JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

AUGUST 1902.

TRANSACTIONS OF THE SOCIETY.

VII. (continued).—*The Genus Synchæta: A Monographic Study, with Descriptions of Five New Species.*

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(*Read June 18th*, 1902.)

Synchæta longipes Gosse.

Pl. IV. fig. 5.

BIBLIOGRAPHY.

GOSSE, P. H.—Twenty-four new Species of Rotifera. Journ. Roy. Micr. Soc., 1887, p. 5, pl. II. fig. 15.
HOOD, JOHN—Chats about Rotifers. Science Gossip, 1887, p. 220.
HUDSON & GOSSE.—The Rotifera. Supplement. London, 1889, p. 17, pl. 31, fig. 4.

Spec. Char.—Body wide and triangular in front; rounded, almost globular posteriorly, possessing a long foot carrying two acute toes; four frontal styles; broad pendent auricles; eye red, cervical. Largest size 204 μ ($\frac{1}{125}$ in.) long by 95 μ ($\frac{1}{267}$ in.) wide at the auricles. Lacustrine.

First found by Mr. John Hood near Dundee, this well marked species was described by Mr. P. H. Gosse in one of the last papers he wrote. The figure accompanying the description must unfortunately have been made from a very abnormal specimen, and it

EXPLANATION OF PLATE VI.

Fig. 11.—*Synchæta baltica* Ehrbg. ♀ Dorsal view. × 180.
„ 11*a* „ „ „ Front view of head. × 180.
„ 12 „ *monopus* Plate ♀ Dorsal view. × 350.
„ 12*a* „ „ „ Front of head. × 350.
„ 13 and 13*a*.—Parasites from body-cavity of *S. pectinata*. × 650.

does not give a good idea of the creature. I have met with it three or four times in the middle of the summer round London, at Hanwell, Woking, and near St. Helens in Lancashire, and from these Mr. Dixon-Nuttall has made the accompanying excellent drawing, but it is rather a rare species not often seen.

The body is very rounded and globular behind, not unlike a wine-glass in shape, the stem of which is represented by the long foot. The head is abnormally large, slightly compressed dorso-ventrally and broad at the auricles, advancing to a regular point in front, and thus giving it almost the shape of an equilateral triangle. The front of the head bears the usual four styles, the outer pair being much the larger and protruding from large triangular fleshy flaps. Two more pairs of setose pimples are situated in front and around the mouth as usual, and the extreme pointed front is furnished with a fine and broad brush of sense-hairs.

The ciliary wreath is of the usual Synchæta type, the wide auricles being more or less pendent and further back in position than in *tremula* and *oblonga*. Immediately behind the auricles the body is considerably constricted and then swells out again to a width equal to that of the head.

The foot is very narrow, elongated, about one-quarter the size of the body, terminating in two small acute toes. It may be swollen a little occasionally, but it can hardly be called "rhomboidal" in outline. The foot is moved about and lashed in all directions like a tail.

The dorsal antenna is in the usual position on an eminence above the eye, and the lateral antennæ issue two-thirds down the sides of the body, slightly on the ventral side. The mastax is large, of usual *Synchæta* type, but, I regret to say, I have omitted to look at the teeth of the unci, and having been unable to find this creature recently, do not know their presence or their number. The œsophagus is short, leading to a stomach of the usual structure with rounded gastric glands. The lateral canals, contractile vesicle as well as the foot-glands, ovary, and muscular system, are all quite normal. The red eye is rounded, not particularly large, and of normal structure.

In the projecting triangular head and narrow foot this species has some superficial resemblance with *S. stylata*, from which it is however quite different in shape, structure, and size.

Synchæta longipes does not carry its eggs. It is a powerful swimmer, very voracious, and catches its prey, consisting of *Polyarthra* and other similar rotifers, and devours them whilst swimming at full speed. The **male** has not yet been discovered.

Its greatest total size is 204 μ ($\frac{1}{125}$ in.), one-fifth of which is represented by the foot and toes. Smaller young animals are always present also.

Synchæta kitina sp. n.

Pl. IV. fig. 6.

Spec. Char.—Body very small, cup-shaped, truncate anteriorly, much contracted posteriorly, head flat or slightly rounded in front, foot short and tapering, carrying two small conical toes. Eye cervical, red, appearing double, imbedded in semi-opaque granules. Size, up to 136 μ ($\frac{1}{185}$ in.) in length by 102 μ ($\frac{1}{250}$ in.) wide. Lacustrine.

In a tube of some water from the reservoirs supplying Dundee with water, containing *Notholca longispina* and other rotifers, which Mr. John Hood sent me in July 1898, I found a very small Synchæta which proved to be new and to which I have given this name in honour of an enthusiastic friend greatly interested in these minute sparks of life. After having had his attention called to it, Mr. Hood was able to send it me again several times, but it has so far not been obtained in any other locality than the neighbourhood of Dundee, where it makes its appearance at the end of May and usually remains until the beginning of September, associated with *Notholca longispina*, *Anuræa cochlearis*, and *Gastropus stylifer*. Its unusual shape, very small size, and mode of swimming at once arrest the attention of anyone familiar with the commoner species of Synchæta, but being so small it requires a fairly high power for observation and identification.

The general shape of the body is that of a cup or wine-glass with somewhat stout stem. The posterior cylindrical and constricted part of the body widens again slightly and then terminates; the foot is short, broad at the base and tapering, carrying two small toes at the end. The foot can be retracted within the body so that only the toes protrude. The auricles are comparatively large, broad and semicircular in shape, and are carried on a level with the front of the head; when contracting the auricles fold over the head. The head is very broad and almost flat in front. Two pairs of tactile styles arise from the front, the larger outer pair from fleshy triangular flaps and the inner pair from the dorsal edge as usual. Four more groups of two or three shorter tactile hairs are placed around the mouth. The vibratile cilia are confined to four regions or patches on the frontal part of the head as usual, in addition to the long cilia on the auricles. The mouth is situated in front near the centre of the head, but slightly ventral, surrounded by the projecting circlet of very fine stiff hairs, part of which are visible from a dorsal view. The eye is cervical, situated in the usual position, and consists apparently of two dark red corpuscles, closely apposed and imbedded in a small mass of semi-opaque granules. The mastax is large, filling the anterior part of the body-

cavity ; the jaws are of usual Synchæta type, but extremely delicate ; the unci have five or six teeth.

The stomach is small, carrying two pointed gastric glands, and the rounded ovary, lateral canals, and contractile vesicle are present as usual.

The dorsal antenna projects from a dorsal eminence a little below the eye, while the lateral antennæ protrude at the extreme posterior and narrow part of the body, as in *S. tremula.*

The integument is very soft, showing more or less distinct fine longitudinal folds. When held fast in the compressor the animal is very restless, contracts and contorts its body in all manner of shapes, so that it can hardly be recognised under these conditions.

