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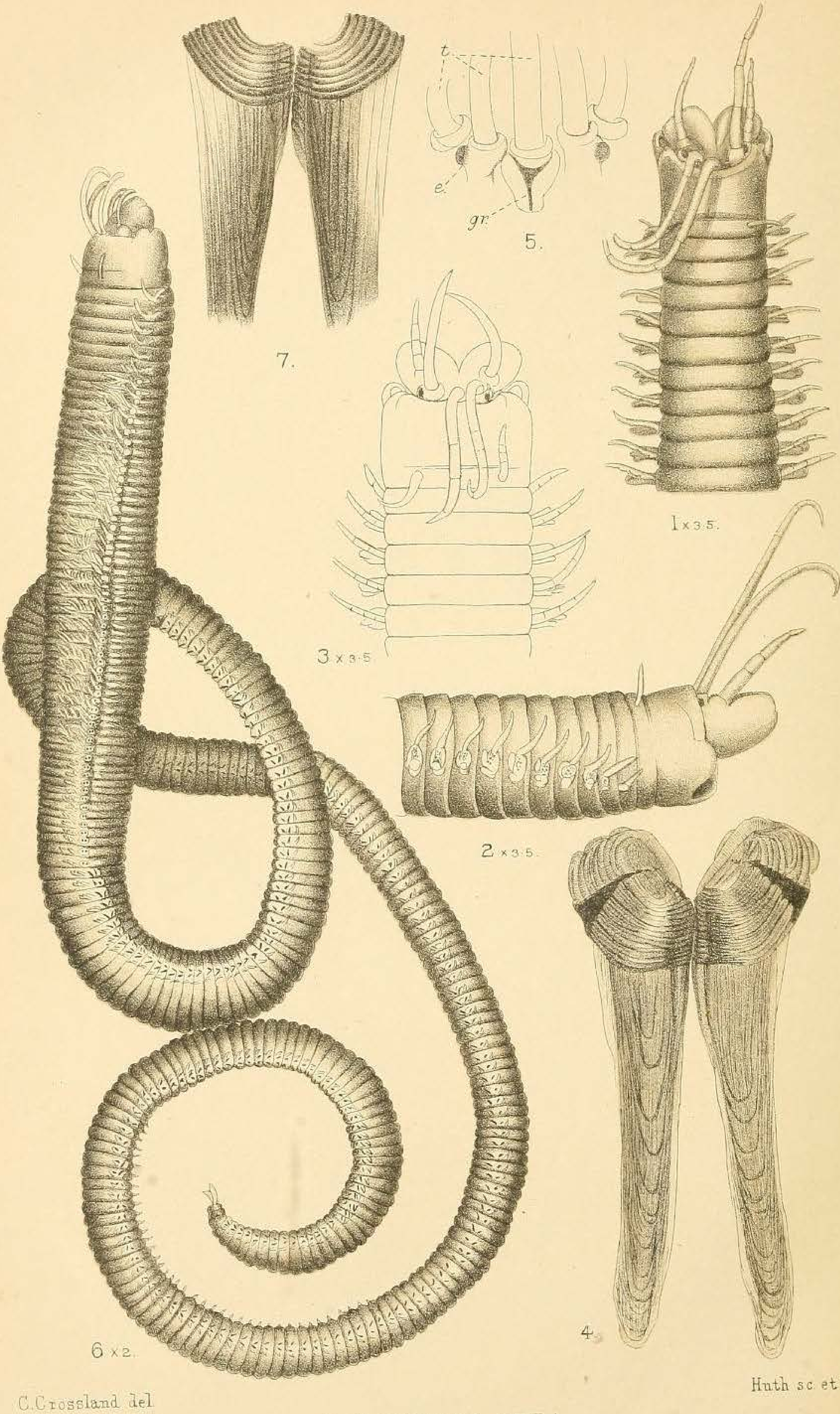
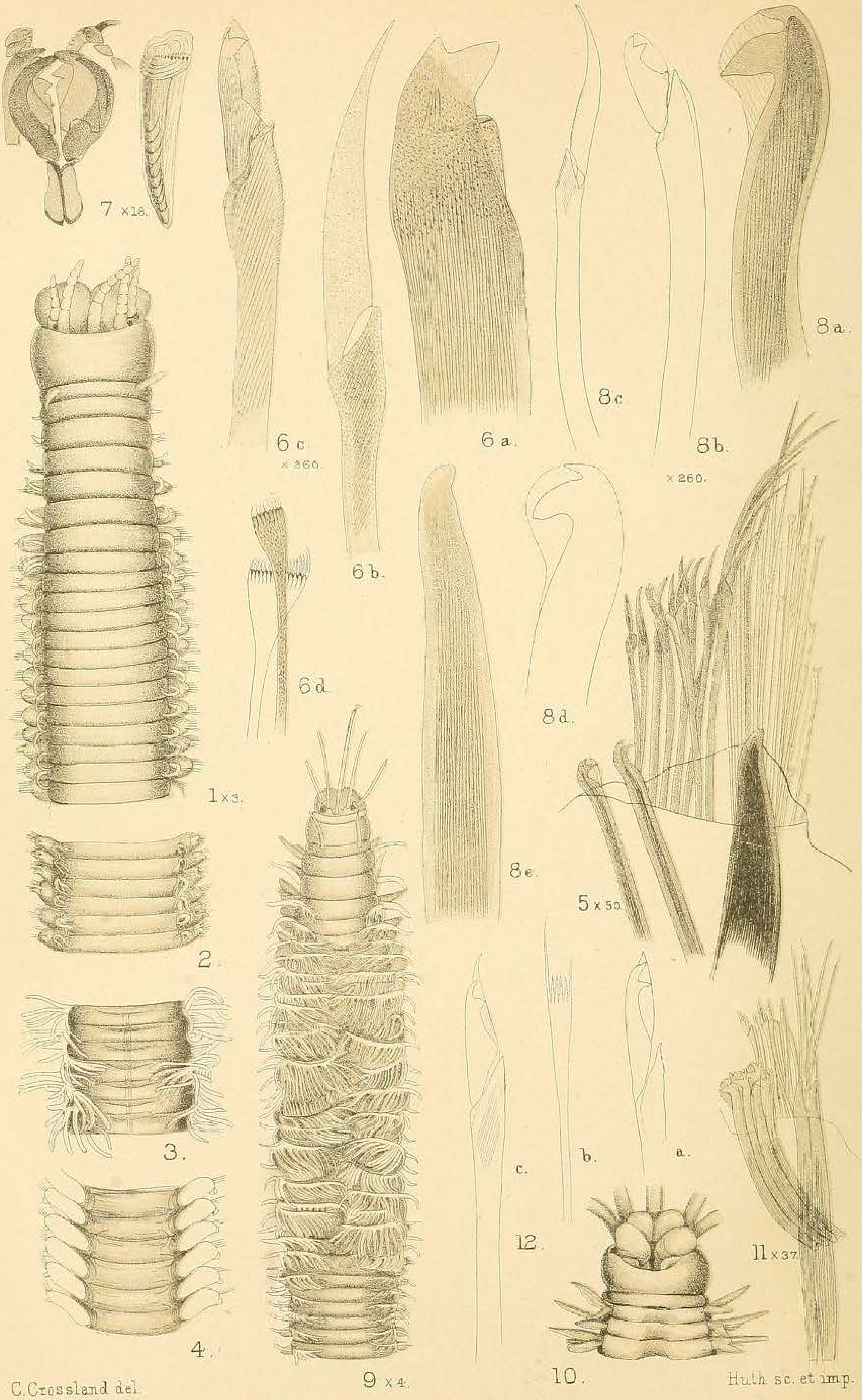


C. Crossland del.

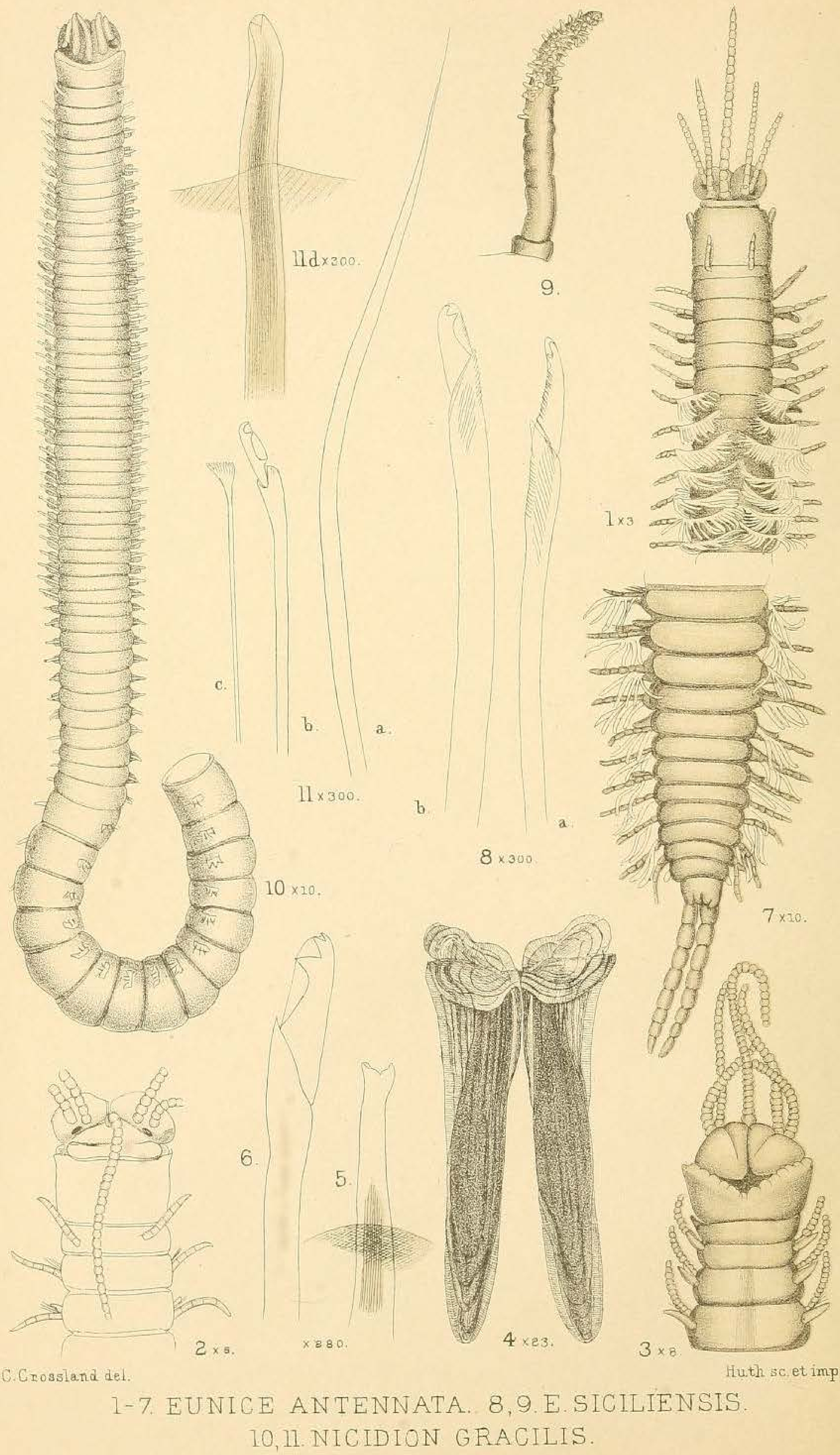
Huth sc. et imp.

1–5. EUNICE AFRA.
6, 7. E. COCCINEA.



C. Crossland del. Huth sc. et imp.

1–6. EUNICE TUBIFEX, full grown.
7, 8. E. TUBIFEX, young. 9–12. E. INDICA.



C. Crossland del.

Huth sc. et imp.

1-7. EUNICE ANTENNATA. 8, 9. E. SICILIENSIS.
10, 11. NICIDION GRACILIS.

4. The Marine Fauna of Zanzibar and British East Africa, from Collections made by Cyril Crossland in the Years 1901 and 1902.—The Polychæta. Part III.* With which is incorporated the Account of Stanley Gardiner's Collection made in the Maldive Archipelago in the Year 1899. By Cyril Crossland, B.A., B.Sc., F.Z.S., the Gatty Laboratory, St. Andrews.

[Received December 15, 1903.]

(Plates XX.–XXII.† and Text-figures 43–66.)

Genus Eunice.

The species fall into the following groups, of which A contains the greater part of the genus:—

A. Generalised species with tentacles of moderate length, jaws of normal form and constitution, gills well developed in the adult, and setæ of the usual kinds.
- *α*. Gills continue to hind end of the body.
  - 1. Gills begin about feet 3 to 8, complex but small in proportion to size of body.
    - *a*. Quadripartite prostomium, gills of up to 30 filaments, and characteristic setæ ... *E. aphroditois*, p. 288.
    - *b*. Bifid prostomium, gills of about 8 filaments, and setæ of quite general form . *E. grubei*, p. 288.
  - 2. Gills begin between feet 15 and 20, attain to from 4 to 10 filaments anteriorly but are simpler posteriorly. Setæ of general form.. ... *E. afra*, p. 289.
- *β*. Gills occur only on the anterior third of the body.
  - 1. Begin about 6th to 9th feet. Body-form characteristic .... *E. coccinea*, p. 297.

