BISCAYAN PLANKTON.

PART III.—THE CHÆTOGNATHA.

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(Plates 4–7.)

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ON THE SYSTEMATIC DETERMINATION OF CHÆTOGNATHA.

CONSIDERING the comparatively small number of species, few animals can be more troublesome to identify than a large collection of Chætognatha. This results not only from the inadequate diagnoses by many of the earlier describers, but also from the scarcity and variability of the external diagnostic characters, the considerable differences in the proportions to one another of the various parts (produced in the less firm species by varying degrees of expansion and contraction), and the difficulties of satisfactory preservation.

Taking these points in a little more detail—Oscar Hertwig reduced to order such species as came under his notice, but unfortunately these were not numerous. Had all later observers given equally careful descriptions, our task to-day would have been easier; but, as it is, cursory descriptions of a few external features, taken apparently, in many cases, from only one or two specimens, are the rule in the literature of the subject. Almost more trouble has been caused by inadequate drawings *; considering how closely alike at first sight are even such undoubtedly "good" species as *hexaptera* and *enflata*, no freehand drawing of the outline of a *Sagitta* can be trusted, because a quite small error in the proportions of head, body, tail, and fins may easily give the misleading outline of another species. Every reporter on a collection of Chætognatha, who desires to help in placing the genera and species on a proper footing, should give an

* Perhaps this sweeping statement may be held to require justification. Among recent papers, one author gives measurements showing the tail-segment of a species to be 24 per cent., or nearly a quarter, of the total length, but draws it 31 per cent., or nearly a third. Another writer says that "the posterior fins touch the vesiculæ seminales," yet draws them far apart; in another species he describes the tail-segment as a fourth of the whole length, and draws it as 35 per cent., or more than a third. When one finds such inaccuracies in easily measurable matters, absolutely no reliance can be placed on the figure as a whole.

outline drawing by *camera lucida* of a typical specimen of every species, however well known, wherever possible.

As regards the variability of diagnostic characters, it seems to be very desirable that for every species in every collection (however common) a table should be furnished showing at least the proportion of tail to total length, with the numbers of jaws and teeth *at different lengths*, until such time as we shall have gained some idea of the variability within the limits of each species. More measurements would be desirable, but are often impossible owing to the imperfect condition of the specimens.

As regards preservation, the material from the 'Research' and from the 'Siboga' Expeditions leads me to believe that the best method is to preserve each specimen separately in formalin, at first weak, then in a stronger solution (5–7 per cent.). Neither sublimate, picric acid, osmic acid, nor spirit (alone or in combination with the foregoing) gives such good results *.

Some characters which have been used in diagnosis seem to require clearing away. The projection, size, and shape of the vesiculæ seminales appear to depend entirely upon the sexual condition of the individual at the moment of capture. The size of the ova seems to me also to be valueless, since one cannot always tell whether they are ripe or not. The extension forwards of the ovaries has more significance, but too much stress must not be laid upon it; for example, the mature ovaries reach to the neck in *robusta*, never (so far as I have seen) more than halfway to it in *enflata*, but a developed ovary of *enflata* and a half-grown ovary of *robusta* are of the same length and have ova of nearly the same size. Drawings and measurements of the head are diagnostically almost valueless—its shape, proportions, and apparent size alter so enormously according to the condition at death, with the extension forwards, outwards, or inwards of the jaws, with the retrusion into the prepuce, &c.

The presence or absence of two diverticula on the alimentary canal in the neck has been used diagnostically by recent writers: so far as my experience goes, these depend on the extent of protrusion or retrusion of the head; at any rate within the limits of the same species I have found some specimens with, and some without, these diverticula.

The colour of the body does not appear to be diagnostic: specimens from deep water are often of a salmon-pink; but in the same hauls some specimens of *hamata* and *macrocephala* were pink, others colourless.

If specimens were always perfectly preserved, the fins would be a good guide to species, and in many cases are of some value when present; but they are so often shrunken, torn, or rubbed away as to be of no help. The form of the corona ciliata is useful, when it is retained on a specimen (by no means always the case) †.

* So far as Chætognatha were concerned, I committed a great error in making the epiplankton hauls too long (generally one hour: half an hour would have been preferable). Specimens which are caught early in the haul become compressed against the sides of the net, and the prolonged pressure flattens and otherwise damages them considerably (*cf.* the account of *S. furcata*, p. 64). More numerous hauls of shorter duration would have yielded better specimens and would ultimately have saved time, at a slightly greater expenditure on bottles, cases, &c.

† In order to see this, and to make outline camera drawings of the whole animal, I have found nothing better than a 1 per cent. solution of methyl blue, used for about one minute. The colour soon fades, and leaves the specimen uninjured for museum purposes. In drawing, I have found the Giltsch-Zeiss support, used with an Abbé camera, invaluable.

It may, then, be asked, what is left by which to distinguish the species of Chætognatha? The general outline of the body counts for something; that is to say, the proportion of head to body, the position of the thickest part of the body, the ratio between the lengths of the postanal region and the trunk. Of these only the last one can, as a rule, be safely expressed in measurements, as the proportions of head and body vary so much with the extent of the death-contraction. Other fairly fixed characters are the presence or absence of a constriction between head and body to form a "neck"; a lateral expansion of the ectoderm at this point *; a sudden diminution of the body-diameter at the anus as contrasted with a gradual tapering, or a marked constriction at the septum †.

The consistency of the body is of some value: those species with comparatively large longitudinal muscles and small muscle-free lateral fields (e. g., *bipunctata*) have a firmer consistency, and in formalin a more opaque appearance, than species with comparatively poor musculature and large lateral fields, such as *hexaptera*; these seem flabby and transparent in formalin, and often have a wrinkled appearance, if not very carefully preserved when alive.

As regards the lateral fins, if well preserved, a comparison of their width with that of the body, and a comparison of the widths and lengths of the two pairs, are more safely expressed by camera drawings than by measurements; their extension forwards as tested by the ventral ganglion, backwards as tested by the vesiculæ seminales, centrally as regards the anal septum, are of great value. The tail-fin is less instructive; its extension forwards as regards the vesiculæ seminales is useful, but its outline is very readily damaged, and a truncate fin easily splits into an apparently bilobed one, or wears into an ensiform shape. Too much stress must not be laid, except in perfectly preserved material, on the triangular or elliptical outline of the posterior fins: it is quite easy to find specimens (*e. g.*, of *furcata*) with an almost triangular fin on one side which had been rubbed into an ellipse on the other.

The most stable parts of a Chætognath are formed by the cephalic armature—the jaws (*cirrhi, uncini*) and teeth ‡. These are often the *only* characters by which to identify a badly preserved specimen, but they must be used with care, since, as I shall show later in dealing with the various species captured, they are liable to considerable variation. Still, allowing a considerable latitude for these variations, their mere numbers afford a fairly accurate criterion when taken in conjunction with the characters already cited. If to these be added a detailed study of the jaw-structure, such as Dr. Krumbach § has recently worked out for several species, the observer may feel

* For this, which has been termed a "neck-fin," I have used the name "collarette."

† Dr. Krumbach writes that he has worked out the form of the tail-segment as a diagnostic character for Mediterranean species.

‡ The counting of these is often troublesome. I use two short slips of glass cut from a slide, lay one across the dorsal surface of the specimen just behind the head, and then, bending the head upwards and backwards with a needle, prevent it from falling forwards again by pushing the second glass slip up against it; and drop a cover-glass on the whole. This enables one to study the armature from the anterior end, and generally to count the teeth and jaws readily.

§ Th. Krumbach: "Ueber die Greifhaken der Chätognathen," Zool. Jahrb. (Abth. Syst. u. s. w.) xviii. 579 (1903).

himself on safe ground. As a secondary character, I find the form of the vestibular ridge, which lies just in front of the posterior teeth, to be of assistance. In many cases below, the anterior and posterior teeth have been figured, but I doubt whether such drawings have much value; the teeth look so different when viewed at different angles.

EXAMINATION OF THE 'RESEARCH' SPECIMENS.

The first hauls examined were dealt with very carefully; the dimensions of every specimen taken, and the jaws and teeth counted, until every common species had the look of a familiar friend. After that, the epiplankton hauls were sorted, chiefly by a dissection-lens, measurement and counting being done only in cases of doubt, or as an occasional check on sorting by eye. Of the mesoplankton hauls, on the other hand, every specimen (except a few young *zetesios*) was measured and counted and identified with care. When the whole collection had been thus sorted into species, every specimen was re-examined; and as there were over 2100 specimens, the task has not been light.

It is therefore possible, though not likely, that a few "*hexaptera*?" have been mistakenly assigned to *furcata*. Mistakes are especially likely to occur with very young specimens (one species excepted), and they have therefore not been recorded when in the least doubtful: small specimens are often impossible of determination in the present state of our knowledge, because the numbers of jaws and teeth are then small, and the proportion of tail to trunk is generally higher than in older specimens; even the character of the jaws alters with age in some species. The one exception referred to above is fortunately the interesting *hamata*, the hooked jaws of which are recognizable even at 5·5 mm. total length; in young *serratodentata* the younger (dorsal) jaws alone are hooked, and more slightly so than in *hamata*.

SAGITTA SERRATODENTATA, Krohn. (Pl. 4. figs. 1–6.)

Characters.—Head small; body slender, pin-like like *bipunctata*, thickest about the middle of its length, tapering gradually forwards and backwards; a marked neck, but no collarette; body firm, retaining its shape. Longitudinal muscles broad, but thin; lateral fields rather narrow; no marked constriction at the septum.

Anterior fin long, extending to ventral ganglion, widest near its posterior end. Distance separating the anterior and posterior fins very short. Posterior fin long, longer and wider than the anterior, extending to (or very nearly to) the vesiculæ seminales; about as much on body as on tail; widest point about midway between septum and vesiculæ seminales. Tail-fin truncate.

Ventral ganglion of medium size, prominent. Corona ciliata long, sinuous, extending from between the eyes to about halfway to the ventral ganglion. Jaws strongly curved; the younger (dorsal) jaws serrated and slightly hooked at the tip *. Teeth of

* For a detailed description, see Krumbach, Zool. Jahrb. Syst. xviii. (1903) 579.

both rows comparatively short and triangular. Vestibular ridge with rounded prominences fewer than the teeth, ridge about the same length as the posterior row.

Length in mm.	Tail as p.c. of length.	Jaws.	Anterior teeth.	Posterior teeth.
15	26	6–7	6	12
14	25–28	6–7	5–6	10–11
13	22–34	6–8	6–7	8–12
12	25–29	7	4–7	8–13
11	27	8	6	9
10	30–35	7	4–6	7–10
9	27–33	6	4	5–6
8	25–31	6–7	3–4	6
7	28–35	6–7	3–4	2–6
6	30	6–7	3–4	5–6
5	30–36	6	2–3	3–4

General Distribution.—The general table of Chætognath occurrences and the table of average specimens following show that this form is essentially epiplanktonic. Plentiful at all horizons to 100 fathoms, it yielded only a single damaged specimen below that level in the closing-net (21 *b*, 200 to 100 fathoms). It occurred, naturally enough, in the open serial nets lowered to greater depths, but may have entered these at any point. The captures with open nets are analysed in the table following *:—

At	0	fathoms this species occurred in	62	per cent. of the hauls, with	8·6	average specimens per hour haul †
	25		66		4·0	
	50		76		9·6	
	75		81		3·4	
	100		90		5·3	
	150		1	haul, with	1·0	
	200		1		1·0	
	250		0		0·0	
	300		1		1·5	
	350		1		1·0	

It is fairly obvious from the percentages of hauls in which the species occurred that the expectation of meeting with *serratodentata* increases with the depth down to

* This table is to be read as a sentence from left to right.

† Throughout the discussion of distributions, the "average specimens" are averaged over *all* hauls at the depth mentioned; not merely over those in which the species occurred. See also note † on next page.