In swimming the motion is slow and steady, the animal revolving on its longer axis as it proceeds, and now and again suddenly changing its direction at right angles to its former course. *S. kitina* does not anchor itself to a thread and revolve on the same spot as does *S. tremula.*

The pretty sketch, fig. 6, has been drawn by Mr. F. R. Dixon-Nuttall from life, and gives a good idea of its usual shape.

In size, this is one of the smallest Synchætæ known, being only 136 μ ($\frac{1}{185}$ in.) in total length by 102 μ ($\frac{1}{250}$ in.) wide at the auricles, whilst smaller individuals are always present also.

Synchæta tavina (Hood).

Pl. VIII. fig. 18.

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HOOD, JOHN.—*Synchæta tavina.* Inter. Journ. of Microscopy and Nat. Science, 1893, pp. 382-3 (1 pl.).

Spec. Char.—Body markedly cylindrical in shape, truncate in front; auricles small; foot short, carrying two small, separated toes; eye cervical, usually appearing double; the lateral antennæ situated in the lumbar regions. Size 254 μ ($\frac{1}{100}$ in.) by 95 μ ($\frac{1}{267}$ in.) wide at the auricles. In brackish water.

Mr. John Hood also discovered this species in the tide pools of the Tay in the early spring of 1893, and published an account of it in the *International Journal of Microscopy and Natural Science* for October of that year.

The shape of the body is conspicuously cylindric, being scarcely wider in front than at the side and somewhat compressed laterally, then tapering gradually to the short foot and toes. The foot is in a line with the ventral side of the body, and the toes are generally carried turned upwards. At first sight it is hardly recognised as belonging to the genus *Synchæta*, so unlike is it to the characteristic cone-shape of nearly all the other species of this genus.

Mr. Dixon-Nuttall's sketch very well represents its usual shape, which of course varies slightly according as it is filled with food or empty. The integument is thin, white, transparent, and shows a number of fine longitudinal folds on the dorsal side. The auricles are small, and in retraction are folded over the head by a muscular band running from the auricle to near the centre of the head. The front of the head is truncate and slightly rounded, carrying the usual two pairs of styles, the outer pair arising from well-marked triangular fleshy flaps. On the extreme raised front of the head are two bundles of very fine diverging stiff setæ, similar to those found in *S. oblonga*. The mouth is nearly central in position, screened as usual by a row of fine, overhanging setæ, which can be seen from a dorsal view in this species. At some little distance from and around the mouth are the usual four bundles of three or four larger setæ which are rather conspicuous. The vibratile cilia are arranged on four ridges or cushions on the front of the head, as is the case with all other species. The cervical eye consists of a clear vesicle partly filled with white opaque and red granules, the latter often separated into two groups, and thus giving the appearance of a double eye.

The mastax is large and of the usual Synchæta type; the jaws are very delicate and difficult to make out; they are of the same type as those of *S. tremula*, the unci are curved, and have four or five teeth.

The œsophagus arises on the dorsal side of the mastax and leads into an ample stomach which is thick-walled anteriorly and thin-walled posteriorly, and to which two elongated gastric glands are attached. The ovary is large, flat, oval or nearly circular in shape and contains large germ-cells.

The lateral canals and contractile vesicles are of normal structure.

The dorsal antenna is situated on a raised prominence in the usual position, and the lateral antennæ are readily seen in the lumbar region. The foot is stout and the two broad and pointed toes are usually carried turned upwards.

I have found the **male** of this species in March 1895 and several times since. It is a small, soft, conical animal with two minute toes, large sperm-sac, long brain with opaque granules at the tip of which red granules forming a double eye are imbedded. It is usually detected by its more rapid movements among the females.

Synchæta tavina swims vigorously and steadily in spiral curves and is rarely anchored to a thread, nor does it carry its eggs. Its habitat is brackish water, and I have obtained it many times from Mr. John Hood from the mouth of the Tay near Dundee, and also from Great Yarmouth in water sent by Mr. H. E. Hurrell, generally in the early spring, March and April. In size it reaches up to 254 μ ($\frac{1}{100}$ in.).

Synchæta littoralis sp. n.

Pl. VII. fig. 15.

Spec. Char.—Body cone-shaped, convex anteriorly, usually cylindrical in the middle, tapering to a stout foot and well separated acute toes; auricles small; four frontal styles. Eyes three, one cervical, large, red, connected by two streams of red granules with two frontal eye-spots; lateral antennæ prominent in lumbar region. Size up to 238 μ ($\frac{1}{107}$ in.) long by 109 μ ($\frac{1}{232}$ in.) wide at the auricles. In brackish water.

For some years past I have received this distinctive species from Dundee, Margate, Great Yarmouth, and various places near the sea coast, always in water that was slightly brackish In general appearance and structure it comes nearest to *S. oblonga*, from which it can, however, be readily distinguished by a much stouter foot, by its three eyes, and a prominent stream of red granules running forward from the cervical eye, which is unusually large, to the two frontal eye-spots, very much resembling *S. triophthalma* in this respect.

The front of the head is convex, and the shape of the body more or less cylindrical, merging posteriorly into a conspicuously stout foot with two fairly thick acute toes, which are always carried well apart. The outer styles emerge from fairly large triangular fleshy flaps, and at the extreme front of the head are two bundles of very fine diverging sense-hairs. The dorsal antenna is situated in its usual position, and the lateral antennæ, which are readily visible, protrude from the sides in the lumbar region and a little on the ventral side.

The integument is white, transparent, folded longitudinally on the dorsal side. The mastax is large, of usual shape and structure, and the unci have five or six teeth. The thick-walled stomach is surmounted by two rounded gastric glands.