B. Forming tubes of characteristic structure and material. Otherwise very like members of group A.
- 1. Compound setæ with sword-shaped articulated pieces anteriorly, sickle-shaped posteriorly ... *E. tubifex*, p. 303.
- 2. All compound setæ of the latter form .... *E. floridana* & *E. tibiana*, *E. conglomerans* § & *E. gunneri* (= *amphiheliæ*, &c.). (These are the remaining species of the group.)

C. With long tentacles, large gills beginning before the 10th foot, three-hooked acicular setæ, and markedly asymmetrical jaws.
- *α*. Head nearly as broad as the rest of the body, tentacles deeply annulated, jaws strong and chitinous.
  - 1. Gills confined to anterior part of the body.. *E. murrayi*, p. 310.
  - 2. Gills continued to near anus .... *E. antennata*, p. 312.

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* For Part I., see P. Z. S. 1903, vol. i. p. 169; Part II., 1903, vol. ii. p. 129.

† For explanation of the Plates, see p. 330.

‡ It is not suggested that this grouping is necessarily of more than temporary utility, but it is certain that in a natural system the larger groups cannot be separated by one character alone, as has hitherto been attempted. Reasons for laying less emphasis upon characters employed for the major divisions by earlier workers are given among the notes on variation of the species described below.

§ These three species are from Ehlers' 'Florida Anneliden,' 1887. *E. conglomerans* is very near to *E. tubifex*, and is distinguished from all other Eunicids by its compound setæ.

β. Head small, tentacles smooth, jaws delicate and calcareous .... *E. indica*, p. 318.
The remaining species of this group are *E. vittata* *, *E. ornata* †, *E. rubra* ‡.

D. Body of characteristic form, bearing gills of one filament posteriorly; jaw-apparatus highly specialised. Comb and acicular setæ absent ... *E. siciliensis*, p. 323.
In the absence of a complete account of *E. schizobranchia* Clp., this species (including *E. leucodon* Ehl. as a variety, see below) is the only member of the division.

E. Of generalised structure but gills absent.
1. Jaw-apparatus of normal form .... *Nicidion gracilis*, sp. n., and others, p. 327.
2. Jaw-apparatus somewhat resembling that of *E. siciliensis* .... *N. edentulum* Ehl., p. 326.
N. balfouriana McI. (as E. 1) and *N. brevis* Ehl. (loc. cit.) are the remaining species certainly known.

Eunice aphroditois Pallas.

Eunice aphroditois McIntosh, 'Challenger,' xii. p. 282; Gravier, Nouv. Arch. du Mus. Paris, 1900, p. 224.

A single specimen, the posterior end of which is in process of regeneration, from Goidu Reef, Maldives. The body is of very nearly the same width throughout, viz. 2 cm. inclusive of parapodia and setæ.

It should be noted that in spite of the large number of their branches the gills are quite small, not covering any appreciable part of the dorsal surface of the body. The articulated piece of the compound setæ has been nearly always lost, but when present it bears two hooks, and, like the acicular seta, corresponds exactly with McIntosh's figures from the Australian specimen obtained by the 'Challenger.' The dorsal bundle of setæ corresponds with Gravier's account in the disproportionately small number and the long slender points of the capillary setæ, and in the number, characteristic shape, and granular surface of the combs. Since these two points were not given by McIntosh, and small variations of the jaw-plates are not of systematic importance, the only certain foundation for Gravier's var. *djiboutiensis* is the third very small tooth found between the longer two of the articulated pieces of the compound and acicular setæ. This difference is hardly sufficient to warrant the addition of a third name, especially in view of the variation in the shape of these teeth noted in the 'Challenger' specimens.

Eunice grubei Gravier.

Eunice grubei Gravier, Nouv. Arch. du Mus. de Paris, 1900, p. 258.

Only three fragmentary specimens occur—two, small, 3 mm.

* = *E. limosa* Ehlers, Borstenwürmer.
† Andrew, P. U.S. Nat. Mus. xiv. 1891, p. 277. "Annelids of N. Carolina."
‡ Ehlers, 'Florida Anneliden.' Results of dredging by U.S. Survey steamer 'Blake,' 1887.

wide, from 10 fathoms in Wasin Harbour, East Africa; and one, larger, 6 mm. wide, dredged off N. Male Atoll, Maldives, from 35 fathoms, bottom sand.

This species is nearly related to the two following, but is readily distinguished from *E. afra* by the early commencement of the gills, and from *E. coccinea* by their persistence to the end of the body.

The specimens correspond very closely and in detail with the account given by Gravier.

The body is flat anteriorly, immediately behind the buccal segment, though arched dorsally behind. The shortness of the segments immediately following the head is also a feature of note.

In the smaller specimens the annulation of the tentacles is not so easily seen as in the larger. These also differ in the jaw-apparatus, which in the younger are delicate and calcareous, in the adult dark brown. The ends of the lower plates, however, remain white, thus, as in their shape, exactly resembling those of *E. flaccida*.

The forms of the other plates call for no remark, and the following are the formulæ of their teeth:—$6-7:6+8-8$ and $5-5:7+7-9$; the latter corresponding closely with that given by Gravier.

The gills usually begin at the third foot, but in the two East-African specimens rather later, viz. at the seventh or eighth.

It is impossible not to regard with great doubt the distinction drawn by Gravier between this species and Grube's *E. longicirris* from Suez. The annulation of the appendages varies in distinctness in these specimens, in the largest of which it can be made out in the anterior dorsal cirri as in Grube's species. The length of the tentacular cirri, which in Grube's specimen reach to the anterior border of the prostomium, may be abnormally great, though in one of these the cirri reach well beyond the anterior border of the buccal segment. When a complete specimen is examined it is seen to be true for these, as for Grube's example, that most of the gills reach scarcely half the length of the dorsal cirrus. The larger anterior ones anteriorly are of about the same length, which, allowing for a reasonable amount of variation, corresponds with both Grube's and Gravier's accounts.

However, the brevity of the latter gives enough uncertainty to justify the creation of a new name for these specimens, until Grube's work can be verified and completed.

EUNICE AFRA Peters. (Plate XX. figs. 1–5.)

Eunice collaris Grube, Annulata Semperiana; Gravier, Nouv. Arch. du Mus. de Paris, 1900, p. 251.

Eunice perrieri Gravier, loc. cit. p. 232.

Eunice mutabilis Gravier, loc. cit. p. 245.

For other synonymy see Ehlers, Nachr. zu Gött. 1897 *.

This species, among the least specialised of the genus, besides

* In a note on this species just received, Dr. A. Willey gives *E. paupera* Gr. as yet another synonym.

being of very wide geographical distribution, adapts itself to a varied habitat.

In East Africa the specimens were collected as follows :—

Two large examples 280 mm. × 10 mm. over all, from the interstices of coral, low spring-tide level, Chumbe Island, Zanzibar Channel.

Nine, mostly of similar size, from the sand of Chuaka Bay, Zanzibar.

One, 170 mm. × 4 mm., from muddy sand, lowest tide-level, Prison Island, Zanzibar Channel.

One, incomplete but apparently originally of the same size, dredged from 10 fathoms, Wasin Harbour.

In the Maldives :—

Two of fair size and two smaller, with fragments, from the reef at Hulule, Male Atoll.

Half a dozen small specimens and fragments of a larger from breaking up stones on Minikoi reef, six fair-sized from the lagoon sand, one from decaying beach-sandstone, and three dredged from 5–7 fathoms in the southern parts of the lagoon of the same atoll.

Fragments, in some cases doubtfully identified, from Goidu reef, off Mahlos Atoll, in 4 fathoms and 22 fathoms, the latter from among *Polytrema* and stones; from 30 fathoms with a rough stony bottom off Suvadiva; and on Minikoi reef specimens were found in sand under boulders.

From Funafuti (collected by Gardiner) :—Two specimens, one from the outer reef, the other from the mangrove-swamp.

From the Seychelles (collected by Dr. E. P. Wright, of Dublin, in 1868. The specimens were kindly lent to me by Prof. McIntosh) :—Two specimens of good size, 6 mm. and 4 mm. wide.

The species is thus recorded from almost every part of the Indo-Pacific area, from the Red Sea to the Philippines, and occurs in almost every kind of habitat.

The examination of this large number leads to some modification of former accounts which were based on one or two specimens only.

The colour of the living animals is somewhat variable, the round or oval white spots and the collar on the fourth setigerous segment (the origin of Grube's name "*collaris*") being often absent or but partially and irregularly developed. The two specimens collected together on Chumbe Island differ in this respect from each other, and form the above arrangement which has hitherto been regarded as specific. The ground-colour of both is a light yellow-brown, interrupted in the one case by uniformly scattered minute white dots alone, in the other irregular transverse blotches of white are added. In neither is there any collar. The tentacles are banded alternately with brown and white, and the feet &c. are white. The specimen from Wasin is similar, but the white blotches are more clearly marked, and on (setigerous) segments three and four entirely displace the brown pigment, thus forming a very conspicuous collar. An irregular, broad, longitudinal band extends from the base of the median tentacle to the posterior border of the first setigerous segment. The tentacles, nuchal and dorsal cirri, feet, and ventral surface are white or nearly so.

The Chuaka specimens were described in my notes as having a colour resembling that of cocoa, with small irregular marks of a yellowish white. The tentacles are banded with white, and the feet &c. are whitish as above.

The above contrast more or less markedly with the appearance of the single smaller specimen from Prison Island. This had a dark red-brown ground-colour, approaching that of chocolate, which throws up vividly the white spots, which are here somewhat larger and more definite in outline than in most specimens, and the collar, which occupies segment five. The parapodia and their appendages, the tentacles and the edges of the palps are yellowish white. Gills bright red as usual. A white mark encircles the base of the middle tentacle and thence extends to the back of the prostomium.

According to Peters, the original example of the species, like those examined by Ehlers, was devoid of markings.

So far, then, from the collar being a principal distinction of this species, it is more often absent than present *.

In all cases the colour dies out posteriorly or is retained only in the intersegmental grooves.

In the Maldive specimens the pigmentation cannot be certainly made out. A fragment of a specimen of this species has been observed to emit a strong blue phosphorescence at night.

The general appearance and proportions of the body, which are very approximately constant and fairly characteristic of the species, have not yet been described in detail. The nearly cylindrical anterior end is but slightly narrower than the broadest part of the anterior half of the body, the position of which is from about the eighth to the twelfth setigerous segments †. Further back still, near its middle, the body expands again, becoming slightly broader yet (see text-fig. 43, p. 292, and its explanation).

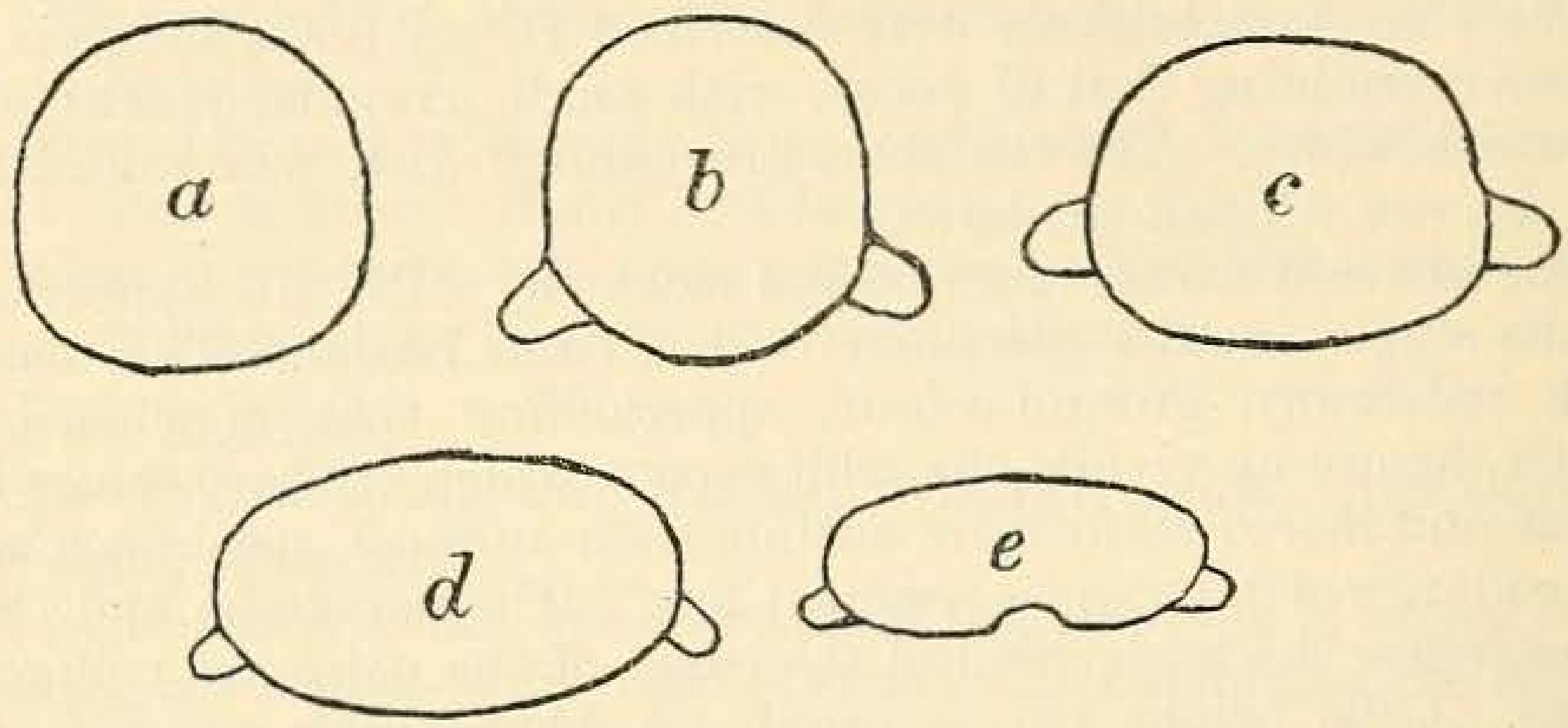
The segments immediately following the buccal are not markedly longer than those composing the rest of the anterior third of the body (Pl. XX. figs. 1 & 2). The first four or five parapodia are rather ventrally placed, so that a narrow, flat surface is enclosed between them, and the body is strongly arched dorsally (see side view of anterior end, Pl. XX. fig. 2) at about the twelfth segment, the parapodia are completely lateral, and the ventral surface becomes more, the dorsal less arched. Further back still both surfaces become nearly flat, the body sometimes being quite

* It is often absent also in *Lysidice collaris*, as noted above, and in *Eunice fasciata*. Ehlers, Nachr. zu Gött. 1897.