100 fathoms. The average expectation of specimens would seem to be greatest at the surface and 50 fathoms, time of day and other variants being neglected.

From the facts cited above it is obvious that the distribution of this species is between the surface and 100 fathoms, possibly but improbably, a little deeper.

Reaction to Time of Day, Light, Rain, &c.

The hauls with open nets in the epiplankton were arranged, so far as circumstances allowed, to test the alleged nocturnal rise and diurnal fall of the fauna of the upper strata, and the effect on it of varying physical conditions. I have endeavoured—with great elaboration, but very little success—to use *serratodentata* as a test-case, since it was fairly plentiful at the higher levels.

In the first place, when arranged on the time-depth tables *, the occurrences show no indication whatever of a nocturnal rise and diurnal fall.

In the second place, with regard to the reaction of this species to light, I adopted Mr. E. W. L. Holt's suggestion of a photographer's actinometer (*cf. suprà*, p. 6).

The numbers of specimens captured † were arranged by light-intensity at the various depths down to 100 fathoms into six groups, according as the sensitive paper of the actinometer reached the standard tint at 2″, 3″ to 6″, 7″ to 10″, 11″ to dusk or dawn, or as the night was dark or brightly moonlit. The only thing that seemed definitely to come out of this attempt was the negative proposition that *serratodentata* has no special affection for moonlight, since six hauls in bright moonlight produced in all but five specimens. On the other hand, the largest numbers of specimens taken at the surface occurred in a 2″ light (48 specimens) and between 11″ and dusk (51 specimens), so that the actual light-intensity of the moment in daylight does not seem materially to affect its presence at the surface.

Now, although the light-intensity of the moment *in daytime* does not seem to affect the distribution of *serratodentata*, nevertheless it would seem that there exists an oscillation of this species, but it is the exact contrary of that generally alleged to affect the epiplankton. Dividing the upper hauls into three groups:—(1) daylight, 3 A.M. to 7 P.M.; (2) night, 7 P.M. to 3 A.M.; (3) hauls taken during or after rain, irrespective of the time of day, and not reckoned under (1) and (2): then we have the following table, showing the average, the maximum, and the minimum number of specimens captured:—

* Reproduced on p. 62: the occurrences of the species are marked in heavy type. The construction is described on p. 7 (*suprà*).

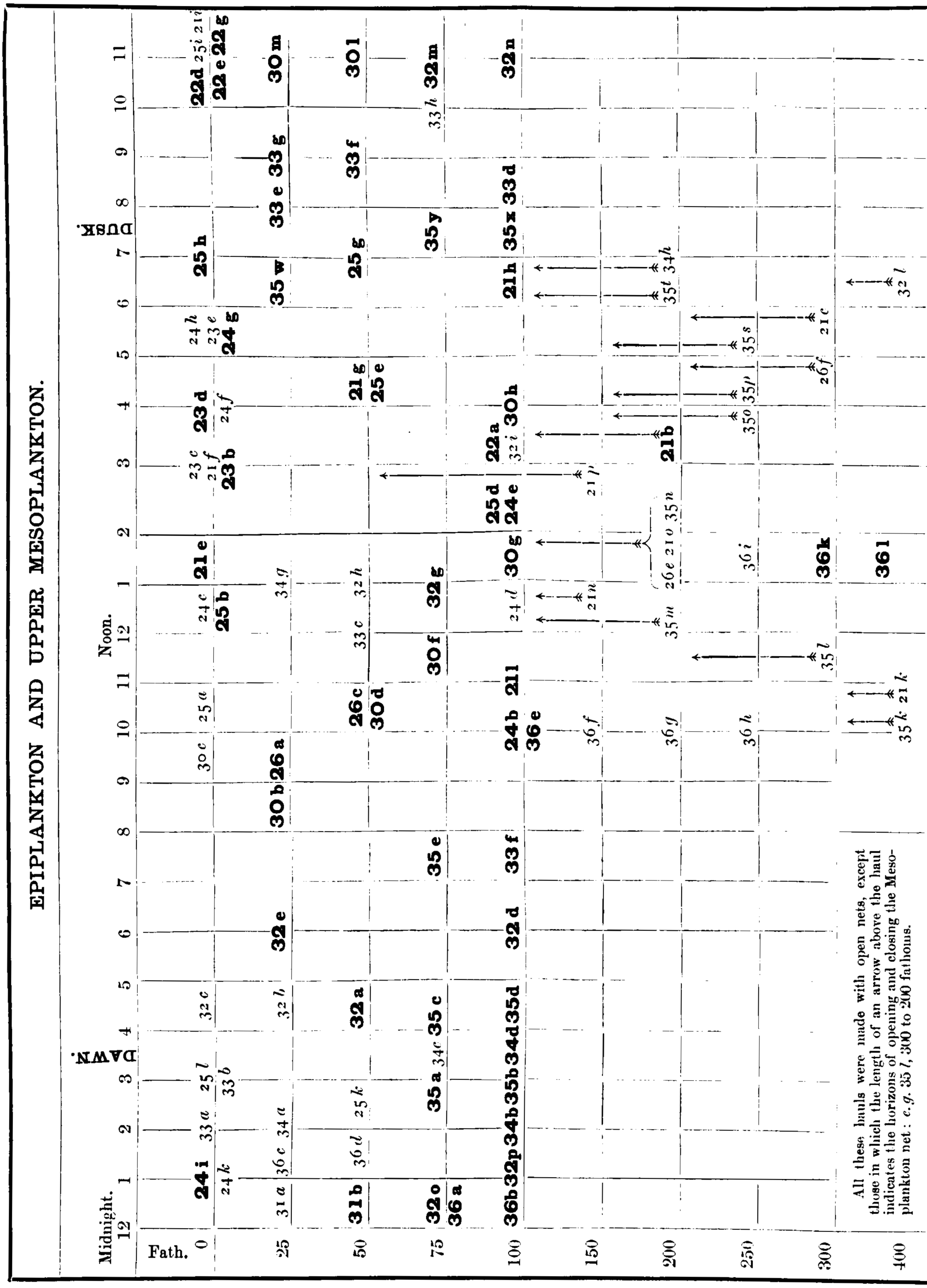
† In these calculations, nine surface-hauls made with a net of 180 meshes per inch linear have been omitted, as it was obvious from a comparison with other nets of wider mesh out at the same time that its small mouth and small filtering area made it useless for catching *Sagitta*. The numbers actually caught have been treated with a time-factor to bring them to the standard one-hour haul, which was the usual period: for example, the numbers taken in a half-hour haul have been multiplied by 2, those taken in a two-hour haul divided by 2, &c. Single specimens, however, have not been divided.

Depth.	Number of hauls.	Day, Night, or Rain.	Specimens.		
			Average *.	Maximum.	Minimum.
0	6	D.	22·1	51	2
	8	N.	0·6	2	0
25	5	D.	4·6	17	0
	4	N.	1·2	3	0
50	7	D.	9·8	28	0
	3	N.	0·6	2	0
75	4	D.	4·0	6	1
	6	N.	1·5	6	0
100	11	D.	5·0	20	0
	9	N.	2·6	6	1
0	2	R.	0·5	1	0
25	3	R.	6·6	8	6
50	3	R.	18·3	28	11
75	1	R.	13·0	13	13
100	2	R.	19·0	28	10

The observations are by no means so numerous as one could wish, but on a comparison with the average catch per haul already given, it will be admitted that this table appears to bring out clearly two points:—Firstly, that the species seeks the surface in daylight hours and shuns it at night; secondly, that during or after rain it descends, being caught in the largest numbers between 50 and 100 fathoms. The two rain-hauls at the surface were in the bright hours of daylight, when the average catch is 22·1 specimens.

The average daylight catches at all depths except the surface are very close to the averages taken over all hauls, whereas the average night catches are well below those general averages. I cannot account for this, except on the assumption that the species shoals at the surface by day and scatters below by night. Although I never worked below 100 fathoms at night, I do not believe that this species sinks below that horizon under any conditions of life, otherwise I should almost certainly have taken, at any rate, occasional specimens in the daylight of early morning or late evening in the closing-net.

* Averaged over all hauls, whether the species was captured or not.



SAGITTA SERRATODENTATA, Krohn.

SAGITTA FURCATA, Steinhaus *. (Pl. 4. figs. 7–15.)

Characters.—Head comparatively small; body thick; neck not well marked in well-preserved specimens; no collarette. Body nearly equally thick throughout the middle third, tapering gradually towards the head, very rapidly to the tail; generally a marked constriction at the septum. Longitudinal muscles broad but thin; lateral fields large; the body is therefore transparent and flabby, easily compressed in the tow-net.

Posterior fin oval (elliptical), never quite triangular, about two-thirds on the body, one-third on the tail; its widest part well in front of the septum; it ends at some distance from the vesiculæ seminales, but extends anteriorly nearly to the anterior fin. Anterior fin widest posteriorly, but not so wide as the posterior fin; it extends nearly to the ventral ganglion. Tail-fin rounded and (? always) bilobed.

Ventral ganglion small. Corona ciliata resembling that of *hexaptera*, but almost entirely on the head, just reaching the neck.

Jaws strong and markedly curved. Teeth long, strong, sharp.

Length in mm.	Tail as p.c. of length.	Jaws.	Anterior teeth.	Posterior teeth.
35	17	6–8	5–7	11–12
33	17–18	7–8	7–8	9–10
31	18–20	8–9	6–7	9–11
28	18–21	7–8	6	9–11
26	19–21	8–9	6	10
23	19	8–9	5	8–9
21	18–21	7–9	5	7–8
19	18–21	7–8	5–6	6–8
17	17–23	8–9	4–5	7–8
15	20–23	8–9	4	6
13	17–23	8–9	4–5	5–7
12	24–25	8	3	5–6

These characters do not in every respect agree with those given by Steinhaus, notably as regards the fins. But from his mention of the "eigenthümliche Runzelung der Epidermis," I gather that his specimens, like the majority of mine, had suffered severely in the tow-net. As I was in some doubt as to the identity of my specimens with *furcata*, Dr. Krumbach, with some of Steinhaus's specimens before him, was kind

* O. Steinhaus: 'Die Verbreitung der Chætognathen im südatlantischen und indischen Ozean.'

enough to inform me that they are specifically identical, even when tested by his new criterion of the character of the tips of the jaws.

No species, to my knowledge, alters more from damage in the tow-net and from faulty preservation than this. In transparent and well-preserved specimens (fig. 7) the lateral fields may shrink inwards so as nearly to carry the anterior fins out of sight; such specimens are slightly flattened laterally. But in specimens caught early in the haul, which were crushed by pressure of the water against the net and were dead before preservation, notably in such specimens when preserved with picric acid, the trunk, or the tail, or more often the whole body, has a corrugated appearance, and the epidermis stands out laterally in a broad selvage, due partly to mechanical dorso-ventral compression, partly, I think, to an actual loosening of the epidermis from the subjacent tissue. This compression often makes the lateral fins appear much wider than they really are, and sometimes even produces such a bridge between the anterior and posterior fins as is attributed to Krohn's species *lyra* * (fig. 9).

The lateral shrinkage or dorso-ventral compression made the identification so troublesome that, for the benefit of future workers, I have drawn four states of *furcata*, of which I take fig. 8 to be the normal.

Distribution.—The general table of Chætognaths and the figures immediately to be given clearly indicate that this is an epiplanktonic species. The following table is an analysis † of the captures with open nets:—

At (fathoms)	it occurred in		average specimens per hour haul
0	37	per cent. of hauls, with	1·8
25	16		0·3
50	84		7·8
75	100		16·8
100	100		26·9
150	1	hauls, with	3·0
200	2		1·5
250	2		2·0
300	1		1·5
350	1		4·5

It occurred also in the closing-nets:—

150–50 fathoms, average specimens 13·0;
200–100 fathoms, average specimens 1·4;

but was not captured below the last zone ‡. From the above facts it is fairly apparent that the species is distributed from the surface to 100 fathoms, with a maximum distribution between 75 and 100 fathoms, a few specimens living between 200 and 100 fathoms.