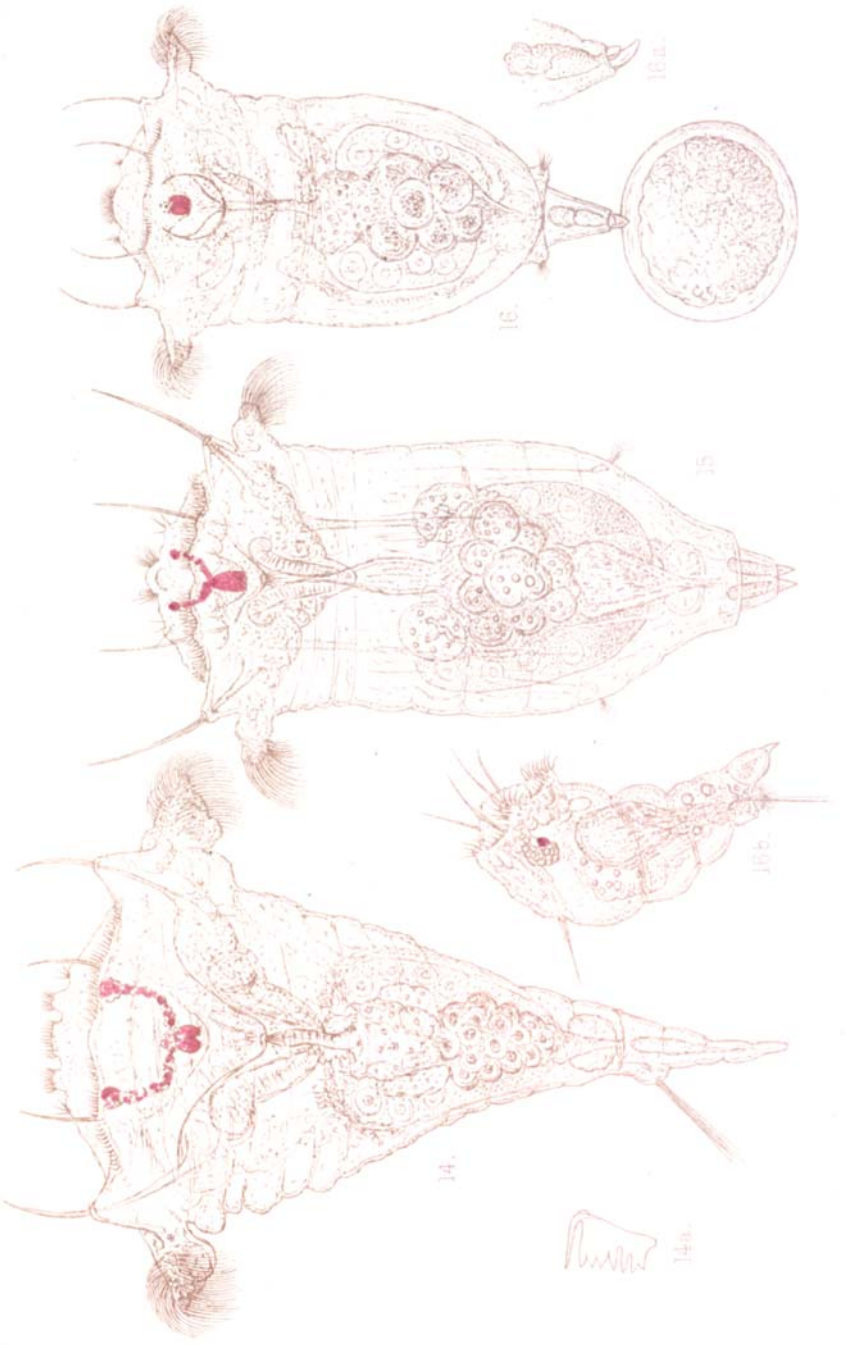
The remainder of the anatomy follows that of other Synchætæ; the eggs are not carried.

The **male** has been seen several times, and has much analogy with that of *S. oblonga*.

The accompanying fig. 15 has been drawn by Mr. Dixon-Nuttall, and gives a good idea of the animal.

EXPLANATION OF PLATE VII.

Fig. 14.—*Synchæta triophthalma* Laut. ♀ Dorsal view. × 400.
„ 14*a* „ „ „ One uncus of the jaws.
„ 15 „ *littoralis* sp. n. Rouss. ♀ Dorsal view. × 375.
„ 16 „ *cecilia* sp. n. Rouss. ♀ Dorsal view. × 500.
„ 16*a* „ „ „ Side view of toe. × 750.
„ 16*b* „ „ „ The male. × 500.



F.R.Dixon-Nuttall del.ad nat. West,Newman lith.

Synchaetae.

Synchæta baltica Ehrenberg.

Pl. VI. fig. 11.

SYNONYMY.

Synchæta apus Plate.

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EHRENBERG, C. G.—Das Leuchten des Meeres. Abhandl. der Akad. d. Wissensch. Berlin, 1834, p. 572, pl. 1, fig. 2.
—— Die Infusionsthierchen. Leipzig, 1838, p. 437, pl. 53, fig. 5.
HUDSON & GOSSE.—The Rotifera. London, 1889, vol. i. p. 126, pl. 13, fig. 1.
PLATE, L. H.—Ueber die Rotatorienfauna des bottnischen Meerbusens, etc. Zeitschr. f. wiss. Zool., Bd. 49, 1890, pp. 1-4.
LEVANDER, K. M.—Zur Kenntniss der Wasserfauna in der Umgebung von Helsingfors. Acta Societatis pro Fauna et Flora Fennica, Helsingfors, vol. xii. No. 3, 1894, p. 18, pl. 1, fig. 4.

Spec. Char.—Body very large, bell-shaped, rounded in front, constricted below the auricles, tapering to a stout foot and thick obtuse toes; four frontal styles; wide front, and large, broad auricles; eye red, cervical, with a tendency to be cleft in two halves. Size 455 μ ($\frac{1}{56}$ in.) to 523 μ ($\frac{1}{48}$ in.) long by 245 μ ($\frac{1}{104}$ in.) to 270 μ ($\frac{1}{235}$ in.) wide at the auricles. Marine, pelagic in the Baltic.

The species to which Ehrenberg gave this name appears to have been first found by a Dr. Michaelis in Kiel harbour in 1830. It was early associated with the luminosity of the sea, because it was found in sea water that was luminous, but according to Ehrenberg's own account, his experiments to prove its luminosity were entirely negative, as Synchæta did not shine when isolated, whilst the water contained other marine organisms, such as Peridinia, which undoubtedly were luminous. There is, therefore, no valid reason for the statement that this Synchæta, or any other rotifer, is connected with the luminosity of the sea.

Ehrenberg obtained his specimen from Dr. Michaelis, and communicated his first account and drawings of this species to the Berlin Academy of Sciences in 1834, the description and figures being afterwards reproduced in his great work on the Infusoria in 1838.

Until quite recently the real *S. baltica* does not seem to have been again met with, or to have been searched for in its particular haunts, the Baltic Sea. Mr. Gosse, in his early writings, mentions a marine Synchæta which he often found and supposed was Ehrenberg's *S. baltica*, and figured it in his *Tenby*. This, however, is the animal now known as *Synchæta gyrina* of Hood. Later Gosse received another, smaller and different marine species from Mr. John Hood of Dundee, which he figured in *The Rotifera*, pl. xiii. fig. 1, under the name of *S. baltica*. It is, however, quite clear now that none of these are identical with Ehrenberg's species, and

I have it from Mr. John Hood that the small marine species he sent to Mr. Gosse in 1888 is the one which is now described in this paper under the name of *S. cecilia*.