† In all cases "*setigerous* segment" is meant, a method of reckoning free from ambiguity.

ribbon-like throughout the posterior two thirds of its length. Text-fig. 43 represents sections of the body, drawn to scale and illustrating these changes of shape.

Text-fig. 43.



Series of sections of the body of *E. afra*, drawn to scale to illustrate the changes of shape in passing from the anterior to the posterior end.

a. Section of buccal segment.
b. " of fourth setigerous segment.
c. " at beginning of gill-region, *i. e.* segment 22.
d. " at the middle of the body.
e. " about 2 inches before the anus.

Prepared from a good-sized specimen from Chuaka.

Gravier's figure of the prostomium and anterior end of the body is apparently from an abnormally contracted specimen. The two lobes of the former always diverge more, the peristomium is longer and less swollen, and the tentacular cirri do not take so remarkably lateral a position (compare figs. 1, 2, & 3, Pl. XX.).

According to Grube's tables * this species belongs to that subdivision of the genus characterised by the possession of tentacles devoid of jointing; but Gravier, while quoting this without comment, figures indications of ringing. The fact is that though in most specimens the tentacles appear smooth at first sight, more or less ringing is sometimes quite obvious † and can always be made out with care. The middle unpaired tentacle, which is from three to four times the length of the prostomium, is considerably longer than the other four, which are of about the same length. Too great reliance on Grube's tables in this matter and in the size of the gills leads to the separation of these specimens into two or three species, as was done by Gravier, the validity of whose species will be considered later.

The jaws (text-fig. 44, p. 293) show no characteristic feature, and

* Grube, Mitth. über die Familie der Euniceen.

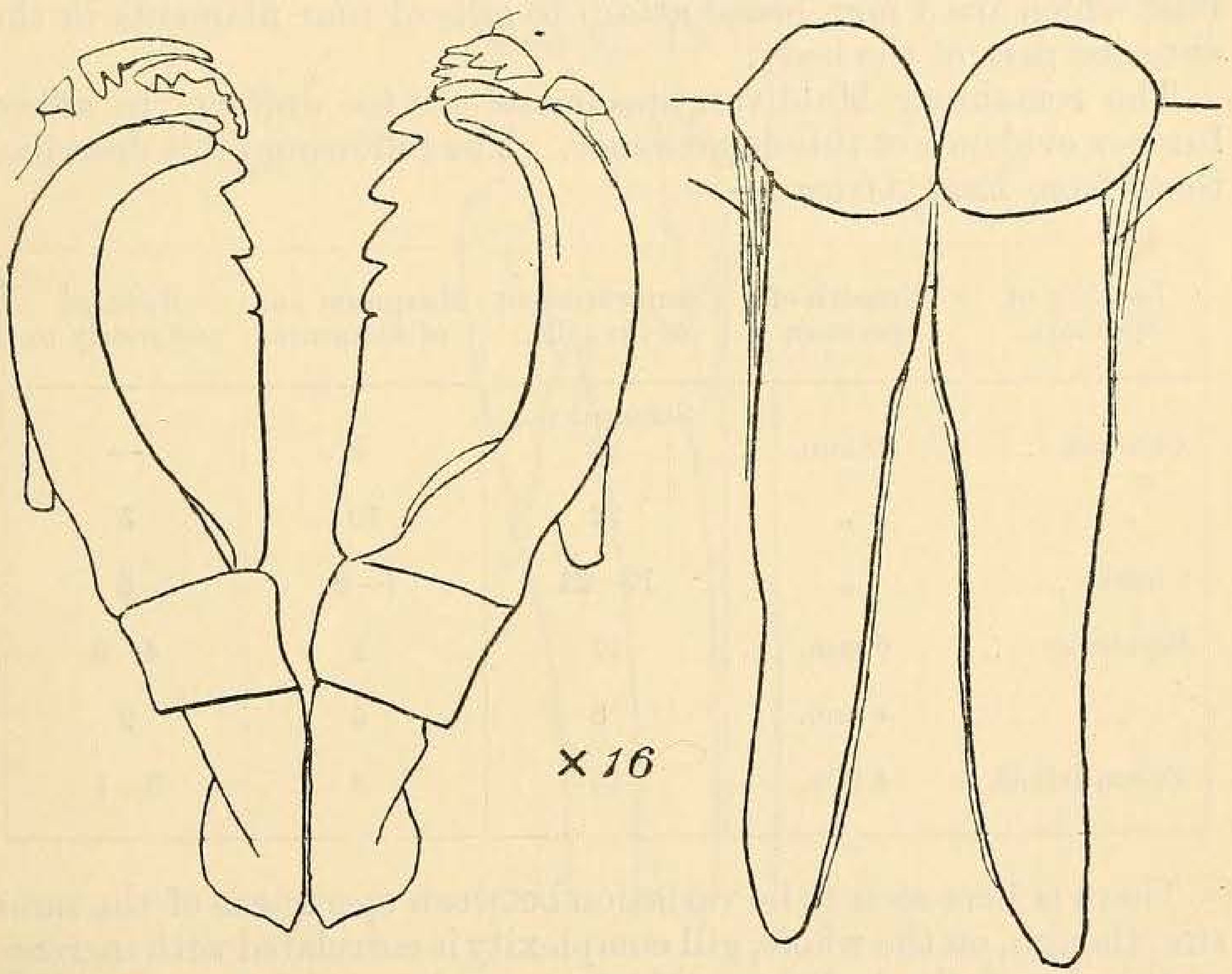
† In *e. g.* two of the nine Chuaka specimens, and the Prison Island and Wasin examples. It is clear too in one of those from the Seychelles, but not in the other.

further vary considerably in the numbers of the teeth they bear, as evidenced by the following formulæ * :—

(1)	4 – 5.	7 + 4 – 8.
(2)	6 – 7.	7 + 6 – 9.
(3)	4 – 5.	6 + 4 – 7.
(4)	4 – 5.	8 + 5 – 9.
(5)	4 – 4.	7 + 6 – 11.

The widely different formulæ (2) and (3) are both from the set of specimens collected at Chuaka.

Text-fig. 44.



Jaws of *E. afra*, from a large specimen from Chuaka. In such every part is black or dark brown, except a narrow border to the lower jaws. The end-plates of the lower jaws are partly calcareous. Contrast the same in a young specimen, as shown in Pl. XX. fig. 4, and compare the latter with Pl. XX. fig. 7, which represents these parts in *E. coccinea*.

The lower jaws bear oval calcareous end-plates whose cutting-edges are almost always entire (Pl. XX. fig. 4 and its explanation). The general shape of the various pieces, as shown by text-fig. 44, is constant.

The feet are well developed throughout the body, and all bear gills except the first fifteen to twenty and those of the last few reduced segments. These attain their maximum development only in the anterior third of the branchiferous region, where, in the Maldivan specimens, they are composed of the usual numbers of

* See Grube, *loc. cit.* p. 19.

filaments, viz. four to six. In the larger specimens from East Africa the number may rise as high as ten, though in no case are the gills large enough to meet over the back. Posteriorly, over the greater part of the body the gills, though remaining of nearly the same length, are simpler, being usually composed of two or three filaments only.

In the very small specimens from the Maldives the gills are proportionately small, their degree of development depending roughly upon the size of the worm. Thus the smallest, which is incomplete and but 1 mm. broad, has only two pairs of gills of three filaments, the others anteriorly being of two and posteriorly of only one. Those of 2 mm. broad have gills of three or two filaments anteriorly and of one posteriorly, while two of the four which are 3 mm. broad attain to gills of four filaments in the anterior part of the body.

The remaining Maldivan specimens are too uniform to afford further evidence of this dependence. The following table describes those from East Africa :—

Locality of specimen.	Breadth of specimen.	Commencement of the gills.	Maximum no. of filaments.	Reduced posteriorly to
Chumbe	10 mm.	Segment no. 20	8	—
,, ...	,,	22	10	5
Chuaka	,,	19—21	7—8	6
Seychelles ...	6 mm.	17	8	4—3
,, ...	4 mm.	8	5	2
Prison Island .	4 mm.	15	4	3—1

There is here seen to be variation between specimens of the same size, though, on the whole, gill complexity is correlated with increase of the size of the body, a conclusion corroborated by a comparison of the earlier descriptions of this species. The second Seychelles specimen is distinctly abnormal in the early commencement of the gills, but this may be connected with the fact that whereas in other specimens these attain their full size three or four segments after their commencement, in this case the increase is more gradual.

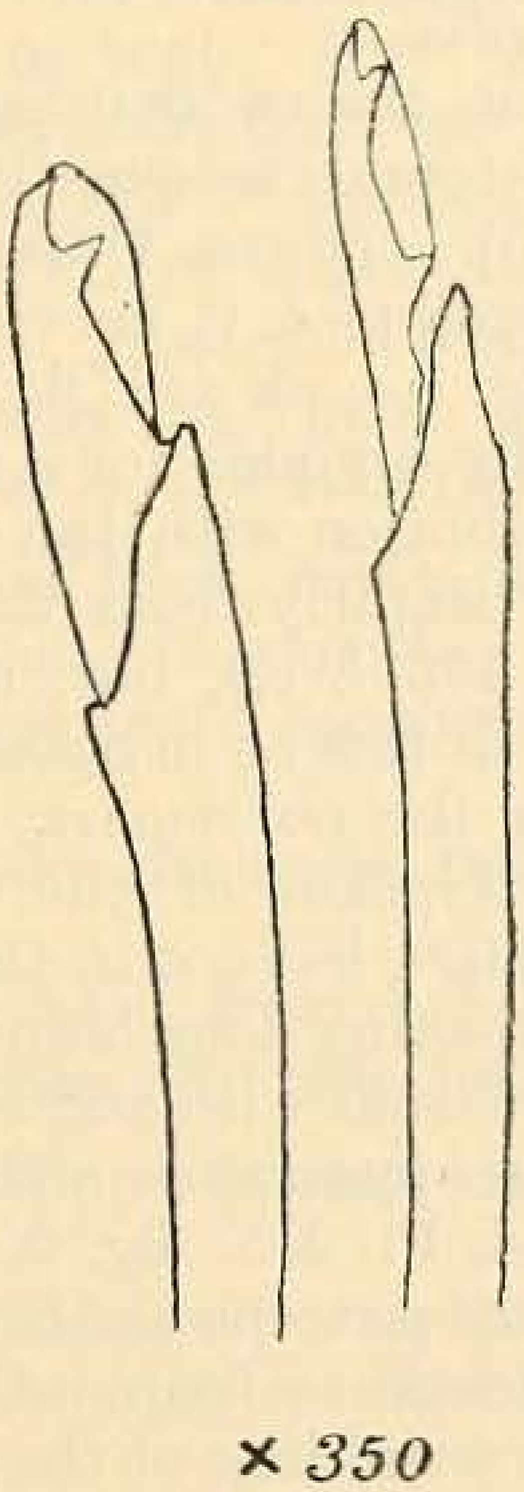
This variation is a great deal wider than is that commented upon by Ehlers when comparing certain specimens from East Africa with these originally named by Peters *. To explain the fact that some specimens have gills of four filaments while others attain to six, he propounds the theory that the species is sexually dimorphic in respect to its gills. It is easy to imagine *a priori* reasons for such a dimorphism, but so far as this account is concerned the grounds for the assertion are of the slightest, and I

* Ehlers, Nachr. zu Gött. 1897.

am assured by Prof. McIntosh that the case of *E. norvegica* adduced as a parallel is quite unproved. The collection of nine specimens together, *all* of which have large gills, makes the theory so unlikely that it has not been thought worth while to resort to microscopic examination to determine that all are of the female sex. The correlation of gill-complexity with body size noted above, mentioned by Gravier for his *E. perrieri* and common to most species of the genus, affords a sufficient explanation without the need of any special theory.