* It is quite possible that the name *lyra* was given to some other species compressed in this fashion: if one may judge from the general description and from the number of teeth and jaws, Krohn very likely had *furcata* before him.

† See note, p. 60.

‡ Unless the specimens mentioned under iii. (p. 74) are really *furcata*.

The occurrences at 0 and 25 fathoms were so few that no indication of any reaction to time of day, light, or rain could be expected, even if such reaction existed. At 50 fathoms and down to 100 the specimens are so closely massed that we may regard the captures at 25 and 0 as stragglers from the main body, just as those between 200 and 100 fathoms.

SAGITTA MACROCEPHALA, sp. n. (Pl. 5. figs. 16–21.)

This species, coming only from considerable depths, presented but few specimens in sufficiently good condition for accurate description. The following points, however, will serve for diagnosis until better specimens are recorded by other observers.

Characters.—Head very large, forming when fully expanded a truncated triangle. Neck narrow and without a "collarette." Body slender, firm, but much thicker in the middle than anteriorly; lateral fields not large. Tail-segment about one-third or more of the total length; tip of tail generally bluntly conical.

Anterior fins small and (?) rounded; posterior fins larger, rounded rather than triangular, about equally divided between trunk and tail; tail-fin often pointed posteriorly.

Jaws curved throughout their whole length, sharply so in the distal fourth. Teeth very dark in colour, borne on an unusually stout bar. Teeth of the anterior row long and slender, slightly curved inwards to the middle line, their bases touching, but in complete expansion of the head they project radially outwards as a half-circlet. Teeth of the posterior row very numerous, closely set, long, and slender; in complete expansion of the head they form a curve which goes completely from the dorsal to the ventral surface, so that the dorsalmost point outwards, the ventralmost inwards.

Corona ciliata not observed. Vestibular ridge covered with a thick cuticle; it extends externally for the whole length of the row of posterior teeth, internally somewhat further, and carries irregular prominences fewer in number than the teeth.

Body sometimes salmon-pink, sometimes colourless. As the generative organs were quite rudimentary in even the largest specimens, it is probable that only immature specimens were captured.

The great size of the head and the large number of teeth, compared with the size of the body, mark this species off from all others hitherto recorded.

The following table * covers all measurable specimens captured; where the percentage of the tail is not given, the total length must be taken as only an approximation.

Distribution.—The vertical distribution of this species is conspicuously shown in the table p. 84, and the diagram Pl. 7. It occurred in 63 per cent. of the 19 hauls which closed at or below 400 fathoms; the only other certain captures were in deep hauls open from 1250 fathoms to the surface (27 *a*, 27 *a'*). Six very small specimens from 32 *l*, 35 *k*, and 36 *l* may be larvæ of this species (*macrocephala*). It failed entirely in the

* The six specimens below the transverse line in the table include all the specimens from 32 *l*, 35 *k*, 36 *l*—that is, all the shallower occurrences. I think that they are larval *macrocephala*, but they are very small and the number of posterior teeth drops rather suddenly. They are included in the curve *macrocephala* on Pl. 7.

Length in mm.	Tail as p.c. of length.	Jaws.	Anterior teeth.	Posterior teeth.
18·0	28	11	8–9	27
18·0	33	10–11	5–7	25–29
17·0	32	9	5–6	32
16·5	33	10	8	27–28
16·0	. .	11	8	31
15·5	32	11	8	33
15·0	36	11	7	26–27
15·0	33	11–12	7	23–24
15·0	33	11	8	29–32
13·0	. .	12	8	25
13·0	. .	10–11	9	27–30
13·0	34	11	7–9	23–24
12·0	. .	9–11	7–10	28–29
12·0	. .	10	8	27
12·0	33	9–10	7	21
12·0	37	10	7	21
11·5	30	11–12	9	21–23
11·0	31	9	7	21
11·0	36	10	6	20
10·5	38	11	9	27
10·5	33	. .	5	21
10·0	. .	11	8	21–22
10·0	35	10–11	9	22–23
10·0	35	10–11	6	17–20
10·0	40	11	6	18–20
10·0	33	12	7	22–23
9·0	. .	11	5–6	14–16
9·0	33	9	10	20
9·0	33	11	6	19
9·0	38	10	6	17–18
9·0	33	11	7	19
8·0	43	9–10	6	15
7·0	. .	10	5	12–13
7·0	35	9–11	5–6	14–15
7·0	. .	10–11	3	6–7
6·5	38	10	7	5–7
6·0	41	9–10	4–5	10–11
5·0	. .	9	3	5
5·0	. .	10	4	7–8
5·0	40	11	4	8

15 hauls which closed between 300 and 50 fathoms, and in every haul with an open net in which the greatest depth touched was less than 350 fathoms. *S. macrocephala* was therefore undoubtedly mesoplanktonic.

SAGITTA ZETESIOS, sp. n. (Pl. 5. figs. 22–27.)

Characters.—Head proportionately of medium size, larger than the body immediately behind it, thus exhibiting a marked neck. Body fairly stout (stouter than *bipunctata*), tapering from the middle gradually towards each end; a collarette present; lateral fields rather narrow, longitudinal muscles well developed; tail 25 to 33 per cent. of the total length.

Posterior fin triangular, slightly more on the body than on the tail, its widest part at or slightly in front of the septum, not extending backwards to the vesiculæ seminales. Anterior fin well separated from the posterior, longer and narrower than the posterior, wider behind than in front, not quite or only just reaching the hinder end of the ventral ganglion. Tail-fin truncate.

Jaws very slender and strongly curved.

Teeth very long and slender, light-coloured (unlike *macrocephala*); the anterior teeth increasing in size ventrally; the posterior teeth at first increasing in length inwards, then decreasing again in the few innermost.

Vestibular ridge well developed, but covered by a thin cuticle only, very slightly mammillated by numerous small and irregular prominences, not extending for the whole length of the row of posterior teeth.

Corona ciliata not observed.

This is a fairly well-marked species. The large numbers of posterior teeth are enough to separate it from all but *serratodentata*, *bipunctata*, *Bedoti*, *hispida*, and *elegans*. From *serratodentata* the absence of serration on the jaws is enough to distinguish it. As compared with *bipunctata*, the head is larger, the body stouter, the lateral fins wider, the teeth very much longer. *Bedoti* (Béraneck), of which I have specimens from the 'Siboga' Expedition, has a much slenderer outline, and *zetesios* may be distinguished readily by the larger number of jaws and smaller numbers of anterior and posterior teeth in specimens of the same size. *S. elegans* (Verrill) has been insufficiently described and figured, so that it is not easy to point to salient characters for differentiation; but at least the proportion of the tail-segment to the total length and the number of jaws are easily checked. *S. hispida* (Conant) has a quite different form: the absence of a neck, the length and shape of the posterior fins, and the slender body all mark it off from *zetesios*, though the numbers of jaws and teeth are almost identical.

The following table has been summarized from 38 specimens. The smallest specimen, 8 mm. long, is possibly referable to some other species.

The specimen of 32 mm., which is at the head of the table, is represented in fig. 23. I have no doubt that it really belongs to this species, but that some curious action of the preserving-fluid has swelled out the epidermis in front of the anterior fin in a way which is common in my specimens of *furcata* and some other species. This was the only specimen in which the vesiculæ seminales projected noticeably. The vestibular

Length in mm.	Tail as p.c. of length.	Jaws.	Anterior teeth.	Posterior teeth.
32	25	8	8	15–17
21	33	8	9	15–18
20	25–28	8–10	7–9	17–19
19	26–28	8	7–8	15–18
18	27	9	6	16
17	29	9	9	18
16	26	9	6–7	15
15	30	8	6–7	13–14
13	26–30	8–10	5–7	11–14
12	25–29	8–9	5–6	11–14
11	27–31	8–9	5–6	11–12
10	25–33	9	4–6	9–12
9	27–33	8–9	4–6	8–12
8	25	8	4	5–6

ridge was slightly more mammillated than in other specimens, in all other respects it agreed with the characters of the species as given above.

The vertical distribution of *zetesios* agrees in its general features with that of *hamata*; and as both the occasions of capture and the specimens were less numerous in this than in the latter case, it is fortunate that they thus receive corroboration. It failed at all depths less than 100 fathoms, and occurred at all depths, though sparingly, between 1000 and 100 fathoms.

The table following seems to show that, as in *hamata*, only small specimens are found near the upper limits of its distribution, the larger specimens are only found deeper.

	Specimens.	Length.		
		Max.	Min.	Average.
I. Open nets lowered to 100 fathoms	5	11	9	10
II. " " 150, 200, 250 fathoms	41	15	8	11
III. " " 300, 350 fathoms; Closing-net " 300–200 fathoms	15	20	8	12
IV. Closing-net, various depths between 1000 and 300 fathoms	7	32	13	19

SAGITTA BIPUNCTATA, Quoy & Gaimard. (Pl. 5. figs. 28–31.)

Characters.—Head small; body slender, the middle third nearly of the same thickness throughout, tapering slightly towards the head, more sharply towards the tail. Body when preserved firm, not flabby. Longitudinal muscles broad, but not stout; lateral fields of medium development; the sides of the body often shrinking inwards in preserved material, so as nearly to conceal the anterior fins. Tail very slender. Posterior fins fairly long, more on the body than on the tail, widest nearly opposite the septum; shorter than in *serratodentata*, and not extending backwards nearly to the vesiculæ seminales. Anterior fins well separated from the posterior, very narrow, not reaching to the ventral ganglion, shorter and narrower than the posterior. Tail-fin rounded posteriorly.

Jaws strong, sharply curved in the distal half. Teeth broad below, closely apposed, rather short and stumpy. Vestibular ridge with very slight prominences, about the same length as the posterior row, projecting markedly at its external end *.

Length in mm.	Tail as p.c. of length.	Jaws.	Anterior teeth.	Posterior teeth.
20·0	22	10	5	13
19·5	25	10	4	18
18·0	22–25	9–10	6–7	13–17
16·0	21	10	5	15
14·0	21	9	5	14
13·0	23	9–10	5	10–12
12·0	25	9	5	12
11·0	22	9	5	8
10·0	20	8	4	8
9·0	22	9	5	10

A curious feature of the collection was the scarcity of this species, although, if the determinations of some earlier observers are to be trusted, a plentiful supply might have been expected. The explanation is probably correctly given by Steinhaus † in saying that this "ist keine rein pelagische Form, ihr Vorkommen beschränkt sich auf die Küsten. Wenn sie trotzdem auf hoher See vereinzelt angetroffen wurde, so ist dies wohl dadurch zu erklären, dass sie mit der Strömung so weit vom Lande abgetrieben ist."

On the other hand, during the homeward voyage, a haul in about 40 fathoms on

* Only traces of the corona were retained in my specimens. A good figure is given by Hertwig, Jen. Zeitschrift, 1880, pl. iv. fig, 20.

† *Op. cit. supra*, p. 28.

Parsons Bank at the entrance to the Channel produced such hundreds of *bipunctata* that the contents of the bottle looked more like vermicelli soup than the results of a tow-net.

The captures in the Bay of Biscay were only six in number (seven specimens in all), and all occurred at less than 200 fathoms in open nets; the hauls were 25 *g* (50–0); 33 *h* (75–0); 32 *d*, 32 *i*, 32 *p* (100–0); 36 *g* (200–0). From the Parsons Bank specimens I have deduced the preceding table, and have given a definition and figures to bring the species into line with the others here described.

SAGITTA DECIPIENS, sp. n. (Pl. 5. figs. 32–35.)