Ehrenberg's figure shows a large Synchæta, with very large and broad auricles, and it was not until 1894 that it was again certainly identified by Dr. Levander, who found it in abundance in the open sea and at various places round the coast of Finland, and has given a better drawing of it in his memoir. A few years previously Dr. L. Plate received some spirit material collected by Dr. Nordqvist in the Gulf of Bothnia and in the northern parts of the Baltic. In this material he found a large Synchæta fully contracted into a ball, showing no foot at all. This Dr. Plate named *Synchæta apus*, and described as a new species. Dr. Levander, however, has proved quite satisfactorily that it is no other than *S. baltica*.

I have considered it necessary to give this short historical sketch of *S. baltica* in order to clear up its identity and separate it from the various species to which this name has been wrongly applied.

Dr. Levander has been good enough to send me some fairly well preserved specimens of *Synchæta baltica*, yet they are not so perfect and fully extended as one could wish. Fig. 11, pl. VI. has been drawn by Mr. Dixon-Nuttall from one of these, and is sufficiently characteristic, but should be compared with Dr. Levander's sketch of the living animal. Fig. 11*a* represents a front view of the head, which has been kindly sent me by Dr. Levander.

The shape of the living *S. baltica*, according to Dr. Levander's description, is bell-shaped, rounded in front, constricted below the auricles, then widening again considerably in the middle of the body, whence it tapers gradually to the thick foot. In the preserved specimens the posterior end of the body shows a ring-like thickening of the integument from which the foot emerges; it may be, however, that this is due to the partly retracted foot, and that in the living animal the body merges gradually into the foot, as shown in Dr. Levander's drawing. The foot is stout, of considerable size, and carries two thick obtuse toes, well separated, in which the fine canals of the foot-glands can be readily seen. The toes are not pointed, but distinctly cut off, or truncate and flat at the tip.

The ciliary wreath is of the usual type, but the auricles are particularly large and very broad and clothed with long vibratile cilia as is well represented in Mr. Dixon-Nuttall's figure. Four frontal styles are present as usual, the outer pair emerging from triangular fleshy flaps of skin. On each side of the extreme front is a tuft of fine radiating sense-hairs; around the mouth on the ventral side are the usual four setose pimples carrying each two or three stiff hairs.

The dorsal antenna is situated on an eminence in its usual position above the eye, and the lateral antennæ emerge low down in the lumbar regions and a little on the ventral side.

The eye is large, red, usually cleft in two halves, and seated on the rounded brain mass.

The mouth is shield-shaped and guarded all round by a single row of very small stiff converging hairs. The mastax is large, of the usual Synchæta shape and type; the fulcrum seems to be particularly long; the unci have each five pointed teeth. The thin-walled œsophagus arises in the middle of the dorsal side of the mastax, is fairly long and not ciliated in its interior. The stomach is thick-walled, consisting of large rounded granular cells, and carrying the usual gastric glands; the intestine is not very well marked off. The lateral canals appear to be attached to the walls of the stomach and reach forward as far as the gastric glands only. According to Dr. Levander each canal forms here a convoluted knot from which two branches are sent off. One branch goes forward a short distance in the body-cavity, is held in position by a fine thread fixed to the body-wall, and ends in a single flame-cell. The contractile vesicle is large, situated at the base of the foot on the ventral side; the lateral canals make several turns in its walls before opening into it.

The ovary is oval, of usual structure, and lies across the body-cavity on the ventral side. Two foot-glands are very prominent in the stout foot.

The eggs are slightly oval in shape and generally carried about. I found several eggs still attached to the toes by a fine thread in the preserved specimens; their size is 109 μ ($\frac{1}{233}$ in.) long by 88 μ ($\frac{1}{289}$ in.) broad.

As far as is at present known *S. baltica* is found only in the Baltic, where it is truly pelagic, occurring in great abundance in the open sea as well as in all the large and small bays. It is well known that the salinity of the water of the Baltic is much less than that of the North Sea, due to its enclosed position, to the absence of tides, and to the great volume of fresh water that is constantly poured into it by numerous rivers.

According to Dr. Levander the greatest total length of *S. baltica* is 523 μ ($\frac{1}{48}$ in.) The largest preserved specimen I have received measured 455 μ ($\frac{1}{56}$ in.) long by 245 μ ($\frac{1}{104}$ in.) wide at the auricles.

The **male** has not yet been observed.

Synchæta gyrina Hood.

Pl. VIII. fig. 17.

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Hood, John.—Chats about Rotifers: *Synchæta gyrina*. Science Gossip, 1887, p. 149, 2 figs.

Hudson & Gosse.—The Rotifera. Supplement. London, 1889, p. 18.

Spec. Char.—Body large, barrel-shaped, not much wider in front, and tapering gradually posteriorly to the short foot and toes; eye cervical, appearing double; auricles comparatively

small but powerful; four anterior styles. Largest size of female 326 μ ($\frac{1}{78}$ in.) long by 145 μ ($\frac{1}{175}$ in.) wide across the auricles. Marine and in brackish water.

Mr. John Hood, of Dundee, first discovered this marine and brackish water species in the spring of 1886, in tide pools of the estuary of the Tay, and gave a description and rough sketch of it in the July number of *Science Gossip* of 1887.

In the autumn of last year I obtained specimens from Great Yarmouth, and subsequently also from brackish water pools near Exmouth and Worthing, which have enabled me to make this description and Mr. Dixon-Nuttall the accompanying excellent drawing, fig. 17. Both the drawing and the well preserved and mounted animals were identified by Mr. Hood, which was necessary, as his rough sketch is deficient in accuracy.

The body is stout, cylindrical or barrel-shaped, widest in the middle, tapering gradually posteriorly; the foot is distinct, short, tapering, and carrying two distinct broad and acute toes, slightly shouldered on the outer side; two distinct foot-glands are contained in the foot. The head also is cylindrical, hardly wider than the widest part of the body. The auricles are comparatively small but powerful; the head is truncate in front without any conspicuous prominences. Two pairs of styles arise in front, the outer pair from very small fleshy eminences. The vibratile cilia in front have the usual arrangement in four regions. The mouth is ventral in position, surrounded by the usual tactile tufts of setæ and circlet of short stiff hairs. The eye is large, cervical, and consists of two dark red closely apposed bodies or clusters of red granules. The mastax is large, of usual Synchæta shape and structure, and of *S. oblonga* type with six broad, lancet-shaped teeth in each uncus. The dorsal antenna protrudes on a dorsal eminence above the eye, and the lateral antennæ are situated at the sides, slightly below the middle of the body.