The compound setæ vary in the shape of the articulated pieces, which may be almost that of an equilateral triangle or, as is more usual, somewhat elongated. Text-fig. 45 gives the extremes of this variation.

Text-fig. 45.



The extremes of forms of the compound setæ of *E. afra*, from specimens from Funafuti and from Hulule, Male Atoll. × 350.

It is well known that differences in the shape are usual between the setæ of anterior and of posterior feet, but such extremes as are here figured are never met with on the same worm. Of *E. afra* nine specimens were specially examined in this respect. Of these two showed a distinct difference in the breadth of the end piece of the compound setæ of anterior and posterior feet, in the other seven no variation in those of the same individual was noticeable. We have to deal with a second variation of a distinct kind, between individuals rather than between the metameric parts of the same worm. Of fifteen specimens examined in detail, eight have setæ which approximate to the elongated type, four those which are broad, two are rather less elongated, and one is somewhat less broad. The acicular setæ project more or less and so are subject to wear in use, as a result of which the hooks and guard are not often found perfect (when they correspond exactly with Gravier's figure) but usually more or less damaged. The larger and posterior hook being the most exposed is seen to wear away the faster, so that in many cases where attrition has gone furthest, the remnants of both hooks are of nearly the same size, the whole then resembling Gravier's figure of this seta in *E. mutabilis*.

A consideration of the range of variability set forth above enables us to estimate the grounds for regarding Gravier's two species, *mutabilis* and *perrieri*, as synonymous with *afra* Peters (*collaris* Grube).

The former (*l. c.* p. 245) differs from the examples regarded as typical in its uniform pigmentation, the position of the eyes, and the complexity of the gills.

The eyes are placed on the swollen bases of the median pair of tentacles, a condition found frequently in these specimens of *E. afra* (Pl. XX. fig. 5). (From Gravier's text and an examination of the present examples, it is evident that this appearance is exaggerated in the fig. *l. c.* pl. xiii. fig. 71.)

The gills are unusually complex for a specimen of this size, but agree in size and distribution with the above. The setæ figured for *E. mutabilis* differ slightly from those given for *E. collaris* (*cf.* figs. on pp. 247 & 253 *l. c.*), but, as explained above, such variations are common in this as in other species of the Eunicidæ. The jaw-apparatus calls for no remark, its formula being $4-4:4+3-5$. In his description of the buccal segment of both *E. mutabilis* and *E. perrieri*, but not in that of *E. collaris* (= *afra*), Gravier mentions a projecting lobe laterally, which is present also in all the specimens here dealt with and seems rather characteristic of the species. For its appearance and proportions see the side view of the head figured, Pl. XX. fig. 2.

As regards the supposed new species *E. perrieri*, the arrangement of the pigment in a mosaic so frequently met with is sometimes artificial and due to the wrinkling of the skin, and a similar coloration of the tentacles (the distal part being uniformly pigmented, not banded) is common, though not the rule.

The groove behind the middle tentacle, described here but not mentioned in the cases of *E. mutabilis* or *E. collaris*, and figured by Gravier on pl. xii. fig. 58, is more or less distinct in all the present specimens. Often its sides are raised into distinct lips, which form the white streak described above in the case of the Prison Island specimen (see Pl. XX. fig. 5). The more ventral position of the first few feet has already been remarked upon. The gills in large specimens with their twenty filaments are much more complex than any hitherto met with in East Africa or the Maldives. The differences between the descriptions and figures (*l. c.* p. 234) of setæ given for *E. collaris* and *E. perrieri* are very trifling, even more so than in the case of *E. mutabilis*.

EUNICE COCCINEA Grube. (Plate XX. figs. 6, 7.)

Eunice coccinea, Grube, Annulata Semperiana, p. 153, Taf. ix. fig. 1.

The facts that this species is one of those with few salient characteristics and is already recorded from the Philippines, Singapore, and East Africa, make it probable that a still wider distribution could be given were its synonymy fully worked out. Grube hints at this in comparing his species with *E. guildingi* Baird and *E. punctulata* Gr. Örsd., both West Indian forms, the descriptions of which, however, are too hasty to be of use. Much weight is laid on the size of the gills, which is here, as in all other species, found to be very variable. The proportions of the body and distribution of the gills offer the most marked distinctions between this species and *E. afra*, the pigmentation (as seen in spirit-specimens), prostomium and tentacles, structure of gills and setæ being almost identical in both. The parapodia differ in being smaller, especially posteriorly, and the dorsal cirri are better developed in the anterior part of the body.

Full-grown specimens are of nearly the same size as those of *E. afra*, but with a much greater bulk anteriorly though having less behind. The following list * gives the sizes of the specimens from the several localities in the Maldives :—

(1) Nairfaru, Fadiffolu Atoll, reef : one specimen incomplete, 11 mm. broad, and a fragment.
(2) Hulule, Male Atoll, reef : one specimen, 210 × 7 mm. ; also a fragment.
(3) Off South Nilandu, from 24 fathoms : one, incomplete, 7 mm. broad.
(4) Off Hulule, Male Atoll, from reef and sand-flats : one small incomplete specimen, 3·5 mm. broad.

Fragments were also found in sand under boulders on Minikoi reef.

The East African specimens, none of which attain to the size reached by those from the Maldives and Seychelles, were collected as follows :—

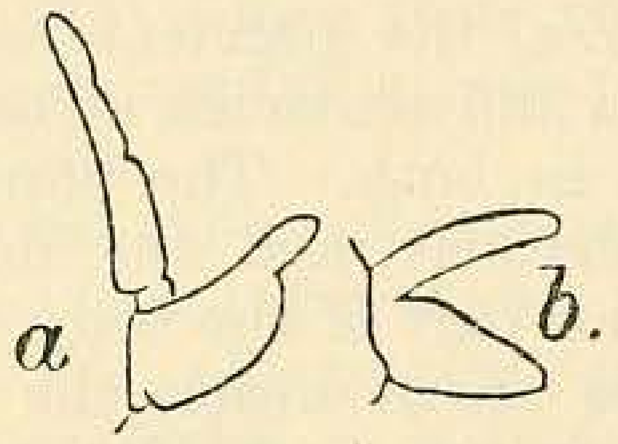
(1) Prison Island, Zanzibar Harbour, at low tide; two fair-sized specimens, 7 mm. broad (at maximum).
(2) Ditto, in 3 fathoms off the north end of the island; one specimen, 4 mm. broad.
(3) Kokotoni Harbour, Zanzibar, 5 fathoms ; a very small specimen, 2·3 mm. broad.
(4) Zanzibar Channel near its northern end, 10–15 fathoms ; one specimen, 6 mm. broad.
(5) Mombasa Harbour, at low tide ; two specimens, 4 mm.
(6) Wasin Harbour, 10 fathoms ; one specimen, 4·5 mm.
(7) Seven large specimens collected by Dr. E. P. Wright in the Seychelles in 1868.

* See also the table on p. 294.

The species is thus seen to be widely distributed, but usually few in numbers.

The largest specimen shows an interesting abnormality of the right nuchal cirrus, by which the structure of the first foot is almost reproduced. If the supposition that nuchal or tentacular cirri are the remnants of reduced parapodia be correct, it is not surprising that variations should occur in which the ventral as well as the dorsal cirrus is retained. Text-figure 46 gives a comparison between this abnormality (*a*) and the structure of the first foot (*b*), which is here, as in most species, somewhat reduced.

Text-fig. 46.



Abnormal nuchal cirrus (*a*) and first foot (*b*) of a specimen of *E. coccinea*.

The very characteristic colour of the animal during life is subject to a small amount of variation. It approaches that described as typical by Grube most closely in the specimens from Mombasa. In one of these, which is in process of regenerating the head and anterior segments, only traces of the colour remain, while in the other it is but a little lighter now than in life. The head and anterior part of the body, a little beyond the last rudimentary gill, are of a brilliant red, of a tint between that of blood and polished copper, the ventral surface being similar but lighter. This colour spreads over tentacles, nuchal cirri, and feet, but the gills and dorsal cirri, with the exception of the first few, are now white, and nearly all colour dies out posteriorly. The sixth setigerous segment is white, and a few similar transverse marks occur behind this. In the posterior two-thirds of the gill-region every segment has a white spot in the middle line and one on each side just above the foot.

This corresponds with Grube's account, and, curiously enough, especially exactly with that of his East African specimen. The appearance in life * may, however, be altered by the presence of a brilliant iridescent green colour covering the head, tentacles, and nuchal cirri. The bases and tips of the latter are, however, white, as are the dorsal cirri, though the longer anterior ones are banded with green. The gills, though as usual red, have a greenish tinge over this. The ground-colour of this specimen, now a dull

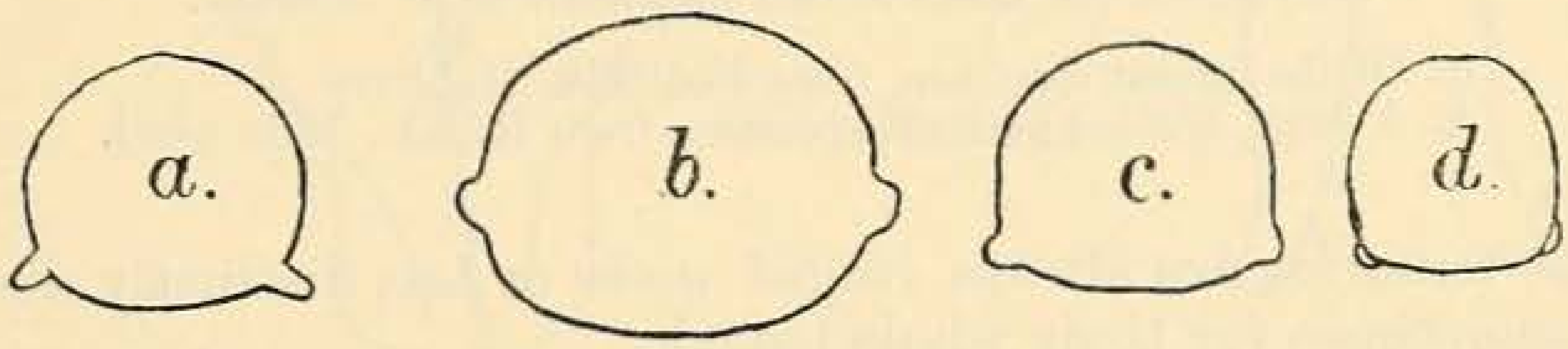
* This coloration was noted from the living specimen dredged off Prison Island. The green pigment remains visible in two other African specimens and the brown pigment and white dots in the remainder.

brown, was a dark coppery red plentifully besprinkled with lighter dots.

Grube lays some stress upon the permanence of the colour of his *E. coccinea* in spirit, but this depends upon so many factors, such as exposure to light, condition of the spirit and even the presence of other specimens in it, that great variation in this respect is inevitable.

In only one of the Maldivan examples is seen the white collar on setigerous segment number 3 which is usual in those from East Africa. The pigmentation, which has now become brown as in the above, is interrupted by more or less distinct white spots, and the skin is covered by a close network of wrinkles giving the mosaic appearance found in several species.

Text-fig. 47.



A series of sections of the body of *E. coccinea*, to show proportions in different parts. From the largest Maldivan specimen. × 2.