Characters.—Head and body of the proportions of *bipunctata* or *serratodentata*, to both of which it bears a strong resemblance; it carries, however, large ova at a very much smaller size. Body very slender, thickest behind the middle of its length, tapering very gradually towards each end. Neck not well marked; collarette very slight. The whole body very transparent, but firm, and retaining its shape. Anterior fin long and narrow, not reaching to the ventral ganglion. Posterior fin about the same length, broader, more triangular; about equally on trunk and tail, widest part at or just behind the septum. Tail-fin truncate. Corona not observed; ventral ganglion prominent. Ovary short and thick, very opaque in the transparent body, extending when apparently ripe as far as the anterior end of the posterior fin. Ova comparatively very large.

Jaws curved slightly, slender; external pillar small or absent. Posterior teeth long and closely apposed; anterior teeth shorter, triangular, with broad bases. Vestibular ridge prominent, with thick cuticle; a very strong process, sometimes forked, at the external edge, extending further at both ends than the row of teeth.

The following table has been summarized from 20 specimens.

Length in mm.	Tail as p.c. of length.	Jaws.	Anterior teeth.	Posterior teeth.
11·5	30	5–6	6–7	15
10·5	28	6	7–8	15–16
10·0	25–30	5–6	6–9	14–17
9·5	31	6	6–7	13–15
9·0	33	5–6	5–10	12–18
8·0	30–37	5–6	8–9	13–16
7·5	40	6	8	14
6	....	6	9	16

Distribution.—As regards the distribution of this form, the occurrences as recorded in the general table, although correct so far as they go, must not be taken necessarily to indicate the extremes of its habitat upwards or downwards; this follows from its small size, which makes the separation of young specimens from young of *serratodentata* and similar forms extremely difficult. The table at least yields *positive* information of its occurrence as high as 100 fathoms or less, between 150 and 50, and between 200 and 100 fathoms. Below the latter zone it failed in the closing-net, and probably does not exist. But it may have reached a higher level than 100, for in three hauls in the open nets at 75 and 50 fathoms I took young specimens which I cannot satisfactorily identify.

The foregoing species were for the most part abundant and well-characterized. But there remain a few specimens to which I dare not give a definite name, for want of sufficient material. As they may help to extend the observations of some future worker, I append a few notes on them.

SAGITTA sp. indet. ? juv.

In open nets lowered to depths between 50 and 250 fathoms, and in one closing-net (200–100), there occurred a number of small and immature specimens of a very slender type, which I dare not assign to any species. Their figures, when summarized, are as follows:—

Length in mm.	Tail as p.c. of length.	Jaws.	Anterior teeth.	Posterior teeth.
9	27–33	6–7	5–6	8–11
8	25–31	6–7	4–6	8–9
7	28	7	4–5	8–9

They occurred in the following hauls:—

25 *e*	35 *e*	36 *g*	36 *i*
35 *b*	35 *m*	36 *h*	36 *k*
35 *d*	36 *e*		

They resembled young *serratodentata,* but showed neither the characteristic hooks nor serrations of the jaws. They bore a still stronger resemblance to *decipiens*, but the posterior teeth seemed hardly numerous enough for that species. They might be young *decipiens*, or *zetesios*, or possibly a separate species, but they are almost certainly not young *furcata* or *macrocephala.*

SAGITTA ? PLANCTONIS, Steinhaus. (Pl. 6. figs. 36–40.)

Under this head I rank three well-preserved specimens of doubtful relation. They bear a close general resemblance to *zetesios*, but differ in that the anterior and posterior fins are nearer together, the anterior fins reach further forward (in one to the end, in two to the middle of the ventral ganglion), the widest part of the posterior fin is level with or behind the septum, the posterior fin is rather more on the trunk than on the tail; the teeth are shorter and thicker, and less closely appressed together; the numbers of posterior teeth are much smaller for the length.

In general characters and in the numbers of the armature they stand closest to *planctonis*, Steinhaus, except for the fact that the anterior fin is rather wider posteriorly and a slight collarette is present: of the detailed characters of the jaws and teeth in *planctonis* we have no information.

	Haul.	Length in mm.	Tail as p.c. of length.	Jaws.	Anterior teeth.	Posterior teeth.
? planctonis.	35 *n*	22	25	8	6–7	9–10
	21 *o*..........	16	25	9	4	7
	24 *e*..........	14	28	8	4–5	7
Species with similar armature.	*planctonis*, Steinhaus		25	8	5–6	up to 12
	furcata, Steinhaus		20	7–10	6	8
	bipunctata, Quoy et Gaimard		25	8–10	4–8	10–15
	neglecta, Aida[1]		25	8	4–5	10–12
	regularis, Aida		30	7	2–4	5–7
	hispida, Conant		25–33	7–9	4–8	8–17
	flaccida, Conant		16	8–9	7–8	10–12
	tenuis, Conant		25	7–8	4–5	7–10
	elegans, Verrill		20	8–12	5–7	12–15
	pulchra, Doncaster		16	6	6	±10

[1] Aida's *neglecta* is almost certainly *bipunctata*, Quoy et Gaim., and his *bipunctata* = *Bedoti*, Béraneck.

It is not worth while to enter into detailed differences between all these species * and my specimens, but the following rough points will serve to differentiate them:—They are stronger in build (*i. e.* stronger longitudinal muscles and smaller lateral fields) than *furcata*, much broader and less pin-shaped than *bipunctata*. The description and figure of *neglecta* are so generalised and give so little detail that it is impossible to say whether this, if a "good" species, has any relation to our specimens. From *regularis* they are readily differentiated by general outline (*cf.* Aida's fig. 17). They are too stoutly built

* It is hard to believe that all the above are separate species. It is even harder to reduce their number, since most of them are quite insufficiently described, and the figures (when they exist) are generally as inadequate as the descriptions.

to be *flaccida* or *tenuis*, and the general outline is quite different from that of *hispida. Elegans* is said to be very much like *bipunctata*, which cannot be said of these specimens. The limitation of the corona ciliata to the body sufficiently separates it from *pulchra*.

There remains a certain number of specimens with more or less hexapterine numbers of jaws and teeth, and of the pliant flabby hexapterine type and proportions. These may include more than one species, but the examples are either so few or so badly preserved that, not having handled as yet large numbers of undoubted *hexaptera*, I prefer to leave them somewhat vague. So far as the numbers of teeth and jaws are concerned, most of them can be fitted only into *hexaptera* (d'Orb.), *magna* (Langerhans), or *tricuspidata* (Kent). Dr. Krumbach has already expressed his belief that *hexaptera* and *magna* are synonyms: with this I agree (so far as is allowable without a comparison of type specimens), at any rate as regards the *magna* of Langerhans; whether Grassi had the same species before him, or not, is hard to say. I incline further to add *tricuspidata* as yet another synonym, having before me large specimens from the 'Siboga' expedition, which by the numbers of the armature are *tricuspidata*, but in other respects agree sufficiently with *hexaptera*. Kent's original diagnosis of *tricuspidata* was not adequate: except for the armature numbers, it might be applied to several species, and his figure might stand for an inflated *hexaptera*; it has certainly a more apoplectic look than most *hexaptera*, but the proportions of the body alter at death in very different directions among these less rigid forms, and I have noted a greater difference in general form between two specimens of *furcata* than exists between Kent's figure of *tricuspidata* and the ordinary drawings of *hexaptera*.

(i.) A few of these specimens are probably attributable to *Sagitta*? *hexaptera*, d'Orbigny, itself. They occurred as follows:—

Haul.	Length in mm.	Tail as p.c. of total length.	Jaws.	Anterior teeth.	Posterior teeth.
25 *k*	14	21	7	3	3
26 *c*..........	11	22	7	3	2
32 *k*	36	25	6–7	4	4

Species indeterminatæ.

(ii.) From several hauls came specimens of which the cirrhi were either in excess of those recorded for *hexaptera*, or were present in very small specimens to the number of eight, the maximum number in the largest *hexaptera* as yet recorded (if Grassi's *magna* be omitted). Some of these were probably young *furcata*, others may be the young of other species.

They may be summarized as follows:—

Length in mm.	Tail as p.c. of length.	Jaws.	Anterior teeth.	Posterior teeth.
22	26	10	5	5
20	22	8	5	3
19	21–26	8–10	3–4	4
15	26–31	9	3	2–4
13	23	8	3	4
12	25–33	9–11	3–4	2–3
10	25	8	2	3
9	27–33	8–11	2–4	2–4

They occurred sparingly between 50 and 500 fathoms.

(iii.) Three large specimens of hexapterine appearance, much compressed, will probably be easily identified by any future observer who takes this species, from the remarkable character of the most dorsal (youngest) jaws (Pl. 6. fig. 41).

These specimens came from 500 and 250 fathoms.

Haul.	Length in mm.	Tail as p.c. of length.	Jaws.	Anterior teeth.	Posterior teeth.
29 *a*..........	33	17	6	7–8	8
29 *a*	29	20	7	4–5	8
21 *m*	28	18	3	7	3

The last specimen had certainly lost some jaws, of which the sockets were to be seen, and probably some posterior teeth. They might possibly be *furcata*, dead and sinking, for the younger jaws in this species resemble those figured in form, but are less strong: against this was the length and sharpness of the teeth, nor did the fins exactly resemble those of *furcata*.

KROHNIA HAMATA, Moebius. (Pl. 6. figs. 42–46.)

Characters.—Head small; body slender, resembling *bipunctata*, firm, retaining its shape (except when considerably damaged), thickest in the middle third, tapering gradually to both ends; neck fairly well marked; no collarette. Lateral fins long, not extending posteriorly nearly to the vesiculæ seminales, but beginning only a little way behind the septum; widest point at or just in front of the septum; fin-rays extending about as far in front of the septum as the fin does behind it, but the fin continued forwards * as an expansion of the epidermis up to or to the middle of the ventral ganglion. Tail-fin truncate.

Jaws slender, not strongly curved, the tips bent through nearly 90° into a hook †. Teeth broad below: in old specimens very closely set, long, and sharp. Corona ciliata not observed ‡.

Distribution.—Some years ago, in a most instructive paper, Prof. Chun § discussed the known occurrences of this species, and utilised them to illustrate the theory that the alleged similarity between the epiplankton of subarctic and subantarctic ‖ regions might be explained by these two cold-water faunas being really continuous by way of the cold deep water of the main oceans.

According to the theory, *hamata*, an essentially cold-water form, should at low latitudes (high upper temperatures) fail in the epiplankton, but be captured in the mesoplankton.

In my Faeroe Channel cruises, *hamata* was fairly plentiful in the epiplankton, but occurred with even greater regularity in the mesoplankton; apparently like some other supposed subarctic forms, it showed even at that latitude a preference for the deep cold water, water which in that area was purely of arctic origin.

It is, therefore, very interesting to find that, even as far north as our positions during the 1900 cruise, it failed altogether in hauls at the surface or 25 fathoms; it appeared once only at 50 fathoms ¶, twice at 75 fathoms, but regularly at deeper horizons down to 2000 fathoms.

At	0	fathoms	it occurred in	0	out of	25	hauls	=	0	per cent.
„	25	„	„	0	„	12	„	=	0	„
„	50	„	„	1	„	13	„	=	7	„
„	75	„	„	2	„	11	„	=	18	„
„	100	„	„	14	„	22	„	=	63	„
„	1000 to 100	„	„	22	„	30	„	=	73	„
„	2000 to 1000	„	„	1	„	7	„	=	14	„

This table shows clearly that while odd specimens (and, as a matter of fact, tiny specimens) may range exceptionally as high as 50 fathoms, it is between 2000 and 100 fathoms that this species is to be sought. Below 1000 fathoms it was only captured

* This is so constant in apparently perfectly preserved specimens that I have no doubt that it is a normal structure.

† This is less marked in the older (ventral) teeth of old specimens, probably the result of wear.

‡ Figured by Strodtman, Arch. Naturgeschichte, 1892, pl. xvii. fig. 18.

§ C. Chun, 'Beziehungen zwischen dem arktischen und antarktischen Plankton,' Stuttgart, 1897.

