin. The last specimen had the whole tail covered with a thin layer of these cells, with their strongest development in the basal part of the tailfin; this animal also showed such cells at the beginning of the lateral fins near the ventral ganglion.

Literature cited

In the present list only those titles are given which are not found in the bibliography of my previous paper (Schilp, 1941).

Hertwig, O., 1880. Die Chaetognathen. Jena. Zeitschr. Naturwiss., vol. 14, pp. 196-303, pls. 9-14.

Möbius, K., 1875. Vermes. Zoologische Ergebnisse der Nordseefahrt vom 21. Juli bis 9. September 1872. Jber. Comm. wiss. Unters. Deutsch. Meere, vol. 2, pp. 153-170, pl. 3.

Ritter-Záhony, R. von, 1910 d. Die Chätognathen. In: F. Römer & F. Schaudinn, Fauna Arctica, vol. 5 pt. 1, pp. 249-288, pl. 5.

Schilp, H., 1941. The Chaetognatha of the Snellius Expedition. Biological Results of the Snellius Expedition IX. Temminckia, vol. 6, pp. 1-99, figs. 1-29.