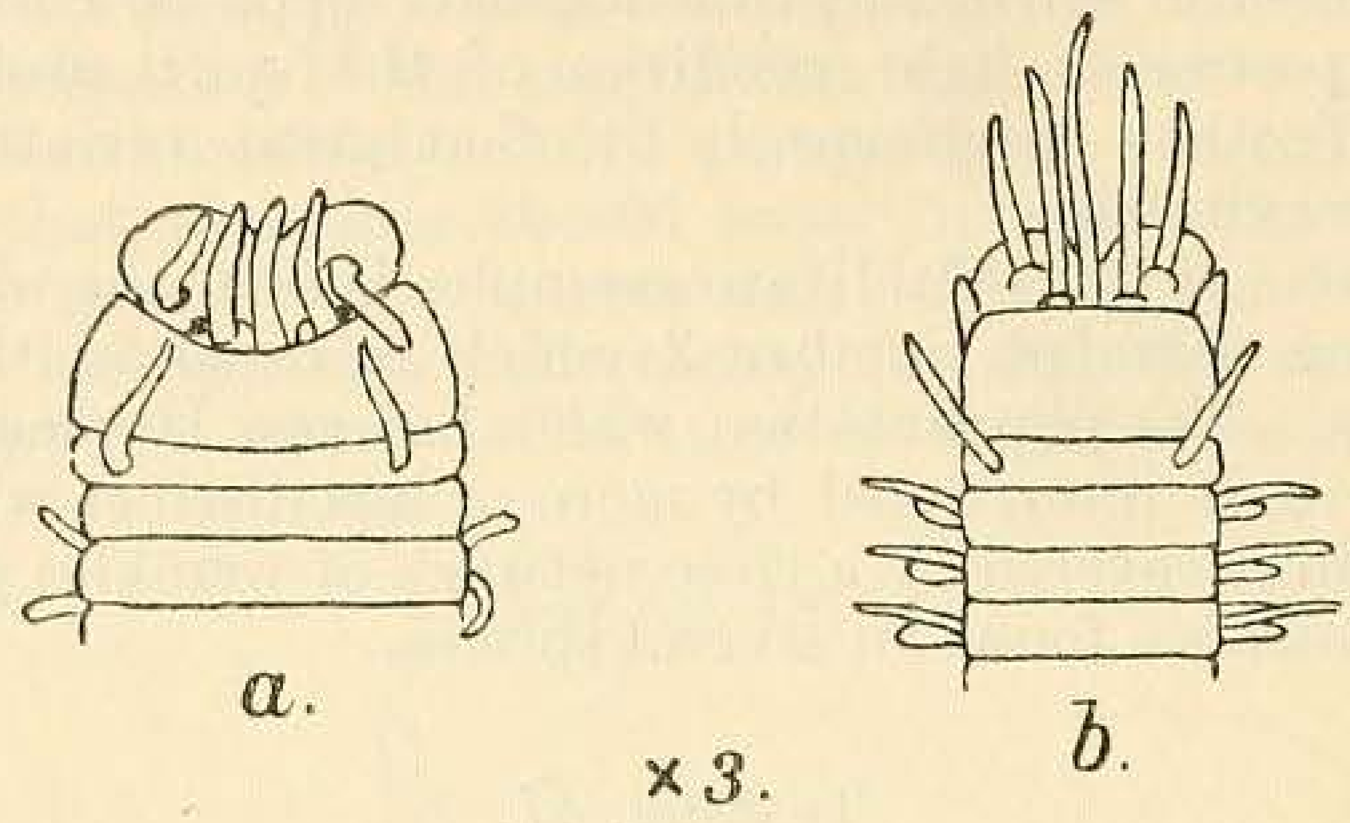
a. Through second setigerous segment.
b. „ middle of gill-region.
c. „ the point where gills decrease in size.
d. „ any part of the posterior two-thirds.

The form of the body is a characteristic contrast to *E. afra*, e. g. the body rapidly enlarges behind the head, becoming very bulky in the branchiferous region and then slender again behind this. The ventral surface is flattened, and may become concave in the middle line, but the body is highly arched dorsally throughout its length, the nearly cylindrical posterior portion having very small parapodia. The sections figured (text-fig. 47) show the usual proportions of the body in different parts, which are also illustrated by fig. 6, Pl. XX. In some cases the body is flatter anteriorly, but never so posteriorly.

The pro- and peristomia and their appendages vary widely in appearance and proportions, not only on account of accidental contractions but also varying with the size of the specimen, being better developed in the smaller specimens from East Africa than in the large ones collected from the Maldives and Seychelles. The outlines given (text-fig. 48, *a* & *b*, p. 300) are from specimens which illustrate the extremes found in this respect. That the proportions seen in fig. *a* are not quite exceptional is shown by the seven large Seychelles specimens, among which they are frequently found together with conditions intermediate between this and fig. *b*.

Compare also the shaded and outline figures of heads of *E. afra* in Pl. XX. figs. 1 & 3.

Text-fig. 48.



Outlines of the heads of two specimens of *E. coccinea*.

a. Of the largest specimen, from Fadiffolu, Maldives.
b. A large, but not extreme specimen from Hulule, Male Atoll.

The tentacles are always ringed more or less distinctly distally and sometimes for their whole length.

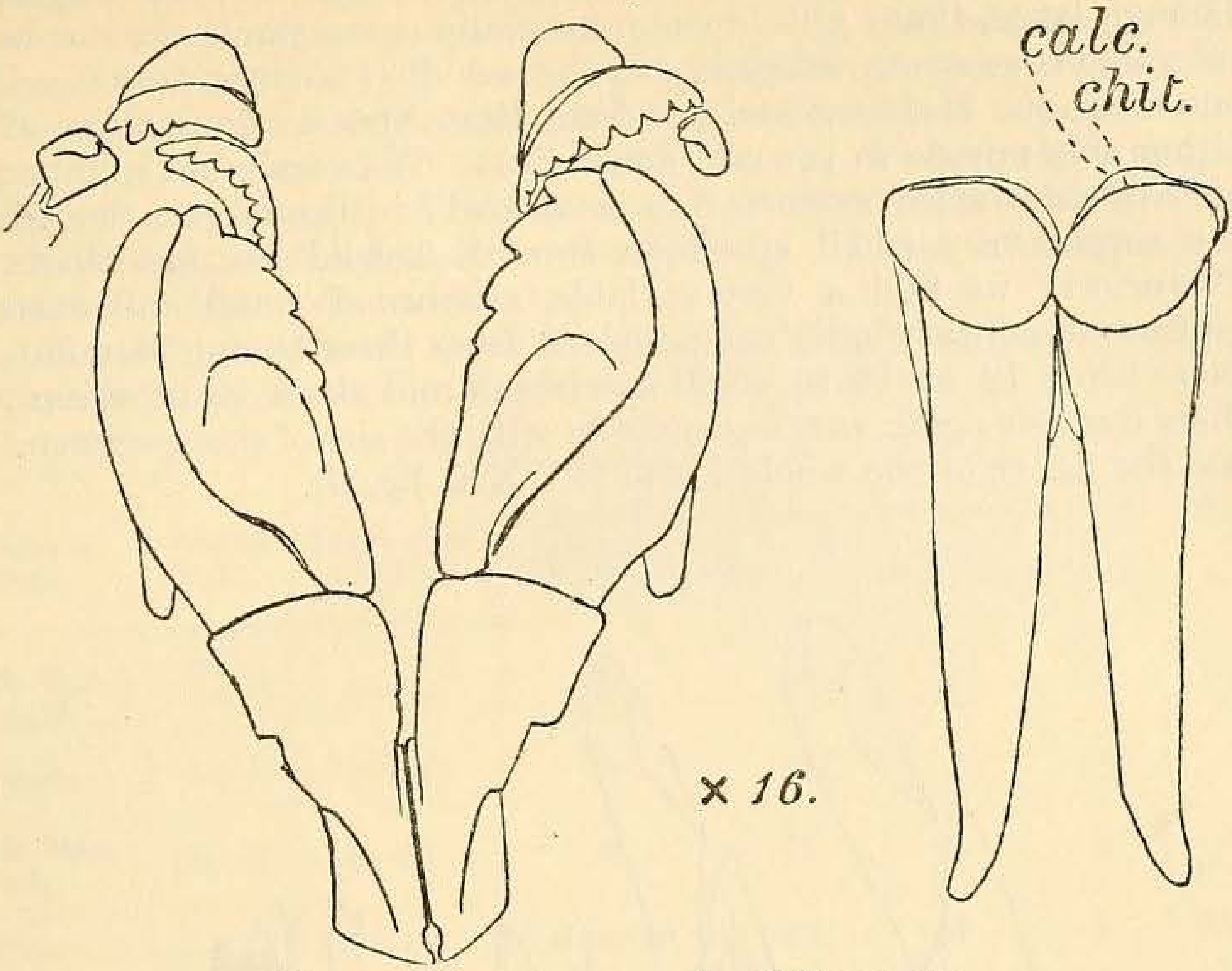
The upper jaw-plates exactly resemble those of *E. afra* both in their shape and in the numbers of the teeth they bear, as shown *e. g.* by the formula $5-4 : 6+4-9$. The end-plates of the lower jaws are, however, characteristically different, even on a first inspection, being black and nearly round. When magnified they show the peculiar markings given by Pl. XX. fig. 7. In some cases a certain amount of white calcareous matter is developed here, in others none at all, but in no case is a large calcareous end-plate formed as in *E. afra* (text-fig. 49, p. 301). The double line at the anterior border of the end-plates (marked *calc.* and *chit.*) give the maximum development of calcareous matter. See also Pl. XX. fig. 7, which represents the ends of the lower jaws of a younger specimen and shows the characteristic concentric brown bands.

As mentioned above, the parapodia are proportionately small even anteriorly, while shortly after the end of the gill-region (which extends over the anterior fifth of the body, or thereabouts) they are so reduced as to project scarcely at all (see Pl. XX. fig. 6 and text-fig. 50 (p. 301)).

At the same time the dorsal cirri, which are long and thick anteriorly, become mere slender little points. The ventral cirrus, which though short and thick is finger-shaped in the first three or four feet, becomes the usual secretory pad through the branchiferous region, at the end of which it becomes cirriform again, though only about half the size of the small dorsal cirrus. Compare the 33rd and 50th feet in text-fig. 50 (p. 301).

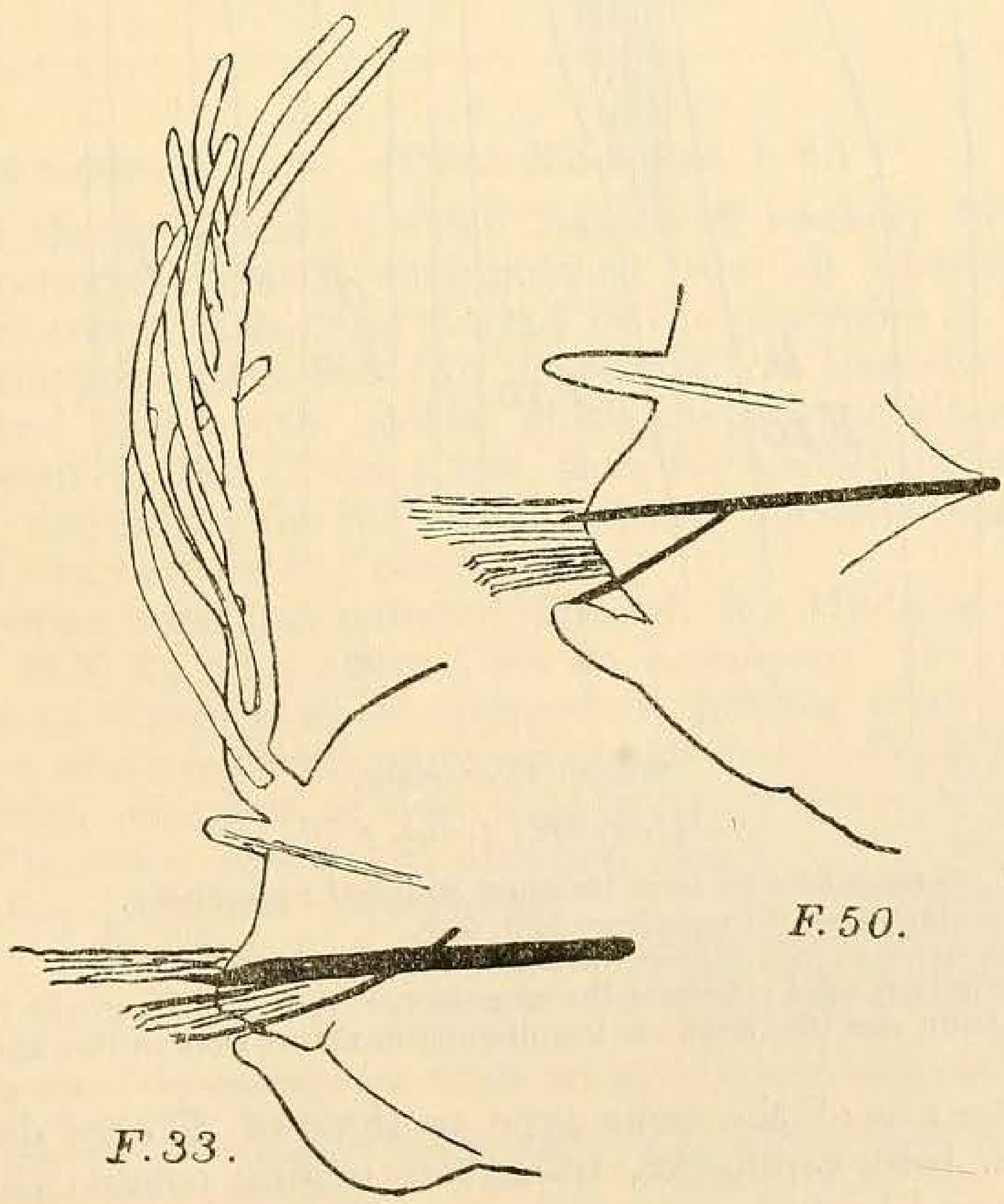
In the smaller African specimens the gills begin at the 6th foot in all but one specimen, where the first is on the 5th. In the large examples from the Maldives and Seychelles the 9th foot is more usually the first branchiferous. The number of full-sized

Text-fig. 49.



Upper and lower jaw-apparatus of *E. coccinea*.