‖ In the discussion of this alleged "Bipolarity," the issue has been obscured to some extent by loosely terming the regions under discussion "arctic" (Labrador, Greenland, Iceland, N. Norway, &c.) and "antarctic" (Patagonia, S. Georgia, the Kerguelen area, &c.). These regions are more correctly classed by temperature as subarctic and subantarctic: between the faunas of truly arctic and antarctic regions, with a permanent sea temperature of 0° C. or thereabouts, no real resemblance has been shown.

¶ This haul, 25 *e*, is under suspicion: it may be a portion of 25 *d*, 100 to 0.

once by the closing tow-net, but large specimens were also captured by the closing trawl between 2000–1000 and 1500–750 fathoms. The species, then, in this area is mesoplanktonic, and certainly ranges as deep as to the zone 2000–1500, probably to deeper water still.

The captures, however, enable another point to be made, namely :—that older (larger) specimens do not frequent even the upper zones of the mesoplankton, but the deeper strata only. Specimens more than 17 mm. in length—and this is small for *hamata*—were met with only below 500 fathoms.

	Horizon in fathoms.	Number of specimens measured.	Maximum length in mm.	Average length in mm.
Open tow-nets	0			
	25			
	50	2	11·0	10·0
	75	4	13·0	10·3
	100	98	13·5	10·5
	150	27	15·0	11·9
	200	11	13·0	11·4
	250	139	15·5	13·9
	300	53	17·0	13·6
	350	38	16·0	12·7
Closing tow-net	500 to 100	28	17·0	11·8
	750 to 500	16	27·0	18·8
	1000 to 750	11	28·0	21·3
	2000 to 1000	1	....	20·0
Closing trawl	1500 to 750	1	....	33·0
	2000 to 1000	1	....	23·0

We may fairly conclude from this table that in the area studied the older specimens are to be found in the deeper strata of the mesoplankton only, though the young forms may frequent higher levels. Only small specimens occurred above 500 fathoms, large specimens only below 500, but small specimens also occasionally occur below 500.

This touches a question of great interest, at which, so far as I know, no connected work has been done. The young of epibenthic and epiplanktonic forms mostly spend an early or larval life at the surface: where do deep-water oviparous forms, whether plankton or benthos, spend their early life ? Do they similarly seek higher levels ? and, if so, do they range also to the surface? The answer for *hamata* appears to be, that they rise higher, but stop short of the surface; *zetesios* apparently follows the same habit. Of course where, as in the subarctic region, the species is epiplanktonic, the young are also epiplanktonic.

The materials are now to hand for a fairly complete idea of the distribution of *K. hamata* in the Atlantic. As an epiplanktonic and mesoplanktonic form it ranges from 81° N. (Römer and Schaudinn) over the North Atlantic, from Greenland and the Labrador Current in the west to Spitzbergen and Lofoten in the east, occasional drifted specimens reaching along the Norwegian coast into the Baltic. In the Faeroe Channel with comparatively high surface-isotherms, it shows a preference for the mesoplankton, although also occurring less plentifully in the epiplankton *. Passing southwards—in the Bay of Biscay it was purely mesoplanktonic. In the South Equatorial Current the same holds good; only young specimens were obtained by the 'National,' and only by the closing-net at considerable depths †. Still further south, young specimens were obtained from a depth not greater than 38 fathoms, at 40° S., by Dr. Schott and Captain Bruhn ‡; in other words, the species rises nearer to the surface at high latitudes with a lower and more suitable surface isotherm. Lastly, I am glad to be able to complete the series by a well-preserved and unmistakable specimen captured at or close to the surface by my friend Mr. Vallentin at the Falkland Islands, well within a subantarctic district.

KROHNIA HAMATA, Moebius, var. (Pl. **6**. figs. 47–49.)

Among the *hamata* were a few specimens which could not be quite reconciled with all the characters of Moebius's species, although probably only a variety. There were two well-preserved specimens of 23 and 12 mm., the smaller serving to connect with some yet smaller larvæ. They differ from *hamata* in the possession of a stouter body, with a less marked taper, of somewhat more curved jaws which seem longer in comparison with the head; the tips of the jaws are longer and only slightly bent. Fins similar in both.

The specimen figured (30 *e*, 23 mm. long) exhibited the characters thus described; there were also heads and damaged specimens from some other hauls, of which at any rate the jaws and teeth showed the same or an intermediate variation from *hamata*. So likewise did the five small specimens in the table; these were further characterized by a ferocious-looking sagination of the jaws: a similar sagination has been described by Strodtmann in some young specimens of *hamata*, which I can confirm from Faeroe Channel material. The saginate jaws are the more ventral (older). The 12 mm. specimen seemed to suggest that the ultimately smooth outline of the jaw was attained by a filling-up of the spaces between the saw-teeth.

The occurrences of this variety have been reckoned as *hamata* in the previous calculations, in the notes on general distribution (p. 81), and in the diagram (Pl. 7).

* The observations on which this statement is based have not yet been published.

† O. Steinhaus: *op. cit. supra*, p. 34.

‡ O. Steinhaus: *op. cit. supra*, p. 47.

Haul.	Total length in mm.	Tail as p.c. of length.	Jaws.	Teeth.
30 *e*..........	23	26	12–13	13
26 *b*..........	20	25	9–10	9
21 *k*	12	25	10–11, 3 saginate.	10
36 *l*..........	9	27	10, 5 „	5
36 *l*..........	8	25	11, 6 „	4
32 *l*..........	7	28	9, 7 „	3–4
34 *e*..........	6	33	9, 8 „	2

KROHNIA SUBTILIS, Grassi. (Pl. 6. figs. 50–52.)

Characters.—Head of moderate size; body extremely long and slender, transparent, not firm and rigid like *hamata* at a corresponding length; thickest at about the middle of its length, but even here only slightly thicker than at the neck, the taper extremely gradual. Neck fairly well marked; a slight constriction at the septum. Lateral fins very long, reaching from the vesiculæ seminales to a third of the distance between septum and ganglion, about two-thirds on the tail and one-third on the body, widest at or in front of the septum; fin-rays present throughout its length. Tail-fin truncate, extending anteriorly to the vesiculæ seminales. Jaws strongly curved, very sharp, usually thin when viewed from the outside. Teeth similarly thin plates, bayonet shaped *. Vestibular ridge (apparently) absent; corona ciliata not observed.

Total length in mm.	Tail as p.c. of total length.	Jaws.	Teeth.
15	36	7–8	11–12
15	40	7	12
14	35	7–8	11
14	35	7	12
14	35	8	10–11
13	30	9	11
12	33	8	13
11	36	8	9–10
9	33	6	10–11
8	37	8	7

* Compare Grassi, pl. i. figs. 9, 10.

I can find no distinction between this species and Aida's *pacifica* except in the corona, which in *pacifica* is confined to the trunk, and in *subtilis* extends also on to the head. As, however, it was not figured by Grassi, and is only one out of several characters, it seems fairly safe to put the two species together. The teeth are not always so numerous as Grassi's number of 18, nor does the head look large unless the cheeks are thrown out and the jaws turned in, in the death contraction.

Distribution.—This species was comparatively scarce. It failed altogether at the surface and 25 fathoms, and was taken only six times in all (13 per cent.) at 50, 75, and 100 fathoms. It failed in all the closing-nets, but appeared in hauls with open nets at 200, 250, and 300 fathoms. The only positive evidence therefore of its distribution points to its habitat being between 50 and 100 fathoms; but the species being so scarce in the locality, too much weight must not be laid upon this.

General Remarks on the Vertical Distribution *.

In handling the captures as a whole, the hauls with open tow-nets can be compared together with fair accuracy, and the hauls with the mesoplankton nets are similarly comparable amongst themselves. But while the former were lowered to a set depth, and towed horizontally at that level for a fixed time (generally an hour), the mesoplankton closing-net was opened at the lowest depth and drawn up vertically through a comparatively small quantity of water before closure †.

The mesoplankton net therefore cannot be expected to capture so many specimens as the open nets used at higher levels. At the same time the hauls were so numerous, that only rare species can have uniformly escaped.

In the following tables, therefore, all hauls which could be usefully compared have been divided between the open nets and the closing-nets.

i. Hauls with open nets.

At … fathoms, occurred	… specimens in	… per cent. of	… hauls, giving as average specimens per hour	
At 0	169	81	16	10·5
25	52	75	12	4·3
50	239	100	13	18·3
75	241	100	11	21·9
100	881	100	22	40·0
150	21		1	21·0
200	12		1	12·0
250	101		2	50·5
300	37		1	37·0
350	33		1	33·0

* As in dealing with *serratodentata* and *furcata* above, nine hauls with a small-mouthed net and 180 meshes per linear inch have been omitted from the following calculations. The captures in all open nets have been treated with a time-factor to bring them to the standard one-hour haul. The captures by the closing-net towed through 250 fathoms have been divided by 2·5, and through 500 fathoms by 5, to bring them to the standard 100-fathom haul. 21 *n* (open for 50 fathoms only) and 21 *a* (a closing-net which arrived open at the surface, a miss-fire of the gear) have also been omitted as not being in line with the other mesoplankton hauls.

† Compare *suprà*, p. 4.

From this table it may be inferred that Chætognaths were less plentiful (or more migratory) between 0 and 50 fathoms: that the population increased down to 100 fathoms at least. Below that level the hauls were scanty and the figures therefore are much less reliable: not only so, but it must be remembered constantly that these open nets, and especially the deeper hauls, pick up a large quantity of specimens on their upward journey which belong to shallower horizons *. The 250-fathom hauls, for example, represent not only the captures in an hour's slow horizontal towing (say a mile and half), but also those of 250 fathoms vertical towing at a greater pace— a very considerable addition. Now it is a fair inference from the above, that if the population below 100 fathoms were as large or larger than at that horizon, the average captures should number considerably more, whereas, except in one instance †, they are less than at 100 fathoms. Hence we may conclude that the population diminishes below 100 fathoms or thereabouts. This conclusion is confirmed by the more accurate method of the closing-net.

ii. Hauls with the closing-net.

Between	fathoms occurred	specimens in	per cent. of	hauls, giving as average specimens per 100 fathoms
150–50	16	1	1	16·0
200–100	42	6	7	6·0
250–150	5	2	3	1·6
300–200	6	3	3	2·0
400–300	9	3	3	3·0
500–400	10	3	3	3·3
750–500	16·4[1]	4	4	4·1
1000–750	11·2[1]	3	5	2·2
1250–1000	1·2[1]	3	3	0·4
1500–1250	0	0	2	0·0
2000–1500	1·2[2]	1	2	0·6

[1] Number captured divided by 2·5. [2] Number captured divided by 5·0.

The sudden drop in the last column after 200 fathoms is most instructive: from 200–1000 fathoms the figures are small, but as steady as could be expected from the comparatively small number of hauls. Below 1000 fathoms is apparently another drop; but even at this deepest stratum there can be no question of the presence of quite large numbers of Chætognaths even at the lowest depth investigated; for example, the three hauls 1250 to 1000 fathoms filtered only a cube of about 16 feet each, but produced one specimen each. Haul 26 *b* (2000–1500 fathoms) was towed at about 1900 fathoms

* Of course exactly the same criticism applies to my hauls with open nets at 25, 50, 75, and 100 fathoms; but with much less force, for these hauls were only towed upwards through a small fraction of their horizontal tow (instead of a large one), and were made in such numbers as practically to eliminate error by comparison. Below 100 fathoms the ratio of vertical to horizontal tow becomes serious, unless very prolonged horizontal hauls be taken, which is bad for the material captured.

† Namely 250 fathoms. Of the two hauls concerned, the one contained considerably more (72), the other considerably less (29), than the average for 100 fathoms.

for an extra twenty minutes, as a steamer collided with us in the middle of the operation and stopped proceedings for that period; it produced five specimens belonging to two species.