The stomach is large, of usual shape, as well as the gastric glands, ovary, lateral canals and contractile vesicle, all of which are clearly indicated in Mr. Dixon-Nuttall's excellent figure. The integument is fairly firm, showing more or less prominent transverse and longitudinal folds, particularly on the dorsal side.

In swimming, this Synchæta moves rapidly, almost rolling in the water like a barrel, without apparent aim; it also spins a thread from the toes to which it attaches itself occasionally.

The eggs are nearly spherical, coloured slightly brown, and 78 μ ($\frac{1}{326}$ in.) in diameter; when laid they fall off at once, and are not carried about.

The **male** has been seen by Mr. Hood, who describes it as a conical slender creature, 85 μ ($\frac{1}{300}$ in.) in length.

Habitat: in sea-water and brackish tide pools, near Dundee, Great Yarmouth, Exmouth, Worthing, and probably all round the coast.

Synchæta triophthalma Lauterborn.

Pl. VII. fig. 14.

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LAUTERBORN, ROBERT.—Wissensch. Meeresuntersuchungen aus der Biol. Anstalt auf Helgoland, 1894, i. pp. 207-13, 1 fig.

Spec. Char.—Body cone-shaped, very wide and rounded in front; foot indistinct; toe thin, style-shaped, apparently single; eyes three, one large cervical, and two frontal eyes. Lateral antenna asymmetrical, large, single, situated on left side of body. Size 181 μ to 265 μ ($\frac{1}{140}$ to $\frac{1}{96}$ in.). Marine, pelagic.

In June 1898 Mr. John Hood found this peculiar Synchæta in the sea near Dundee, and sent me some living specimens for identification. I recognised it at once as the animal Dr. Robert Lauterborn had discovered off the coast of Helgoland in August 1893, and of which he had given a rough figure and short description in his *Beiträge zur Meeresfauna von Helgoland.* Since his first capture, Mr. Hood has found it repeatedly and has sent it to his correspondents, and I have no doubt it could be obtained at other points along the coast during the summer months. Mr. Dixon-Nuttall has made a fine and accurate portrait of it (fig. 14) which gives a better idea of its appearance than any amount of description. The general outline of this species is cone- or top-shaped, very broad anteriorly and very slender posteriorly, ending in a thin, pointed, style-like toe, which appears to be single. The auricles are very large, and the front of the head is rounded, and so wide as to be, with the auricles, very nearly as broad as the animal is long. The usual pair of large outer frontal styles project from large triangular fleshy flaps, and the two smaller styles are situated on the dorsal edge just above the frontal eyes. A peculiarity of this species is that it has three deep red eyes: a cervical eye which is double, in the usual position, and two frontal eyes situated in front, a short distance below the dorso-frontal edge of the head. Two streams of minute red granules usually connect the dorsal eye with the frontal eyes, as if the latter were connected with the cervical eye by means of very fine tubules. I have noticed a similar tendency in several other species such as *S. oblonga*, and more rarely in *S. tremula*, but only in *S. littoralis* are the frontal eyes so constant and so prominent as in *S. triophthalma.* The dorsal antenna is present in its usual position, but the main and unique feature of this Synchæta is that it has a single, very large and asymmetric lateral antenna, protruding from a fleshy prominence low down on the left side of the body near the toe. There is no trace of a lateral antenna on the right side. The

foot is not well marked off, and body, foot, and toe follow each other without much distinctness. The foot-gland is elongated and club-shaped and apparently single.

The mouth is situated in the usual position on the ventral halt of the front of the head; around the mouth are four groups of five or six fairly long stiff sense-hairs, and outside these there are the usual four patches of vibratile cilia. The mouth is oval in shape, and guarded by a wreath of short, closely-set, overhanging, stift hairs. The mastax, œsophagus, stomach, ovary, lateral canals, and rest of the anatomy are quite normal of Synchæta type. One uncus of the jaws is represented in fig. 14*a*. The egg, when extruded, is carried about for a time, attached by a thread, but often becomes detached. I have observed an individual carrying two eggs. It is oval in shape, 75 μ ($\frac{1}{340}$ in.) long by 58 μ ($\frac{1}{440}$ in.) broad.

In swimming this Synchæta sails in long graceful curves, without undue haste, and reminds one of the flight of the swallow through the air. When once seen this species can be recognised by this mode of swimming, which is very different from that of the other species.

The **male** has not yet been observed.

I have been very successful in preserving and mounting this animal fully extended, and showing all its characteristic peculiarities.

The size varies a good deal according as the animal is young or full grown, from 181 μ to 265 μ ($\frac{1}{140}$ in. to $\frac{1}{96}$ in.). The width across the auricles is very nearly the same.

Its habitat, as far as known, is the open sea round Helgoland, near Dundee, and the Bay of Naples, appearing in the summer months from May.

Synchæta monopus Plate.

Pl. VI. fig. 12.

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PLATE, L. H.—Ueber die Rotatorienfauna des bottnischen Meerbusens, etc. Zeitschr. f. wiss. Zool., Band 49, 1890, pp. 1–42.

LEVANDER, K. M.—Wasserfauna in der Umgebung von Helsingfors. Acta Soc. pro Fauna et Flora Fennica, Helsingfors, 1894, pp. 1–72, 2 pls.

Spec. Char.—Body a greatly swollen bag, very thin-walled and extremely transparent, terminating in a very small foot with single toe. Head small, with four frontal styles and small auricles. Eye red, cervical. Size 254 μ ($\frac{1}{100}$ in.) long by 164 μ ($\frac{1}{155}$ in.) broad. Marine, pelagic in the Baltic.

This remarkable pelagic marine species was named by Dr.

L. H. Plate from material collected by Dr. O. Nordqvist in the Bay of Bothnia. The specimens having been killed and preserved in spirit, were all fully contracted, so that only a very imperfect description could be given. Dr. Levander has, however, found this form again in great abundance in the open sea near Helsingfors, and has given a better account of it with a drawing. He has also been good enough to send me some fairly well preserved specimens and two sketches of the dorsal side and front view of the head, which are here reproduced (figs. 12 and 12*a*), so that I owe my acquaintance with this peculiar Synchæta to these. Not having seen it in the living state, however, my account of it must be largely taken from Dr. Levander's description.

The shape of the body is quite unlike that of any other Synchæta, and instead of the usual cone it presents an extremely thin-walled, very transparent, bag-like, rounded vesicle, constricted anteriorly, with a very small head, which, however, has the usual characteristic Synchæta structure. The body terminates in a very small swollen foot carrying a single toe.

The whole structure of all the organs is so fine and delicate that it appears evident the whole organism, in acquiring these characters, has been evolved with a view to render itself as transparent, and therefore as invisible as possible, which is characteristic of many pelagic animals.