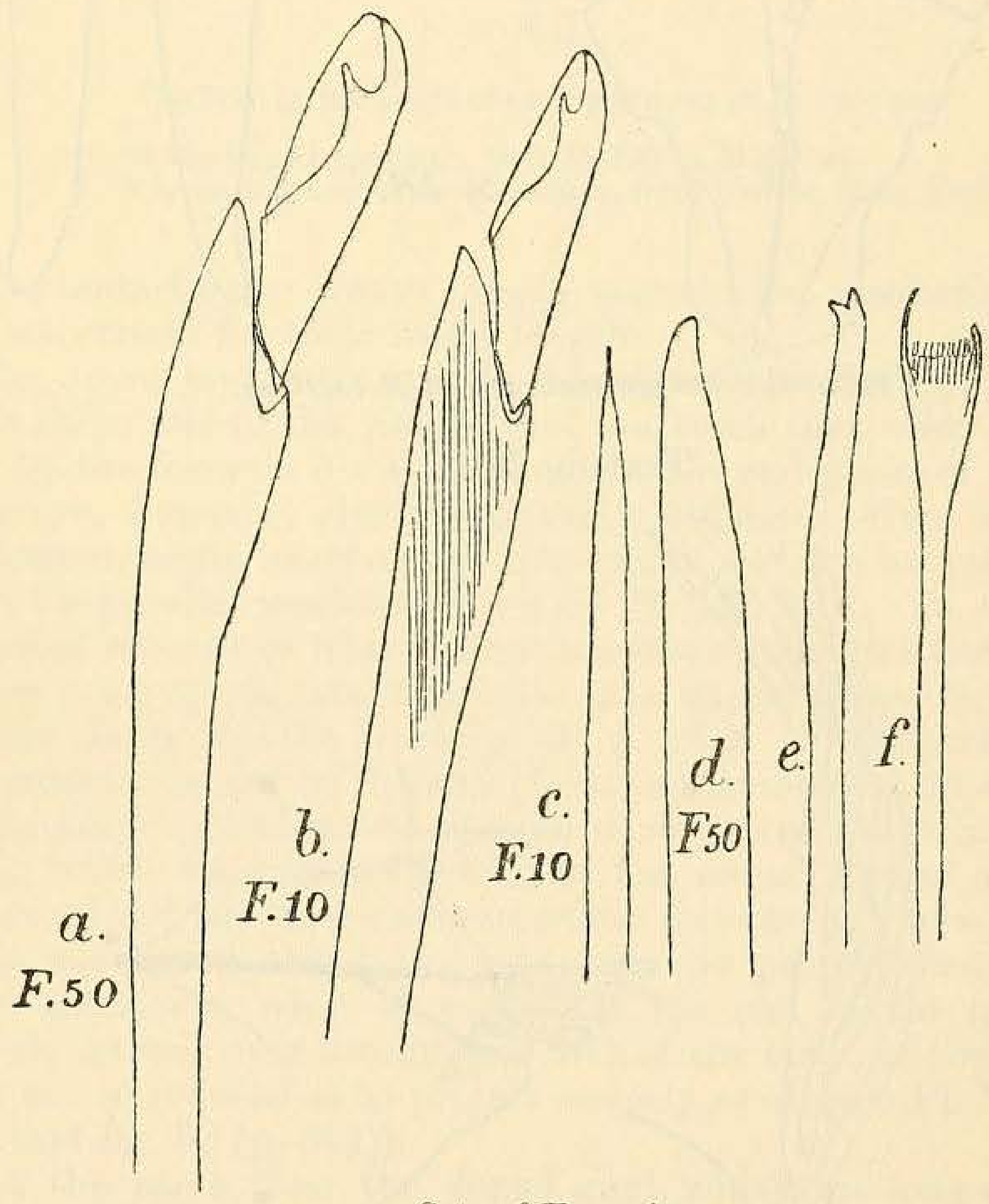
Text-fig. 50.



The 33rd and 50th feet of *E. coccinea*.

gills varies between 24 in small examples and 110 in larger. Though large, these gills do not normally cover the back, a considerable bare space remaining in the middle except in two cases, one from the Maldives and one from East Africa, where those of either side mingle in the mid-dorsal line. The maximum number of filaments varies between 6 in small to 17 in the larger, though the single, very small specimen from Kokotoni has but three. Posteriorly we find a very variable number of small and even quite rudimentary gills composed of from three to one filament, there being 12 or 15 in small specimens and about 50 in others, their number again varying roughly with the size of the specimen. See the figure of the whole worm (Pl. XX. fig. 6).

Text-fig. 51.



Setæ of *E. coccinea*.

a, *b*, *f*, × 350; *c*, *d*, *e*, × 70.

a & *b*. Compound setæ from 10th and 50th feet respectively.
c. Aciculum (one of three) from 10th foot.
d. The single aciculum from the 50th foot.
e. Acicular hooked seta from the same foot.
f. A comb seta (the teeth are less distinct in nature than in this figure).

The setæ are of the same type as those of *E. afra* described above, viz. bent capillaries, triangular ending combs with very fine teeth, and hooked compound setæ. Of these latter, specimens taken from anterior feet differ somewhat from those from posterior. Compare *a* and *b* in text-fig. 51, p. 302, which are from the 50th and the 10th foot respectively of the same specimen. The anterior feet may contain three acicula, some of which end in peculiarly elongated points (text-fig. 51, *c*). Posteriorly a single thicker aciculum (*d*) accompanies a slender but black acicular seta which ends distally in two small hooks. These latter project markedly from posterior feet.

The subjoined table gives the principal variations observed in the specimens from the Maldives and Seychelles.

Specimen from	Size of body.	Large gills on feet nos.	Followed by rudimentary gills.	Maximum no. of filaments.	Length of pro-stomium.	Length of tentacles.	How far these jointed.
Hulule Male (dredged)	mm. −×3·5	5—47	15	9*	mm. 2	mm. 3	Over whole length.
S. Nilandu ...	−×7	5—50	15	13	3	10†	ditto.
Hulule Male (reef) ...	210×7	6—60	18	17	3	5	Only distally.
Fadiffolu	−×11	9—120	about 50	13	3	3	Wrinkled only.
Seychelles	×9·5 up to 11.	Always begin at 9 and extend to 80–100.	about 50	10—17 according to size of specimen.	2	3 or 4	Distally jointed.

EUNICE TUBIFEX, sp. n. (Plate XXI. figs. 1–8.)

One of the five‡ species which make stiff leathery tubes with lateral openings. This is distinguished from all other species of the genus except *E. depressa* Schm.§ by the possession of both the kinds of compound setæ found in the family, viz. those with knife-shaped and those with hooked sickle-shaped end-pieces. The former occur in the anterior feet, then for a short distance both together, and finally for the greater part of the body's length the ordinary "Sichelborsten" occur alone.

The worms were first collected through the kindness of Capt. Agnew, R.N.R., who allowed me to accompany the Zanzibar Government Steamer when engaged in putting fresh chains to the buoys which mark the southern approaches to Zanzibar. The tubes, which are a foot or more long by about three-eighths of an inch in diameter, were found attached singly to the chains, from which they projected horizontally. All were overgrown with hydroids, polyzoa, and alcyonarians, which, with the organisms collected from the under surface of the buoys themselves, formed

* This is one of the specimens in which the gills overlap across the back. The gills are not abnormally complex.

† The tentacles are abnormally slender distally and may have been injured.

‡ See second note on page 308.

§ See first note on page 308.

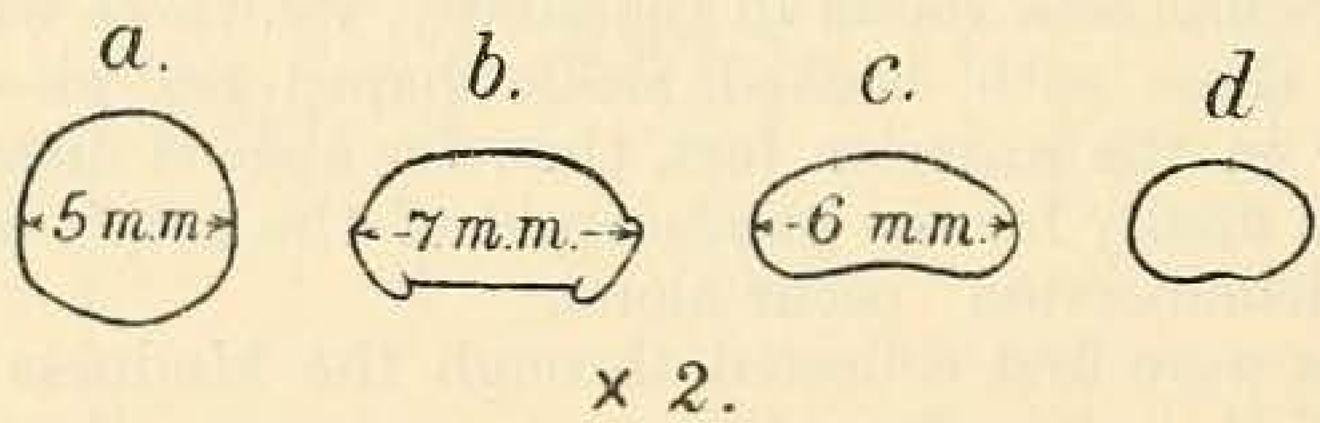
a most important addition to my collection, since several species of all these groups were here met with for the first time. Some time later I came across specimens of this species at low spring-tide on the west shore of Puopo Islet, Kokotoni Harbour, Zanzibar. Here the tubes were attached at their bases to the flat rock, and were stiff enough to stand vertically upright even when the water had left them. Tubes were also dredged in Wasin Harbour, whence also come three much younger specimens, which show important differences from the full-grown ones previously collected.

The openings of the tubes are arranged more or less alternately on either side as in *E. tibiana* Ehl., but are less numerous and the tubes are straighter. The basal part of the tube is very like the fragment figured by Ehlers (*l. c.* Taf. 22. fig. 1), which shows well their characteristic texture and surface. Although the tube-wall is not thicker than ordinary brown paper and is free from foreign material, it is perfectly opaque and so tough and elastic that the tubes are cut or torn open with some difficulty.

The colour of the animal in life is uniformly blood-red, except towards the hind end, where the body becomes blackish.

The head is broad and the peristomial segment, as usual, cylindrical (Pl. XXI. fig. 1), but immediately behind this the body flattens ventrally, and a little later dorsally also, becoming in section a narrow rectangle. A slight increase in breadth takes place for a centimetre or two behind the head, after which the body is parallel-sided for the greater part of its length, becoming narrower and more cylindrical towards the tail. The diagrammatic sections explain these changes (text-fig. 52). The segments are very short throughout, though the six following the head are longer than the rest (see fig. 1, Pl. XXI.).

Text-fig. 52.



Diagrammatic sections of body of *E. tubifex*, sp. n.

a. Just behind buccal segment.
b. In region of glandular feet, *i. e.* about 24th segment.
c. In the branchial region.
d. Near hind end of body.

The prostomium (Pl. XXI. fig. 1) is short and broad, deeply notched in front and covered by the anterior edge of the buccal segment behind. The short and thick tentacles are indistinctly ringed and have each a small thickened basal portion. The middle one is about twice as long as the prostomium, the next pair but very little shorter, while the outer are but half this length. The median pair is inserted at the same level as the middle tentacle, but at some distance laterally from it and close to the outer pair, the insertion of which is more anterior. Immediately beneath these last are the small but distinct eyes. The first ring of the peristomium is of moderate length, the second very short, and the nuchal cirri are small and smooth.