In the diagram, Pl. 7, I have endeavoured to express the comparative distribution of Chætognaths as a whole at all depths, and also some points in that of the common species. (1) The lines labelled *decipiens* and *zetesios* merely record the vertical extension of these two species from positive observations (that is, closing and shallow open nets; the deep open nets being regarded as untrustworthy): they did not occur in sufficient numbers to give any indication of a centre of distribution. (2) The three diagrams marked *serratodentata*, *furcata* i., and *hamata* i. represent, as ordinates to the curves, the average number of specimens per hour haul by open nets at various depths. They seem to show that *serratodentata* is most plentiful down to 100 fathoms, *furcata* most plentiful from 50 to 150 fathoms, and that these upper *hamata* (which are all very young specimens, p. 76) are numerous between 150 and 300 fathoms *. These three diagrams are all drawn to one scale, and the ordinates to the curves are placed at the lowest or towing-depth of the net. (3) The remaining four curves deal with the closing-net, and are also all drawn to one scale. They are not to be compared with the foregoing curves, because they represent, as ordinates to the curve, the average number of specimens per 100-fathom haul of the closing-net at various depths. The ordinates in this case are placed in the centre of the zone studied: thus the ordinate for 150–50 fathoms is drawn on the 100-fathom line. The curve marked *furcata* ii. shows that the population, high at 150–50, drops suddenly between 200–100 fms.; below this zone the species was not captured in closing-nets, and presumably does not occur †. The curve marked *hamata* ii. ‡ shows clearly enough the influence of a large number of young specimens between 200–100 fathoms. Both *hamata* ii. and *macrocephala* curves seem to show a rise in population between 750 and 500 fathoms, as indicated by the ordinate on the 625-fathom line: this is of course repeated in the curve of general capture of all species. Whether this really indicates a zone of thicker life here or not, will be more easily seen when other groups have been worked out, but I certainly noticed the same rise in population when counting the Copepods in a series of typical hauls. The curve marked "all species together" is a graphic expression of the last column in the table on page 80. Unfortunately it by no means agrees with the only previous attempt to deal with the vertical distribution of Chætognaths as a whole.

Last year Mr. R. T. Günther published a paper "On the Distribution of Mid-water Chætognatha in the North Atlantic during the Month of November" (Ann. Mag. N. H. (7) xii. p. 334). Of his main general conclusions, the most important—namely, "that the upper hundred fathoms contain but few individuals as compared with the deeper

* The drop in this curve at 200 fathoms, based on a single observation, would probably have flattened out as indicated by the dotted line if more observations had been taken.

† The specimens recorded in open nets below 100 fathoms were therefore probably caught in the vertical journey upward: an instance of the deceptiveness of the method of open nets.

‡ This includes *hamata*, var., p. 77.

waters of the Atlantic"—is, to my belief, absolutely deceptive, and must be attributed to the faulty method of capture employed and to the consequently inadequate evidence laid before him. In the first place, if one may argue from his diagram *, no hauls were taken at depths between 50 and 200 fathoms. Now, as has been shown above, this includes the most populous zone in the ocean, and is well known to be so from the results of other expeditions. Apparently it was entirely passed over in these collections. In the second place, the species not having been identified, the deduction entirely neglects the fact that different species inhabit different depths. Lastly, the conclusion takes no count of the weakness of the method of serial open tow-nets at great depths—namely, that it does not eliminate the organisms captured in the upward journey at higher levels: this alone is enough to vitiate the conclusion. The effect of the upward journey through what (according to my results) are more populous zones can to some extent be gauged from the following observations:—My average specimens between 1250–1000 fathoms were 0·4; now hauls 27 *a* and 27 *a'* missed fire, and the closing-net failed to close, its contents therefore represent specimens obtained on the upward journey only. These two hauls contained no less than 39 specimens belonging to six species; ten specimens belonged to *serratodentata* and *furcata*, of which I was unable to prove the occurrence below 200 fathoms by the closing-net!

The closing-net brings comparatively little to the surface, but of this little we at least know accurately where it was caught †; and when my curve of "all species together" is compared with Mr. Günther's result, there can be little doubt that a large proportion of his specimens were caught on the upward journey.

With Mr. Günther's second conclusion—that small specimens are more plentiful at the higher levels, large specimens are more characteristic of greater depths—I am in entire agreement, although I fear we might not agree exactly as to levels. But, so far as my results go, this follows from the presence at higher levels of young specimens which seek deeper water when adult (compare pp. 68 and 76).

The only other attempts to record the vertical distribution of Chætognatha as yet have been made by Strodtmann and Steinhaus on the materials of the 'National' (German Plankton) Expedition. Unfortunately the results of the surface and horizontal hauls have not yet been published; only vertical and closing nets are available, and these only for parts of the cruise. It is, therefore, of no value at present to compare the results of the 'National' and 'Research' in detail; in so far as they overlap, they agree in the main, except in that the 'National' failed to prove the existence of Chætognaths below 1500 m. (812 fms.).

SUMMARY OF THE OBSERVED DISTRIBUTION.

These conclusions are stated less dogmatically in the foregoing text: a reference to

* No detailed list of the hauls on this cruise has been published. Since the above was in print, I learn through Mr. V. H. Blackman that two hauls were made between the depths mentioned.

† By disconnecting port and starboard engines, and using them separately as required, we were able to keep the wire rope straight up and down: Mr. George Murray's criticism of the uncertainty of the horizon therefore falls (Journ. R. Geog. Soc. xiii. p. 153).

the pages cited will give the necessary qualifications and the evidence. It is hardly necessary to remark that all these statements refer exactly only to the area studied and to the period of the cruise. They are not necessarily, many of them not even probably, true for distant localities under different conditions.

Sagitta serratodentata was epiplanktonic, extending from the surface to 100 fathoms, with the highest number of average specimens at about 50 fathoms (p. 59). It showed no indication of a nocturnal rise and diurnal fall (p. 60). On the contrary, although not affected during the day by the actual light-intensity of the moment, still on the whole it sought the surface by day and deserted it by night (p. 61). During or after rain it abandoned the surface even in bright daylight, the largest number of specimens being then found from 50 to 100 fathoms (p. 61).

S. furcata was also epiplanktonic, with a maximum distribution between 50 and 100 fathoms (pp. 64, 81). Occasional specimens reached the surface and 25 fathoms, but it was not taken below 200 fathoms (p. 64).

S. macrocephala was purely mesoplanktonic, ranging from 400 (? 300) to 2000–1000 fathoms (pp. 65, 67).

S. zetesios was also mesoplanktonic, ranging from 100 to 1000–750 fathoms (p. 68). At less than 300 fathoms only small specimens were taken; the large specimens were all from greater depths.

S. bipunctata, being apparently a neritic form, occurred very sparingly in the epiplankton (p. 70).

S. decipiens belonged to the upper mesoplankton; it was taken with certainty only between 100 and 200 fathoms (p. 70).

Krohnia hamata was mesoplanktonic, never reaching as high as 25 fathoms, but extending to the 2000–1500-fathom zone (p. 75). Above 500 fathoms only small specimens of 5–17 mm. were found, extending into the lower epiplankton (p. 76); the length of these smaller specimens on the whole increased with the depth, and their maximum distribution was about 150–250 fathoms (pp. 76, 81). Only below 500 fathoms were large specimens to be found, mixed with a few small specimens, possibly corpses.

K. subtilis occurred only in the upper mesoplankton and lower epiplankton, in too small numbers for accurate deduction.

Chætognatha as a whole increased in numbers as one passed from the surface to 100 fathoms (p. 79), and diminished again in numbers between that level and 200 fathoms (p. 80). At about 200 fathoms there was a sudden drop in the population, which then remained fairly steady down to about 1000 fathoms (p. 80), with a possible indication of a slight increase in the 750–500-fathom zone (p. 81). Below 1000 fathoms was a second sudden drop (p. 80). Chætognaths occur, however, in considerable numbers even at the lowest zone studied, 2000–1500 fathoms (p. 80).

In the following table the first three hauls refer to the mesoplankton trawl, the remainder to tow-nets of "comparable" hauls.

Table of the Occurrence of the commoner Forms.

Depth in fathoms.	Haul.	*serratodentata.*	*furcata.*	*macrocephala.*	*zetesios.*	*decipiens.*	*hamata.*
500—250	29 *a*						
1500—750	30 *a*	..	..	..	..	..	+
2000—1000	30 *e*	..	..	..	..	..	+
0	21 *e*	+					
	21 *f*						
	21 *i*						
	22 *d*	+	+				
	22 *e*	+					
	22 *g*	+					
	23 *b*	+	+				
	23 *c*						
	23 *d*	+	+				
	23 *e*	..	+				
	24 *c*						
	24 *f*	..	+				
	24 *g*	+					
	24 *h*						
	24 *i*	+					
	24 *k*						
	25 *a*	..	+				
	25 *b*	+					
	25 *h*	+					
	25 *i*						
	25 *l*						
	30 *c*						
	32 *c*						
	33 *a*						
	33 *b*						
25—0	26 *a*	+					
	30 *b*	+					
	30 *m*	+					
	31 *a*	+					
	32 *b*						
	32 *e*	+					
	33 *e*	+	+				
	33 *g*	+					
	34 *a*						
	34 *g*						
	35 *w*	+					
	36 *c*	..	+				
50—0	21 *g*	+					
	25 *e*	+	..	..	..	..	+
	25 *g*	+	+				
	25 *k*	..	+				
	26 *c*	+	+				
	30 *d*	+	+				
	30 *l*	+	+				
	31 *b*	+	+				
	32 *a*	+	+				
	32 *h*	+	+				
	33 *c*	..	+				
	33 *f*	+	+				
	36 *d*	..	+				
75—0	30 *f*	+	+				
	32 *g*	+	+				
	32 *m*	+	+				
	32 *o*	+	+				
	33 *h*	..	+				
	34 *c*	..	+				
	35 *a*	+	+	..	..	..	+
	35 *c*	+	+	..	..	..	+
	35 *e*	+	+				
	35 *y*	+	+				
	36 *a*	+	+				

Depth in fathoms.	Haul.	*serratodentata.*	*furcata.*	*macrocephala.*	*zetesios.*	*decipiens.*	*hamata.*
100—0	21 *h*	+	+	..	..	..	+
	21 *l*	+	+				
	22 *a*	+	+				
	24 *b*	+	+	..	+	..	+
	24 *d*	..	+				
	24 *e*	+	+	..	+	..	+
	25 *d*	+	+	..	..	..	+
	30 *g*	+	+	..	..	+	+
	30 *h*	+	+	..	..	..	+
	32 *d*	+	+	..	..	+	+
	32 *i*	..	+	..	..	..	+
	32 *n*	+	+	..	..	+	+
	32 *p*	+	+	..	..	+	+
	33 *d*	+	+				
	34 *b*	+	+				
	34 *d*	+	+				
	35 *b*	+	+	..	..	+	+
	35 *d*	+	+	..	..	..	+
	35 *f*	+	+	..	..	..	+
	35 *x*	+	+				
	36 *b*	+	+				
	36 *e*	+	+	..	+	+	+
150—0	36 *f*	+	+	..	+	+	+
150—50	21 *p*	..	+	..	..	+	+
150—100	21 *n*	..	+				
200—0	21 *a*	+					
	36 *g*	..	+	..	+	+	+
200—100	21 *b*	+	..	..	..	..	+
	21 *o*	..	+	..	..	..	+
	26 *e*	..	..	..	..	+	
	34 *h*	..	+	..	..	..	+
	35 *m*	..	+	..	..	+	+
	35 *n*	..	+	..	..	+	+
	35 *t*						
250—0	36 *h*	..	+	..	+	+	+
	36 *i*	..	+	..	+	..	+
250—150	35 *o*	..	..	..	+	..	+
	35 *p*						
	35 *s*	..	..	..	..	..	+
300—0	36 *k*	+	+	..	+	+	+
300—200	21 *c*	..	..	..	+	..	+
	26 *f*	..	..	..	+		
	35 *l*	..	..	..	..	..	+
350—0	36 *l*	+	+	?	+	+	+
400—300	21 *k*	..	..	..	+	..	+
	32 *l*	..	..	?	..	..	+
	35 *k*	..	..	?			
500—400	21 *m*	..	..	+	+	..	+
	35 *h*	..	..	..	..	..	+
	35 *i*	..	..	+	..	..	+
750—500	22 *b*	..	..	+	..	..	+
	30 *k*	..	..	+	..	..	+
	34 *e*	..	..	+	+	..	+
	34 *f*	..	..	+	+	..	+
1000—750	23 *a*	..	..	+	..	..	+
	27 *c*						
	31 *d*	..	..	+	..	..	+
	32 *f*						
	32 *k*	..	..	+	+	..	+
1250—1000	24 *a*	..	..	..	?		
	27 *b*	..	..	+			
	31 *c*	..	..	+			
1500—1250	25 *f*						
	30 *i*						
2000—1500	25 *c*						
	26 *b*	..	..	+	..	..	+

APPENDIX.