The small head, as will be seen from fig. 12*a*, which represents a front view, carries a normal ciliary wreath in two interrupted regions, four frontal styles, and two small but distinct auricles.

The cervical eye is red, seated on the oval brain mass. The dorsal antenna is slightly raised above the eye, while the ventral antennæ emerge very low down close to the foot, somewhat on the ventral side. The mouth is shield-shaped and guarded by the usual screen of fine hairs. The mastax is also small, of Synchæta structure, and the unci have five strong teeth, which I was able to see in some swollen specimens where the unci had been forced through the mouth.

The œsophagus is a very thin, long tube, not ciliated internally, leading to a small thick-walled stomach, to which very small and rounded gastric glands are attached.

The ovary is very small, oval, containing about eight germ-cells.

The muscular system is of normal character; a dorsal and ventral pair of extremely thin and narrow muscular threads originate both in the head and in the foot, and are inserted a little below the middle to the body-walls.

The excretory system is represented by lateral canals, which are attached, on either side, to the wall of the stomach, whence they continue forward for a short distance, being suspended quite freely in the body-cavity by a very fine thread attached to the side

of the body; each canal ends in a single flame-cell. The contractile vesicle is fairly large, and situated below the stomach.

The whole of the internal organs, digestive system, ovary, &c., take up only a very small proportion of the comparatively large body-cavity, so that this *Synchæta* at first sight looks much more like a small *Asplanchna priodonta* than anything else. The dorsal half of the body-cavity is smaller than the ventral half, and sometimes the ventral wall is swollen out to such a degree as to extend much beyond the foot.

Synchæta monopus has not the appearance of being so vigorous a swimmer as its near relatives. Dr. Levander states that it occurs in great abundance, associated with *S. baltica*, from the middle of June to October, in the bays and open sea near Helsingfors, and it is evidently also found in other parts of the Baltic. It has not yet been found on the English coast, or in any other seas. It does not carry its eggs.

Its size is 254 μ ($\frac{1}{100}$ in.) long by 164 μ ($\frac{1}{155}$ in.) wide. The **male** is not known.

Synchæta cecilia sp. n.

Pl. VII. fig. 16.

Spec. Char.—Body small, pear-shaped in form, rounded in front; four frontal styles; foot distinct, conical, carrying apparently a single toe. Lateral antennæ situated at extreme base of body. Eye cervical, red, with a tendency to separate in two halves; carries one or more eggs about attached by a thread to the toe. Greatest size 142 μ ($\frac{1}{180}$ in.); width at auricles 82 μ ($\frac{1}{310}$ in.); male 78 μ ($\frac{1}{326}$ in.) long. Marine.

In November 1895 I first obtained this small and attractive marine species from Mr. F. Daunou, who had found it in a tide pool close to the sea at Margate. Since then I have received it repeatedly, sometimes in large numbers, from Mr. John Hood, of Dundee, and from Mr. Hurrell, of Great Yarmouth. A great peculiarity, which at once attracts attention, is that it habitually carries about its eggs, one, two, or sometimes three in a string, in its restless gyrations.

In size it is one of the smallest Synchætæ, and in shape it is cylindric, somewhat pear-shaped, convexly rounded in front, rounded behind, with a distinctly marked-off foot of fair size, bearing a small conical, apparently single, toe. The foot and toe are often bent dorsal-wards. The auricular lobes are small. In front the head bears the usual prominent four styliform bundles of stiff sense-hairs, the outer pair emerging from triangular fleshy flaps. On each side of the shield-shaped mouth there are the

usual four tufts of sense-hairs, but only two of these tufts can be seen from a dorsal view. The crimson eye is in the usual position, and consists of two apposed red bodies. The dorsal antenna protrudes from a conical elevation in the usual situation. The lateral antennæ are situated at the extreme base of the body, where the foot begins. The mastax is fairly large, of normal structure, and of *S. tremula* type, with six teeth in the thin, flat, and broad unci, the first tooth being longer than the others. A short, thin-walled œsophagus leads to a thick-walled, rounded, yellow stomach, the anterior part of which is thin-walled, and having large cells in its wall, and densely ciliated inside. The stomach carries ample gastric glands of irregular shape. The lateral canals, contractile vesicle, and muscular system are distinct and normal. The integument is fine and soft, and with a high power numerous very fine longitudinal folds can be observed in it. The ovary is flat and rounded, and contains a number of large nucleated germ-cells. The egg is large, being estimated at about one-fifth of the total bulk of the animal, and oval in shape; it is attached to the toe by means of a fine mucous thread, which is sometimes lengthened, and the egg then follows the animal at some distance behind. I have seen two and three eggs attached side by side or one behind the other in a string—a peculiar sight. This habit of carrying its eggs is quite uncommon in Synchætæ, but with this species it appears to be habitual, and dozens of individuals can be seen with eggs in a fresh gathering, while of course there are also always some without them. Mr. F. R. Dixon-Nuttall has made the attractive drawing, fig. 16, and also fig. 16*a*, which shows a side view of the single toe with a small knob, looking like a rudiment of a second toe.

On comparing this new species with the described forms it seemed to me that it had some resemblance with the marine Synchæta Mr. Gosse has figured and described in the Monograph, p. 126, as Ehrenberg's *S. baltica*, though there are some discrepancies in the description, and he does not mention that it carries its eggs. I therefore applied to Mr. John Hood and inquired what animal it was he sent to Mr. Gosse, from which he made the drawing on pl. xiii. fig. 1, as mentioned in the text, and Mr. Hood informs me that it was this Synchæta to which I have now given the name of *S. cecilia*. Mr. Gosse has never seen the real *S. baltica* of Ehrenberg, which, as far as is known, is confined to the Baltic, and hence his mistake.

The male.—At the end of October last Mr. Hurrell sent me some sea water in which this species was very abundant, and amongst them I noticed some carrying bundles of two to four small male eggs. By isolating these I soon obtained the male, which is represented in fig. 16*b*. It is a small cylindrical creature 78 μ ($\frac{1}{326}$ in.) in length, with a foot and toe turned ventral-wards. The front of the head is conical and carries four styles; the base of the cone

bears a nearly circular wreath of vibratile cilia. The brain-sac carries a red eye imbedded in grey granules, and just above it the large dorsal antenna is seen to emerge, slanting backwards. The lateral antennæ are also conspicuous by their size, protruding low down at the sides of the body. A mouth, jaws, and digestive tract are absent; a large sperm-sac fills the greater part of the body-cavity. The male was seen to attach itself invariably to the side of the female. Although the males became abundant in the water I never observed an egg with thicker walls that could be recognised as a fertilised resting egg, and such eggs are so far quite unknown in any Synchæta.