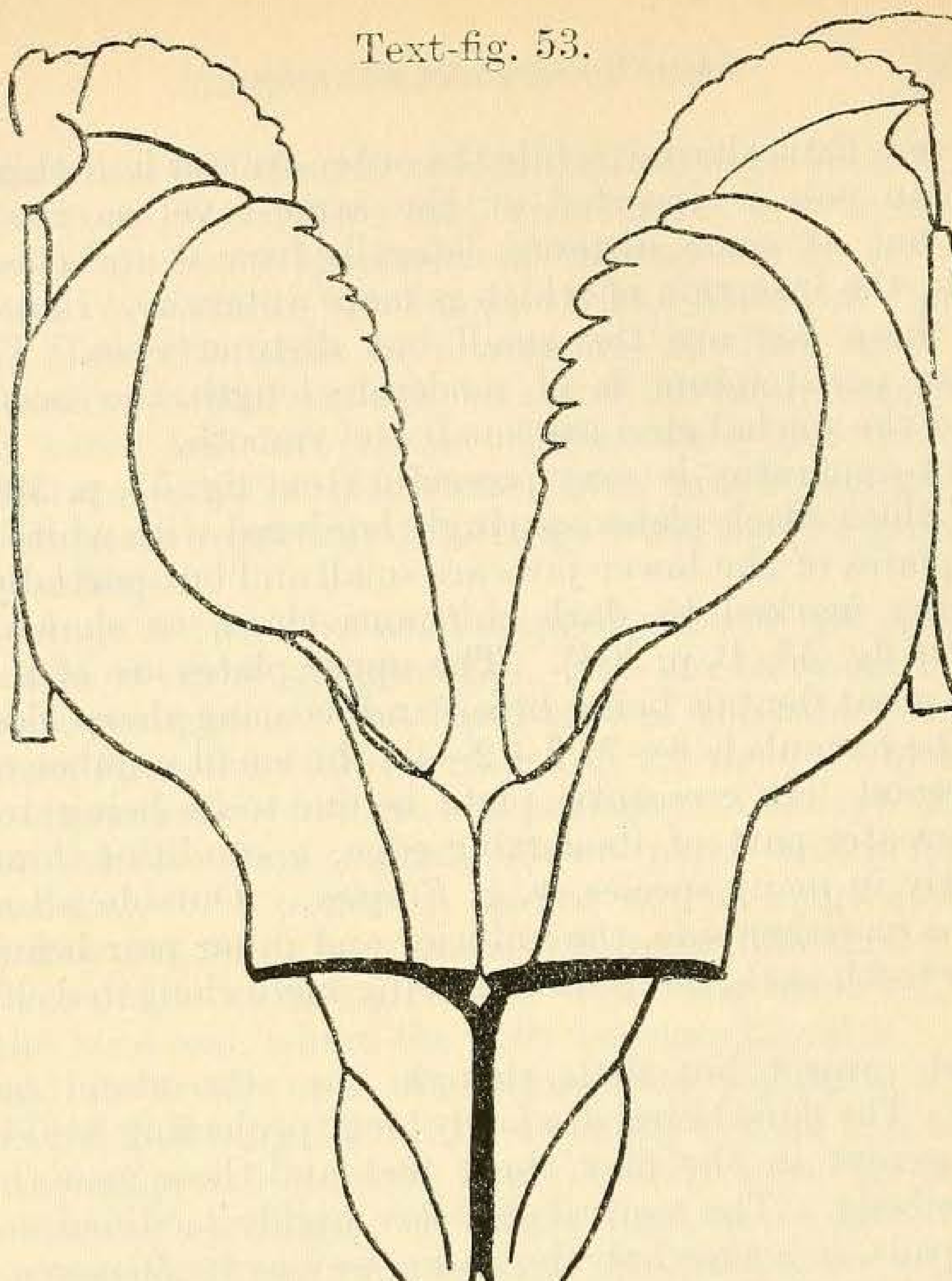
The jaw-apparatus is very powerful (text-fig. 53, p. 306), consisting of thick black plates sparingly bordered with white matter. The end-plates of the lower jaws are small and but partially calcareous, being marked by dark chitinous rings, as shown in the figure (text-fig. 53, B, p. 306). The upper plates are of the usual form, the great dentals being broad and bearing sharp closely-set teeth. The formula is $6-7:7+2-9$; the small number of teeth on the second left crescentic plate is due to its being toothless over the greater part of its cutting-edge, a condition found less prominently in many species, e. g. *E. afra*. Outside all are two paragnaths on either side, the anterior and inner pair bearing one triangular tooth each, the posterior being mere elongated chitinous bands.

The feet project but little, though the setæ stand out prominently. The dorsal cirri are fairly long, projecting well beyond the setæ, except in the first three feet and those near the hind end of the body. The ventral cirri are highly modified, forming secretory pads, in somewhat the same way as in *Diopatra*. The first is thick and finger-shaped, but they rapidly become still thicker until the twelfth is a conical knob as large as the setigerous portion of the foot. The breadth continuing to increase dorso-ventrally, at the 24th foot it is nearly three times as wide as this. Since these pads are broader than the feet, they are pressed together fairly closely, forming an almost continuous band down the sides of this region of the body, as shown in Pl. XXI. fig. 4. Ventrally they end in a free flap, dorsally in a little point, the remnant of the true cirrus. The figures of the feet (text-fig. 54, p. 307) explain the changes of form and arrangement of these organs. The lower border and inner angle of the pads are extremely vascular, and, at about the 120th foot, these surfaces contain a close network of blood-vessels. Posteriorly, at the point where the gills become conspicuous, the pads gradually decrease in length, and when the former attain their full size about segment 120, the latter become rapidly smaller, and for the rest of the body beyond segment 130 are merely little conical points. One lip of the seta-sac is pointed and projects a little beyond the other, which is rounded.

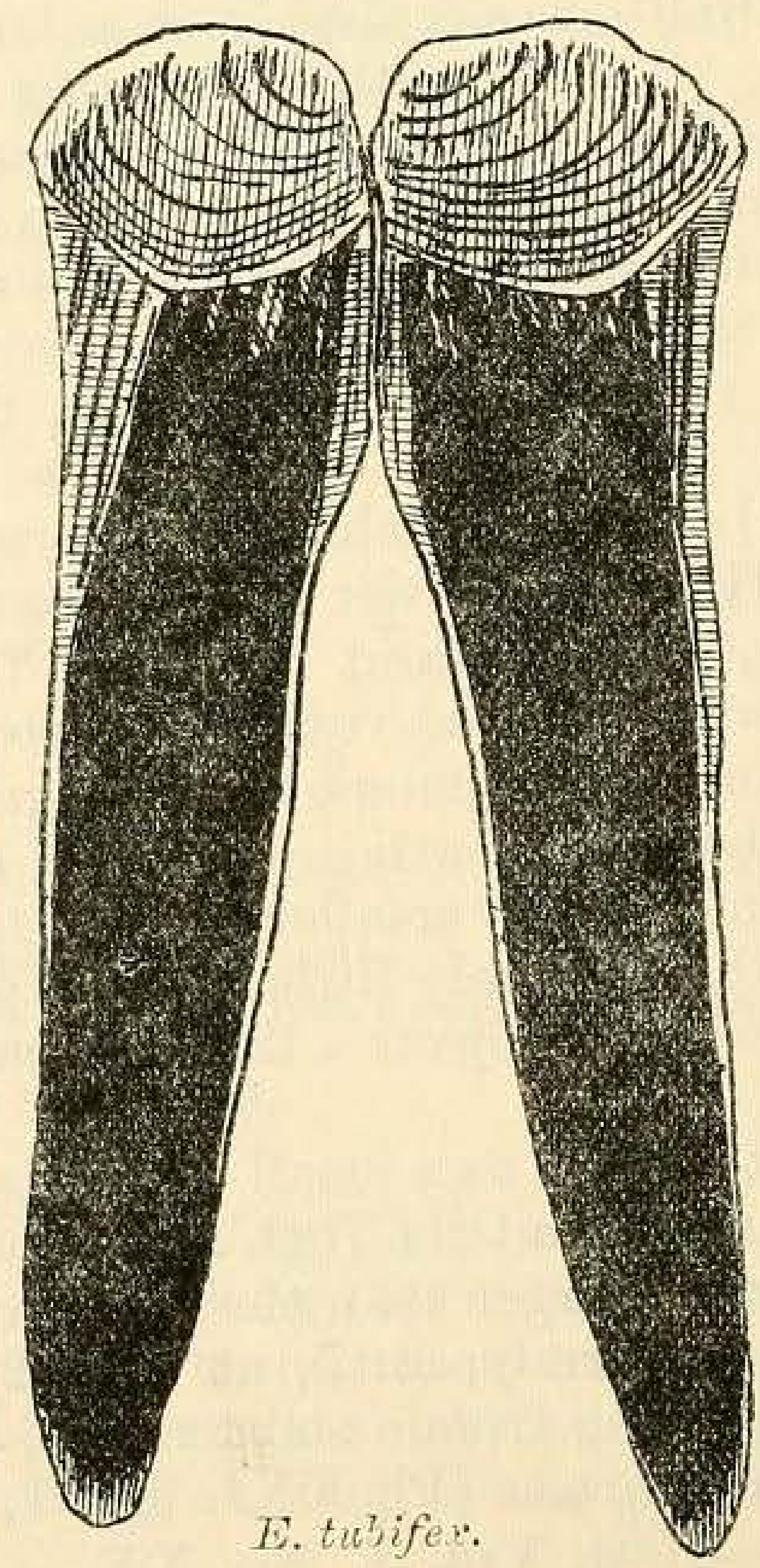
The gills begin at foot 35 as a small papilla and do not become at all conspicuous until about the 70th foot, where they consist of two filaments somewhat larger than the dorsal cirrus. From this point they increase uniformly, until, at the 120th foot, five long filaments are found arising from a short rachis, a condition which seems to last to near the anus (Pl. XXI. figs. 1, 2, & 3).

Text-fig. 53.

A



B

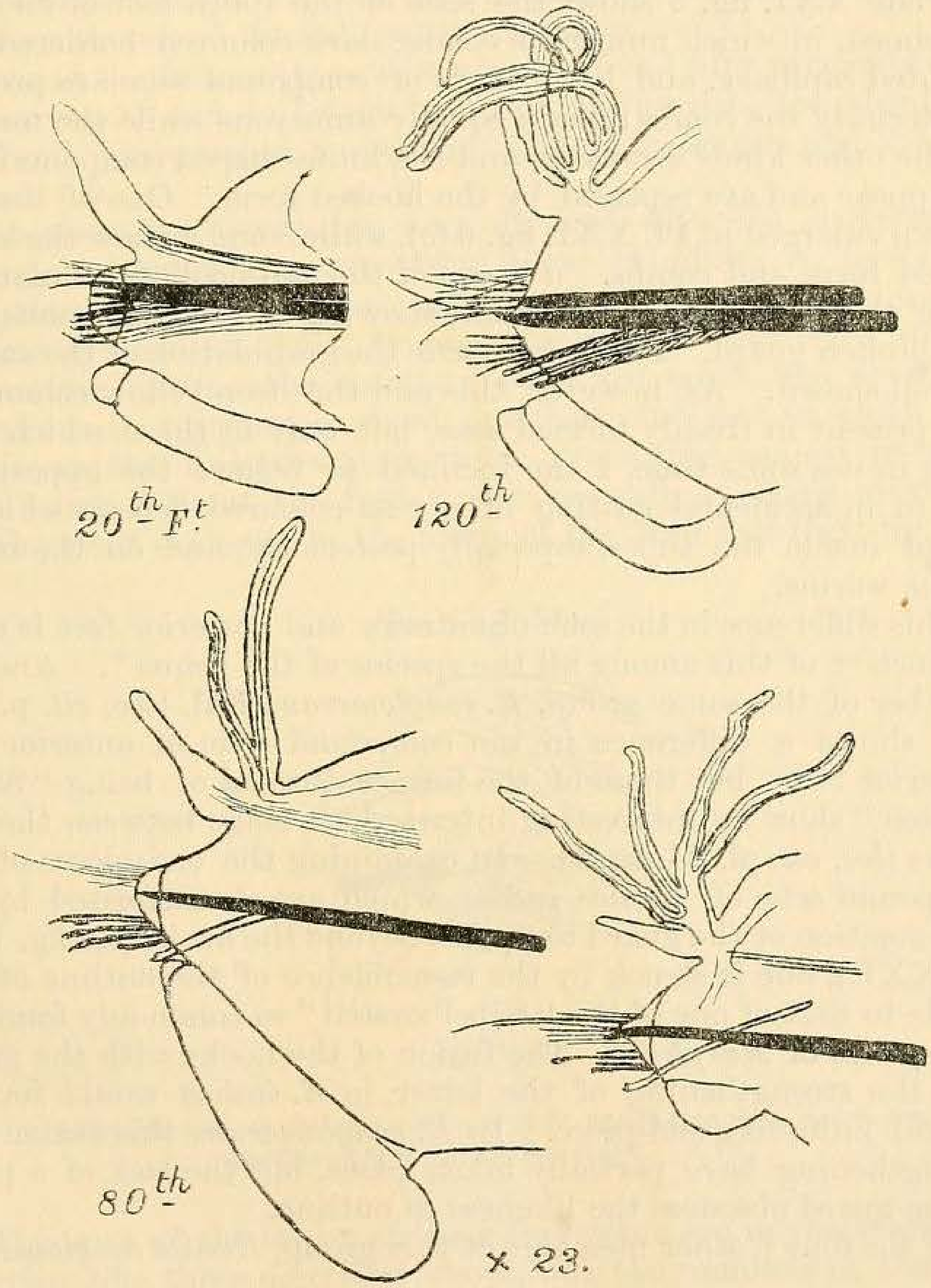


E. tubifex.

A.—Upper jaw-plates of an adult specimen.
B.—Lower jaw-plates of the same.
Both × 18.

The setæ are, anteriorly at least, in dense well projecting bundles (Pl. XXI. fig. 5), and of characteristic strength, form, and colour. The majority of each kind are of a yellow colour, and have a more markedly granular surface than even those of *E. aphroditois*, and all except the combs are strongly striated. These last are about as numerous as the capillaries posteriorly, and thus, as in form, recall those of *E. aphroditois*.

Text-fig. 54.



Feet of an adult specimen of *E. tubifex*.

The lower right-hand figure represents one from near the hind end of the body.

Both capillary and compound setæ are thick and strong, and the former are shorter than usual, recalling those of *Diopatra*. The acicula are two or three in number anteriorly, but further back only one, accompanied by one or two, more rarely three, acicular setæ. The former are densely black except at their points, which are bevelled and slightly bent (Pl. XXI. figs. 5 and

8, *e*); the latter are yellow, more or less sharply bent towards their end, which is two-hooked and normally covered by a guard (Pl. XXI. fig. 6, *a*). The compound setæ are of two kinds. In the anterior feet are found setæ whose end-pieces are knife-shaped (Pl. XXI. fig. 6, *b*). At about the 130th segment (at which point the ventral cirrus has changed from a broad secretory pad to a conical form) those with two-hooked ends appear and shortly thereafter are the only kind occurring. Groups of setæ in which all these forms occur are shown in Pl. XXI. figs. 5 & 6, *a*–*e*.