CHÆTOGNATHA FROM THE FALKLAND ISLANDS.

My friend Mr. Vallentin was kind enough to send me six specimens which he collected at Port Stanley in 1896. They included only two species.

Krohnia hamata, Moebius.

A well-preserved specimen of this interesting species has been already mentioned (p. 77) as completing the chain of occurrences required by Chun's theory of the continuity of the subarctic and subantarctic Plankton through the tropical Mesoplankton. The specimen, from between the surface and 6 fathoms, was about 18 mm. long, with at least 8 jaws and 11 teeth; the exact numbers could not be given without damaging the specimen, as both jaws and teeth were turned strongly inwards in contraction.

Sagitta serratodentata, Krohn.

There were five specimens, from the surface to 6 fathoms, quite indistinguishable from the Biscayan specimens and agreeing with them in numbers.

Length. mm.	Tail as p.c. of total length.	Jaws.	Anterior teeth.	Posterior teeth.
9	33	6	2–3	3
15	26	7	8	7–8

This species has already been recorded from the subantarctic region, obtained by the Hamb. Magalhaens. Expedition (Steinhaus).

Literature.

A list of the literature of Chætognatha was published by Strodtmann:—"Die Systematik der Chætognathen," Archiv für Naturgeschichte, lviii. p. 333. This was supplemented by Steinhaus, 'Die Verbreitung der Chætognathen im südatlantischen und indischen Ozean,' Inaug. Diss. Kiel, 1896. Since then the following papers on the system of Chætognatha have appeared:—

T. Aida.—"Chætognaths of Misaki Harbour." Annot. Zool. Japon. i. p. 13 (1897).

L. Doncaster.—"Chætognatha." Fauna and Geog. Maldive and Laccadive Archipelagoes, i. p. 209.

T. Krumbach.—"Ueber d. Greifhaken d. Chätognathen." Zool. Jahrb. (Abth. Syst. &c.) xviii. p. 579 (1903).

O. Steinhaus.—"Chætognathen," in Hamburg. Magalhaens. Sammelreise, Lief. v. (1900).

EXPLANATION OF THE PLATES.

Plate 4.

Fig. 1. *Sagitta serratodentata.* × 7.
2. A jaw. × 105.
3. Tips of two jaws. × 430.
4. Teeth of the left side, from the ventral surface. × 210.
5. Vestibular ridge of the left side, from the ventral surface. The tips only of the posterior teeth are shown. × 210.
6. Dorsal view of the anterior end, showing the corona ciliata. × 24.

Fig. 7. *Sagitta furcata,* Steinhaus. Very well preserved, except for a shrinkage inwards of the lateral fields, which carries the anterior fins nearly out of sight. × 3·5.
8. The same, perfectly preserved, representing the supposed living outline. × 3·5.
9. The same, badly preserved and dorso-ventrally compressed: the epidermis in the posterior two-thirds flattened and loosened, making the fins appear too broad, and forming a *lyra*-like bridge between the lateral fins. × 3·5.
10. The same, very badly preserved, violently contracted antero-posteriorly and somewhat compressed dorso-ventrally. The epidermis very greatly flattened and corrugated. × 6.
11. Corona ciliata and eyes. × 60.
12. A jaw. × 60.
13. Anterior and posterior rows of teeth, from a cleaned specimen. × 106.
14. Vestibular ridge, ventral view. × 106.
15. Vestibular ridge, anterior view with teeth in place. × 106.

Plate 5.

Fig. 16. *Sagitta macrocephala,* sp. n. × 9.
17. The head, from the ventral surface. × 24·5.
18. The vestibular ridge and posterior teeth of the left side, from the ventral aspect. × 105.
19. A jaw. × 49.
20. The first and last tooth, and four from the centre, of the posterior row, from a cleaned specimen. The thickness of the bar *b* is also indicated. × 105.
21. *a.* The teeth of the anterior row, from a cleaned specimen, seen from the anterior end. *b.* The smallest tooth, from the dorsal surface. × 105.

Fig. 22. *Sagitta zetesios,* sp. n. × 4.
23. Specimen 32 mm. long, probably referable to this species, with an (artificial ?) expansion of the epidermis in front of the anterior fin. × 2.
24. Vestibular ridge of the left side. × 60.
25. Anterior teeth, from a cleaned specimen. × 105.
26. Posterior teeth, from a cleaned specimen. × 105.
27. A jaw. × 33.

Fig. 28. *Sagitta bipunctata,* Quoy et Gaimard. × 3.
29. A jaw. × 140.
30. Anterior and posterior teeth of the right side. × 140.
31. Vestibular ridge, showing position of first and last tooth. × 140.

Fig. 32. *Sagitta decipiens*, sp. n. × 7.

33. A jaw. × 140.
34. Anterior and posterior teeth of left side, nearly from the anterior aspect. × 210.
35. Vestibular ridge, showing position of first and last tooth. × 210. The strong cone on the external surface is not always so well developed.

PLATE 6.

Fig. 36. *Sagitta ? planctonis*, Steinhaus. × 6.

37. Dorsal view, showing relation of corona ciliata to head and to ventral ganglion, patches of sense-cells, "neck-fin," &c. × 17.
38. Vestibular ridge of left side, ventral view. × 140.
39. Anterior teeth of right side, *in situ*. × 140.
40. Posterior teeth of left side, *in situ*. × 140.

Fig. 41. *Sagitta* sp. indet. (iii.), p. 74. Three jaws. × 19.

Fig. 42. *Krohnia hamata*, Moebius. × 4.

43. A jaw. × 106.
44. Tip of a jaw. × 520.
45. The teeth. × 210.
46. Corona ciliata. × 61.

Fig. 47. *Krohnia hamata*, var. × 4.

48. Tip of a jaw. × 290.
49. Saginate jaw of young specimen. × 290.

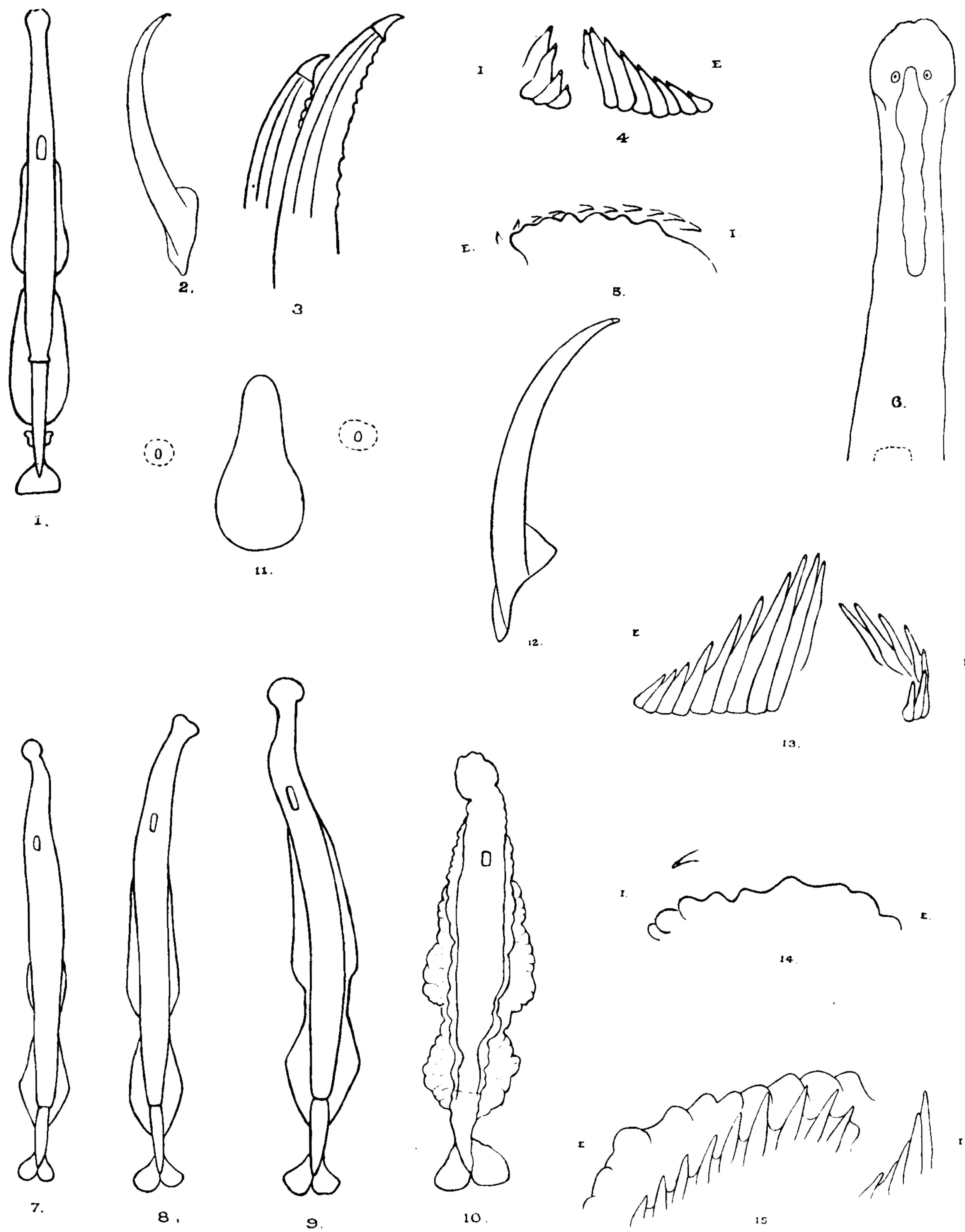
Fig. 50. *Krohnia subtilis*, Grassi. × 4.

51. A jaw. × 106.
52. The teeth, drawn in place. × 210.

All figures have been drawn with the Abbé camera. The letters E and I indicate respectively the external and internal aspects of the teeth, the vestibular ridge, &c.

PLATE 7.