Size of female: 142 μ ($\frac{1}{180}$ in.) in length by 82 μ ($\frac{1}{310}$ in.) wide at the auricles; young and smaller animals are always present also. The male: 78 μ ($\frac{1}{326}$ in.) in length; the eggs are slightly oval in shape. Female eggs, 61 μ ($\frac{1}{415}$ in.) by 47·5 μ ($\frac{1}{535}$ in.); male eggs, 42·5 μ ($\frac{1}{600}$ in.) by 35·7 μ ($\frac{1}{710}$ in.).

Synchæta vorax sp. n.

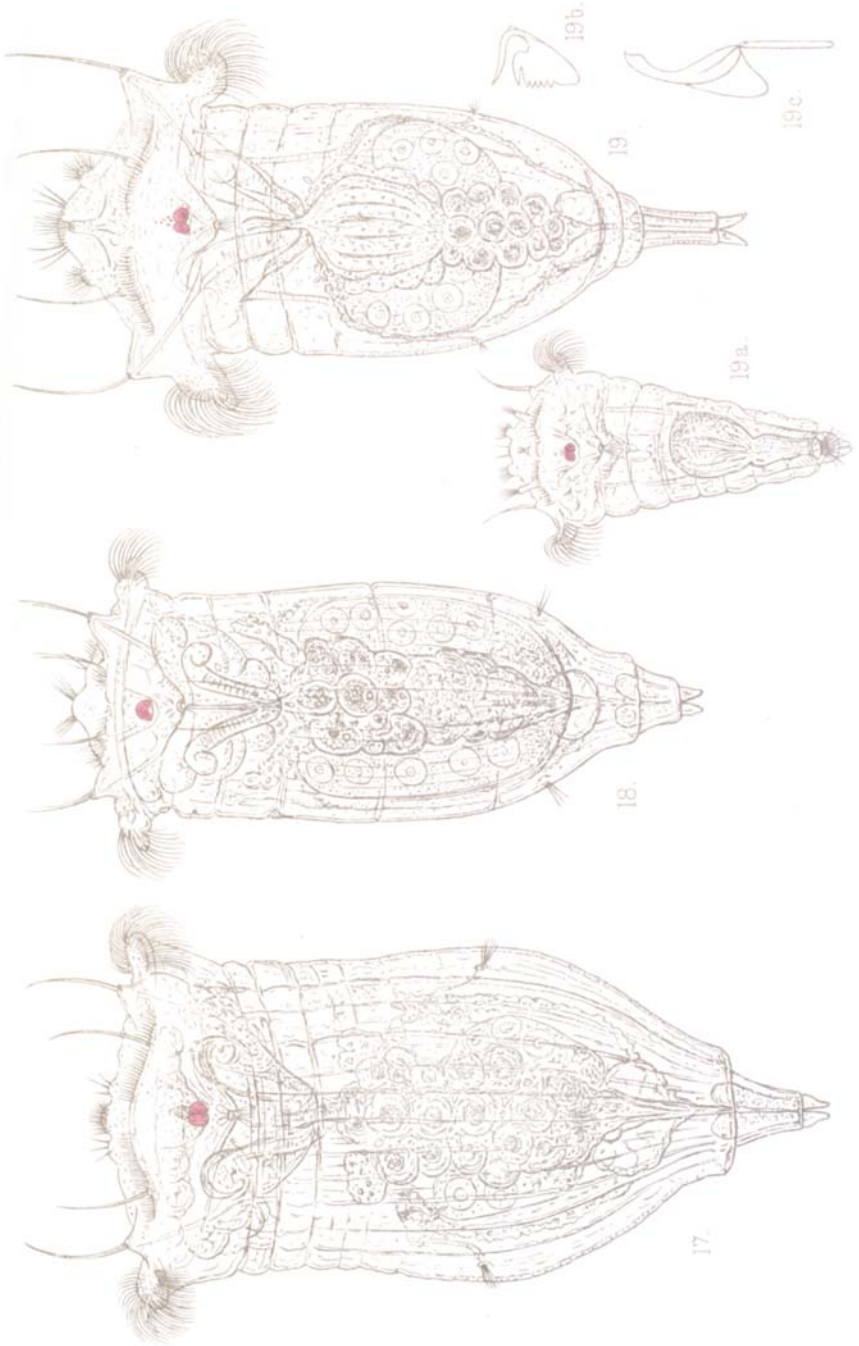
Pl. VIII. fig. 19.

Spec. Char.—Body stout, more cylindrical in shape rather than conical, pointed anteriorly, with a well-marked, narrow, fairly long, and flexible foot, carrying two distinct toes. Frontal styles four; in addition to usual dorsal and lateral antennæ it has a unique tubular frontal antenna. Cervical eye large, red, appearing double. Size of female, average 272 μ ($\frac{1}{93}$ in.) long by 136 μ ($\frac{1}{185}$ in.) broad across the auricles. One large specimen measured 340 μ ($\frac{1}{75}$ in.) long by 149 μ ($\frac{1}{170}$ in.) broad. **Male** with three tubular frontal antennæ and two movable, setose, fleshy processes in front of head; 149 μ ($\frac{1}{170}$ in.) long. Marine.

In June 1898, in sea water from the harbour of Dundee sent by Mr. John Hood, I first discovered a few specimens of this new and savage species in company with *S. triophthalma*, and then again in June 1899 Mr. Hood obtained it in the same spot in larger numbers, which I was able to preserve and mount most perfectly. It has not been met with at any other season or place, and seems to be a summer form.

EXPLANATION OF PLATE VIII.

Fig. 17.—*Synchæta gyrina* Hood ♀ Dorsal view. × 300.
„ 18 „ *tavina* Hood ♀ Dorsal view. × 325.
„ 19 „ *vorax* sp. n. Rouss. ♀ Dorsal view. × 275.
„ 19*a* „ „ „ The male, dorsal view. × 300.
„ 19*b* „ „ „ One uncus of the jaws.
„ 19*c* „ „ „ One ramus and fulcrum of the jaws.



F.R.Dixon-Nuttall del ad nat.

West, Newman lith.

Synchaetae.