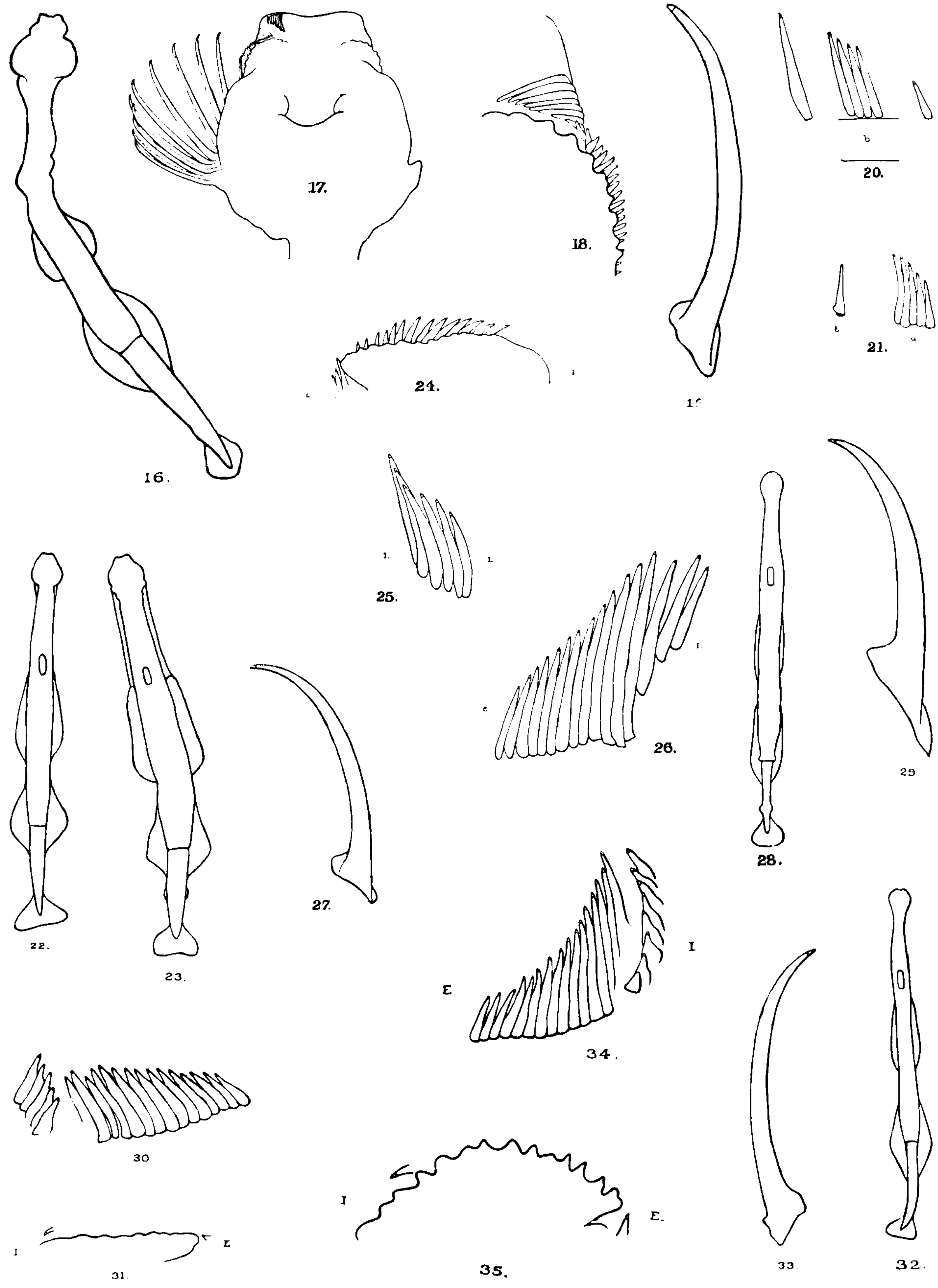
Table of frequency of species of Chætognatha according to depth.



G. H. Fowler del. Langley photosc.

BISCAYAN CHÆTOGNATHA.

Figs. 1-6. *Sagitta serratodentata*; 7–15. *Sagitta furcata*.



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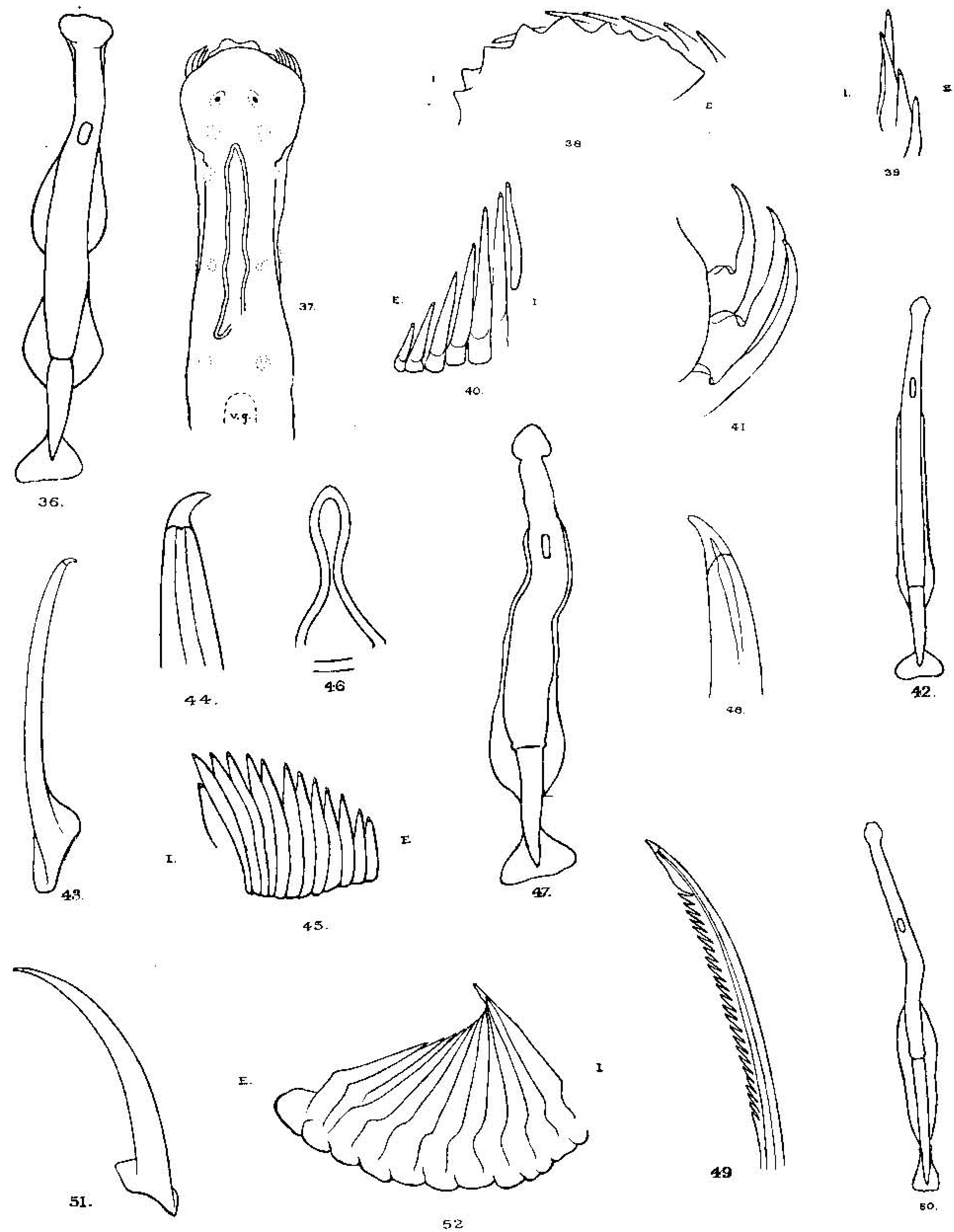
BISCAYAN CHÆTOGNATHA.

Figs. 16–21. *Sagitta macrocephala*; 22–27. *Sagitta zetesios*; 28–31. *Sagitta bipunctata*; 32–35. *Sagitta decipiens*.



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BISCAYAN CHÆTOGNATHA.

Figs. 36–40. *Sagitta ? planctonis* ; 41. *Sagitta* sp. indet. ; 42–46. *Krohnia hamata* ; 47–49. *Krohnia hamata*, var. ; 50–52. *Krohnia subtilis*.

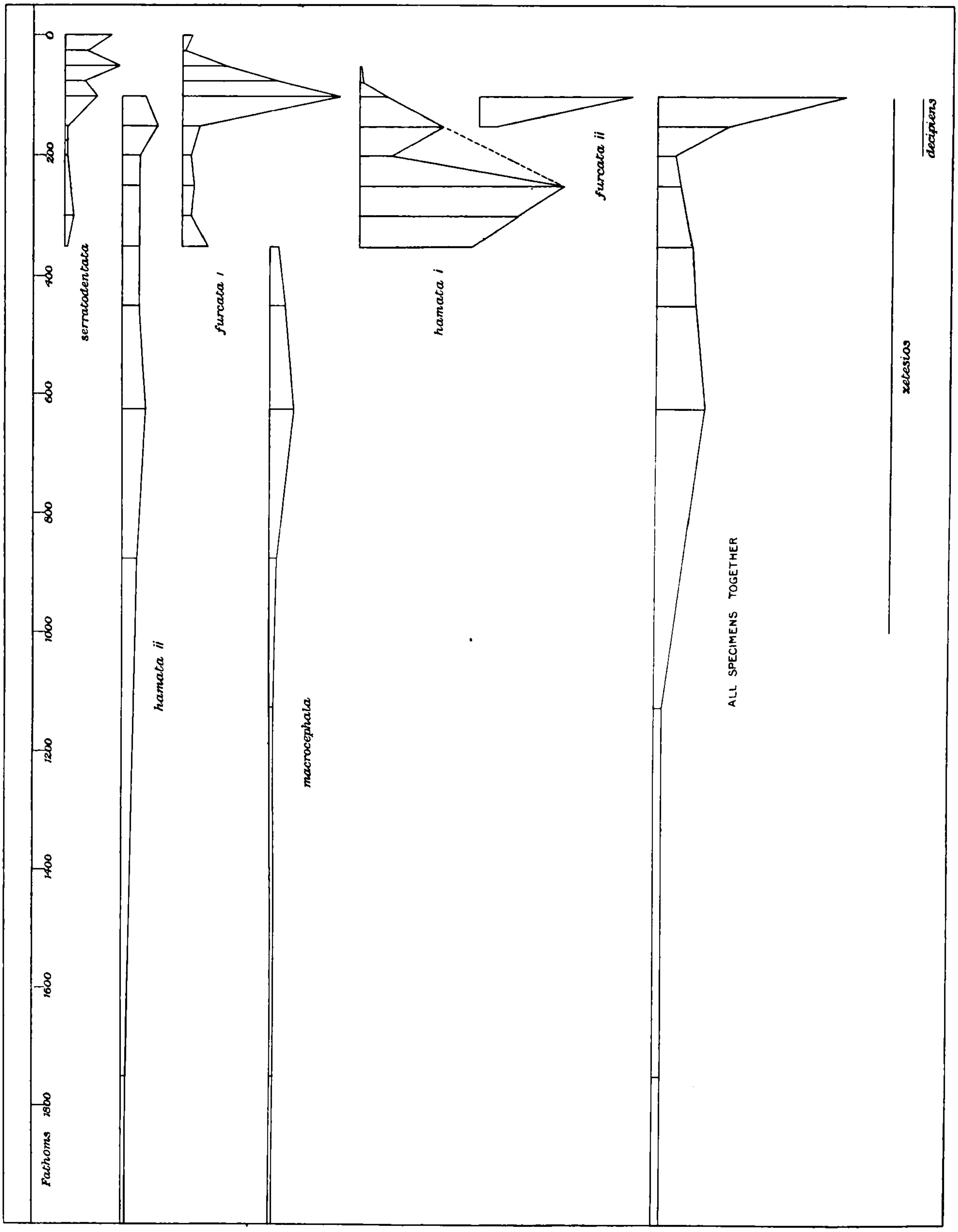

TABLE OF FREQUENCY.

BISCAYAN PLANKTON: PART III. CHÆTOGNATHA.

(TRANS. LINN. SOC., Ser. 2, ZOOL. x. 55–87.)

Temporary correction-slip.

Page	Line	
57	6	*Add*: "In the measurements of 'total length' and of 'tail-segment,' the tail-fin has been included, greater accuracy with less damage to the specimen being attained thereby."
58	5 from bottom.	*For* "body" *read* "trunk."
63	7	" " "
67	10	" " "
69	3	*Add*: "A slight short thickening of epidermis behind the head, scarcely enough developed to be termed a collarette."
69	7	*For* "body" *read* "trunk."
78	5 from bottom.	" " "
78	2 from bottom.	*For* "usually" *read* "unusually."