The body is more cylindrical in shape than the other species of the genus, rounding off towards the foot, which is very flexible and distinctly marked off, narrow, fairly long, and terminated by two small pointed toes always carried well apart. The auricles are powerful, but less broad than in some other species; the head is prominently pointed in front, and carries the usual pair of style-like antennæ issuing out of a triangular flap of the integument, and two small styles on the dorsal frontal edge of the head. Below the frontal eye, exactly in the middle of the front and above the mouth, this species has a large tubular antenna of peculiar structure, not known, so far, in any other species of Synchæta. It consists of a bundle of fine setæ protruding out of a fairly long, fleshy tubule pointing straight forward. The usual median dorsal antenna above the eye is also present. The mouth is situated immediately below the pointed front, is surrounded by the usual four tufts of stiff setæ and four patches of vibratile cilia. The mouth-opening itself is V-shaped and, as in all other species, is guarded by a single row all round of closely set, short, stiff hairs, all converging over its centre. The lateral antennæ are very small, and situated in the lumbar region, about two-thirds down the side of the body, and slightly on the ventral side. The median eye is large, deep red in colour, looking like two eyes closely apposed. The mastax is large and of usual *Synchæta tremula* type with some variation in the shape of the rami (fig. 19*c*); the unci have one large tooth and four or five very small teeth, mere serrations (fig. 19*b*). The large stomach, intestine, lateral canals, and contractile vesicle are of usual structure and call for no particular remark. The ovary is large and roughly oval in shape. The eggs are not carried about, and I have seen an egg lying beside the ovary with a rather stout, smooth shell, measuring 11·5 μ by 9·5 μ.

This species swims with such impetuosity through the water that its rush cannot be described otherwise than furious; its course is straight forward, then it dashes suddenly round in another direction, lashing its foot up and down and right and left, attacking any other Synchæta that may come in its way, and not at all particular as to species. I have seen it seize an unfortunate *S. triophthalma* with its jaws, carry it in its mouth and devour it without a moment's stop in its furious career.

No other Synchæta of my acquaintance is so fast in motion and so fierce of temper. In this respect it can only be compared with *Ploesoma hudsoni*, which is equally wild and fierce.

In retraction the auricles are turned in over the head, and a fold of the skin closes over them, while the foot is completely retracted within the body.

The male. The Synchæta males are rare, but I observed the male of this species attached to the posterior part of a large female, while at the same time the latter was rushing through

the water at express speed with a *S. triophthalma* in its jaws, which it was devouring. Seizing the opportunity, I secured and mounted all three in a slide. The male is small, conical in shape, has no mouth, mastax, stomach, or intestine; a small rounded sperm-sac takes the place of the stomach. The front of the head carries the usual four styles. The median frontal tubular antenna, which is so prominent and characteristic in the female, is also present, but of small size; in addition to this, the male has on the front two small tubular antennæ, one on each side, which is very strange. Further, it has at the extreme front of the head, but slightly ventral in position, two stout, fleshy, freely movable processes, surmounted by a broad brush of long stiff hairs. In no other male have I seen such organs.

A deep red eye, usually imbedded in a mass of semi-opaque granules, is present. Size of male 149 μ ($\frac{1}{170}$ in.).

Mr. Dixon-Nuttall has made excellent drawings of the male and female from living specimens (figs. 19 and 19*a*), by means of which this species will be readily identified.

Synchæta neapolitana sp. n

Pl. V. fig. 9.

Spec. Char.—Body small, top-shaped, sometimes swollen at sides; head broad, and rounded in front; four frontal styles; auricles fairly large; lateral antennæ very small, situated two-thirds down the sides of the body; eye red, cervical; foot with two distinct joints, the last joint bearing a blunt spur, and carrying a single pointed toe. Size: female up to 163 μ ($\frac{1}{155}$ in.) long by 108 μ ($\frac{1}{235}$ in.) wide at the auricles; male 75 μ ($\frac{1}{340}$ in.) long. Marine.

In June 1897, Mr. H. S. Jennings of U. S. America sent me, from the Zoological Station at Naples, a rough sketch of a Synchæta which had just been collected in very large numbers in the open sea in the Bay of Naples, showing a spur-like projection on the foot as its most distinctive feature. At that time I was unable to recognise or diagnose this animal, but having since made a careful study of, and become personally acquainted with, all the known species of Synchætæ, and having also received some preserved specimens from Mr. Jennings, I can now say that it is undoubtedly a new species, which I have named *S. neapolitana*.

A very few specimens of the somewhat larger *S. triophthalma* I discovered in the same material.

From the Director of the Naples Zoological Station I learn that this new *Synchæta neapolitana* appears in the bay occasionally

in June in immense swarms, when the sea has been very calm for a long time, but not every year. Mr. Jennings' preserved material, prepared for the purpose of studying the segmentation and development in the egg, is not very good as regards the adult Synchæta, the great majority of the animals being badly contracted, but by searching some fairly extended specimens have been secured, of which the following is a description :—

The body is top or cone-shaped, either straight or slightly swollen at the sides. The front part of the head is broad and rounded, and bears four styles, the outer pair arising from triangular fleshy flaps, and auricles of fairly large size. The foot has two distinct joints, and carries a spur-like process at its dorsal end. It is somewhat difficult to decide whether this process is a true spur, an organ otherwise unknown in this genus, or a second toe turned upwards, and to some extent gone out of use. The process is situated on the dorsal side of the second joint of the foot, but to the left of the median line, and originates a little higher than the base of the true toe, which seems to be the only exit for the secretion of the large and apparently single foot-gland. Whatever its true meaning, this structure forms the most prominent distinctive character of this species, and fig. 9*a* gives an enlarged view of the foot and spur-like structure.

The mastax is of usual Synchæta shape and structure, the unci have teeth similar to those of *S. oblonga*, but their exact number could not be ascertained in the preserved specimen. The stomach is not large, of usual structure, and carries two rounded gastric glands. A rounded ovary, contractile vesicle, and lateral canals are present. The cervical eye is single, with occasionally a slight appearance of splitting in two halves, but I could see no trace of frontal eyes such as *S. triophthalma* possesses. The dorsal antenna is situated on a fleshy projection above the eye, and the lateral antennæ are very small and protrude at a point about two-thirds down the side of the body and slightly on the ventral side.

In life the eggs are carried about attached to the toes. I found a large number of both male and female eggs in the preserved material, and also the **male**, which is of usual structure and represented in figs. 9*b* and 9*c*, dorsal and lateral view.

Mr. F. R. Dixon-Nuttall has made a good drawing of both male and female, figs. 9*a*, *b*, and *c*, after looking at and comparing a number of specimens which were not too well preserved.

The size of the female varies considerably, as usual, from 109 μ ($\frac{1}{233}$ in.) to 163 μ ($\frac{1}{155}$ in.) long by 75 μ ($\frac{1}{340}$ in.) to 108 μ ($\frac{1}{235}$ in.) wide at the auricles. The **Male** is 75 μ ($\frac{1}{340}$ in.) long. The eggs are oval in shape and measure :—female eggs, 61 μ ($\frac{1}{415}$ in.) long by 51 μ ($\frac{1}{500}$ in.) broad; male eggs, 44 μ ($\frac{1}{575}$ in.) long by 34 μ ($\frac{1}{750}$ in.) broad.