Plate XXI. fig. 5 shows the setæ of the 100th foot of an adult specimen, in which numerous combs, dark-coloured bordered and striated capillary, and both kinds of compound setæ are present. Posteriorly the combs remain equally numerous while the number of the other kinds decreases, and the knife-shaped compound setæ disappear and are replaced by the hooked form. One of these is shown enlarged in Pl. XXI. fig. 6 (*c*), while *b* and *d* show the knife-ended form and combs. *a* is one of the two-hooked acicular setæ from the tail-region of an adult, showing merely the remnant of the broken guard. In all these setæ the granulation of the surface is well shown. As, however, this and the deep yellow colour are not present in freshly formed setæ, but only in those which have been in use some time, I am inclined to believe the appearance due to an accidental coating of a rust-coloured deposit which is found inside the tubes, especially posteriorly, and on the bodies of the worms.

This difference in the setæ of anterior and posterior feet is quite distinctive of this among all the species of the genus *. Another member of the same group, *E. conglomerans* Ehl. (*loc. cit.* p. 93), also shows a difference in the compound setæ of anterior and posterior feet; but those of the former, instead of being "Säbelborsten," show an interesting intermediate stage between the two forms (*loc. cit.* pl. 24. fig. 4). In examining the end-pieces of the compound setæ of *Eunice indica*, which are characterised by the prolongation of the guard to a point beyond the hooks (see fig. 12, *c*, Pl. XXI.), one is struck by the resemblance of the outline of the whole to that of one of the "Säbelborsten" so commonly found in the species of *Marphysa*. The fusion of the hooks with the guard and the strengthening of the latter in *E. indica* would form a typical knife-like end-piece. In *E. conglomerans* this fusion and strengthening have partially taken place, but the lack of a point to the guard obscures the likeness in outline.

Of the four † other members of this group, *Eunice conglomerans*

* Except *E. depressa* (Schmarda, Neue wirbellose Thiere, p. 127), the description of which is so slight as to be practically useless. Grube (Mitth. über die Fam. der Euniceen) gives the species as a *Marphysa*, upon what evidence except its possession of these "Säbelborsten" is not known. *Marphysa fallax* is the only other Eunicid in which these two kinds of setæ occur in one worm, and *Eunice impexa* Grube (Annulata Semperiana) and *E. jeffreysii* McIntosh (Annals & Mag. Nat. Hist. ser. 7, vol. xii. 1903) are the only other species of *Eunice* in which "Säbelborsten" occur.

† Roule (Comptes Rendus, tom. cxxvi. p. 1167) includes *Eunice amphiheliæ*, *E. floridana*, and *E. philocorallia* all under *E. gunneri* Storm, thus reducing the group to four members in all.

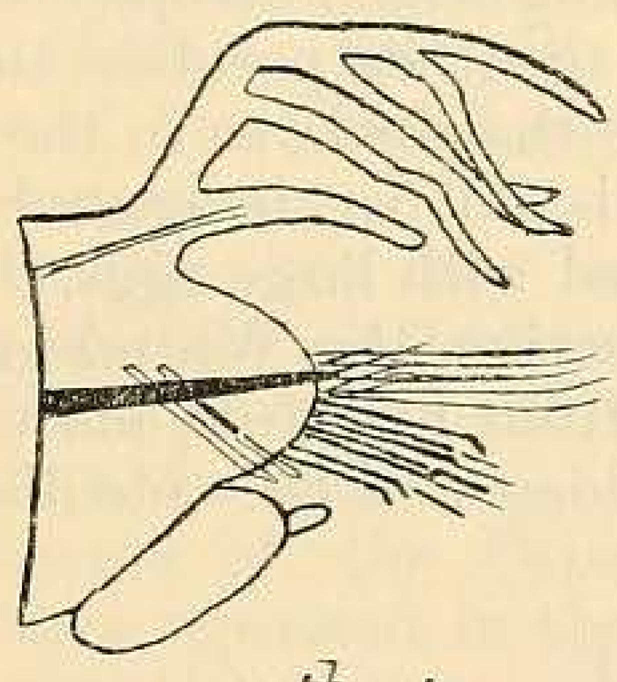
shows a close relationship in other respects besides the compound setæ considered above. The general form of the body, insertion and length of the tentacles, late commencement of the gills, form of the ventral cirri, and details of the setæ other than those mentioned above, are all points in which this species differs from both *E. tibiana* and *E. floridana* and approaches *E. tubifex*. At the same time the difference between the two species in all these characters is perfectly distinct.

The smaller specimens are not at once recognisable as belonging to the same species, striking and interesting differences occurring between them and the full-grown examples.

Two of the fragments consist of a head and fifty segments each, measuring 35 mm. in length by 4 mm. in breadth, the third of a head and 35 segments measuring 13 mm. in length and 2·5 mm. in breadth.

Fragments of two tubes were dredged with the above-named specimens, and these differ from those of adults in being soft and translucent. The proportions of the body, head and its appendages are as above, though the sides of the body are not so vertical because the secretory pads are much less developed. These are in proportion about one-third the size to which they attain in the full-grown specimen, remaining conical in shape and being without the free lappet ventrally. Their maximum development is shown in the figure of the 30th foot (text-fig. 55).

Text-fig. 55.



Thirtieth foot of a young specimen of *E. tubifex*, to show maximum development of the secretory pad. × 18.

The jaws of the larger of these fragments are in shape and proportion like those described above, but the numbers of the teeth are somewhat smaller, as shown by their formula $4-4 : 8+2-8$. In the smallest of all a great difference in the appearance of the whole is brought about by a further lessening of the number of teeth and by the delicate translucent brown material of the plates. Fig. 7, Pl. XXI., represents this apparatus, and a comparison of this with text-fig. 53, A (page 306), shows that in other respects the jaws of young and full-grown examples are alike.

In this smallest specimen the gills begin at foot 21, and the thirteen pairs present consist of one or two filaments, which are only as long as the dorsal cirrus; in the two larger specimens they begin at feet 15 and 17 and consist of three or four longer filaments attached to a short rachis as in the adult. Apparently in correlation with the early appearance of the gills, the knife-ended compound setæ are confined to a few of the anterior segments. In the smallest example a single hooked seta is present in the eighth foot and by the twelfth has replaced all but two of the former kind, though one knife-ended seta still exists in the twentieth foot. In the larger fragments hooked setæ appear at about the eighteenth segment, and a few knife setæ continue in decreasing numbers for about twelve segments more, after which only the former are present. The ordinary setæ are all nearly colourless, and in the smallest specimen the acicula and acicular setæ are of a light brown tint. In the smallest the acicular setæ begin at the sixteenth foot, in the larger at the thirtieth as against the eightieth in those full-grown. Fig. 8, Pl. XXI., shows these setæ, *b* and *c* the two kinds of compound, *a* and *d* two shapes of the acicular setæ, and *e* the aciculum. Contrast Pl. XXI. fig. 6.

The character of the tube-fragments found and the state of the ventral cirri show that the modifications for the tubicolous mode of life are not yet completed, and among these are to be reckoned the later appearance of the gills and of the change in the setæ. The long row of rudiments of gills in front of those which are of a functionally useful size in the adult are doubtless vestiges of the anterior gills of the young which atrophy when the worm attains its full size and enters upon its peculiar tubicolous mode of life. It is interesting to note that here, as in the case of *Eunice indica*, structural immaturity is no bar to sexual ripeness, since one of these fragments is loaded with large eggs.

The empty tubes, described by Whitelegge as resembling those of *E. tibiana*, brought from Funafuti, most probably belonged to this species, and are evidence of its wide distribution through the Indo-Pacific area.

Eunice murrayi McI.

E. murrayi McIntosh, 'Challenger' Reports, vol. xii. p. 288, pl. xxxix. figs. 7 & 8, pl. xx. figs. 19 & 20.

Two large specimens, 6 mm. broad over all, from among coral at lowest tide-level, Pungutiayu Islet, East Africa; two others, very little smaller, from 10 fathoms in Wasin Harbour; one minute specimen, incomplete, dredged from 2 or 3 fathoms in Chuaka Bay, Island of Zanzibar.

From the Maldives are two large specimens from the reefs at Hulule, Male Atoll, and Goidu Atoll.

Speaking roughly, the species is like *Eunice antennata*, but with the gills confined to the anterior segments, the other differences between the two species, though occurring in every part, being inconspicuous. But in mode of life and appearance when alive, the species is distinct from all others. The two specimens from

Pungutiayu were found inhabiting tubes made of comparatively large fragments of shell and pebbles attached lengthwise to the underside of a stone. This mode of tube-building is common among *e. g.* the Terebellidæ *, but forms a contrast to the more or less free tubes of most tubicolous Eunicidæ. The apparent absence of tubes in the case of dredged specimens is not surprising in view of its lack in such a worm as *Onuphis holobranchiata*.

The ground-colour of the body is greenish, like that of verdigris, in tint, mottled with light brown. The tentacles, nuchal and dorsal cirri are annulated, the former being quite moniliform and the constrictions are emphasised by lines of chocolate-red. The large gills are blood-red.

These specimens correspond in all details with the single example dredged by the 'Challenger' in 18 fathoms off the Cape of Good Hope, except that at first it seemed that the latter had fewer teeth on its jaw-plates and differed in the distribution of its gills. These differences are, however, accounted for by an examination of the variation of the specimens before us.

The formula for the teeth given by the 'Challenger' Report, viz. $5-6 : 5+6-9$, is different to that of the majority of these specimens, which vary about $6-7 : 6+8-12$, but is very near that of one specimen, $5-6 : 5+8-10$. The largest number of teeth found on the great dental plates is seven on each.

In these specimens the gills begin on the third foot, with one exception, where the first branchiferous is the fourth foot. In that of the 'Challenger' they begin on the fifth or sixth. However, a state approximate to this latter is found in three of the six specimens, whose first two, three, or four gills are very short simple filaments, mere vestiges of those found on the corresponding feet in the remaining three specimens. The last gill-bearing foot is usually about the forty-fifth, but may be between the twenty-ninth and fifty-fifth in specimens of approximately the same size. The maximum number of filaments found is twelve, and the gills may or may not meet over the back.

Prof. McIntosh's figures of the Cape specimen correspond exactly with the parts they represent in these specimens also. As he notes, the tentacles should be longer, as in *E. antennata*. Also the trifid ends of the acicular setæ are normally covered by a guard in the usual way.

A *résumé* of the remaining differences between this species and the two succeeding may be useful to future workers.

The form of the body is as in *E. antennata*, and though somewhat flatter anteriorly, is equally highly arched dorsally behind. The prostomium and its appendages form another likeness, but the tentacles are more distinctly moniliform than in the majority of specimens of *E. antennata*. The strength and size of the dental apparatus, the shape of its plates (especially the lower or mandibular) and the numbers of the teeth they bear, are so closely alike in this

* It is possible of course that the worms were inhabiting the tube of a Terebellid temporarily, but not likely that two such tubes should have been left vacant and occupied by the same species of Eunicid at the same time and place.

species and *E. antennata* that these structures afford no certain means for their separation.

The size and distribution of the gills form a striking likeness to *E. indica*.

The setæ are like those of *E. indica* in the bent, bluntly pointed termination of the acicula, absence of a third hook to the compound setæ of posterior feet, and the presence of three or even five of the trifid acicular setæ in each foot. But the guard of the compound setæ is not produced to a point beyond the hooks in the way which is so characteristic of *E. indica*.

The young specimen, less than 1 mm. broad, referred to above is but doubtfully identified as of this species. The prostomium is quite undivided in front, but the tentacles are very deeply annulated. Simple gills, as long as the dorsal cirri, occur on feet 6 to 10 only. The setæ are of the *antennata* type.

A very nearly allied species is described by Ehlers (Florida Anneliden), named *E. rubra* by Grube (Annulata Oerstediana). The jaws, however, are delicate plates and the acicular seta is sometimes bidentate.

Eunice antennata Sav. (Plate XXII. figs. 1–7.)

Eunice antennata Ehlers, Ostafricanische Borstenwürmer, Nachr. Ges. Gött. 1897.

E. flaccida Grube, Anneliden des Rothen Meeres, Monatsb. d. k. Akad. Wiss. Berlin, 1869; Gravier, Nouv. Arch. du Muséum de Paris, 1900.

E. torresiensis McI., 'Challenger' Reports, xii. p. 270.

E. elseyi Baird, McI. tom. cit. p. 286.

**E. paucibranchiata* Grube.

The identity of this common species with Grube's *E. flaccida* is rendered certain by the full description of specimens from the same locality by Gravier. Although Ehlers does not give reasons for his identification of the specimens from Zanzibar which he examined with Savigny's *E. antennata* from the Gulf of Suez, it is evident that he is dealing with the same species again, so that the circumstantial evidence for the identity of the two amounts to a practical certainty. Savigny's description taken by itself is hardly sufficient, as he does not describe the setæ nor the jaw-plates with enough care. The figures of the head, feet and gills, and general body-form can, however, hardly be surpassed.

The abundance of large specimens of this species in East Africa forms a contrast with its comparative rarity in the Maldives, whence only two full-grown specimens were obtained. This difference is probably connected with the habitat (which, for the African specimens, is given below), and it is conceivable that a dwarf variety has been evolved in the latter locality. In Ehren-

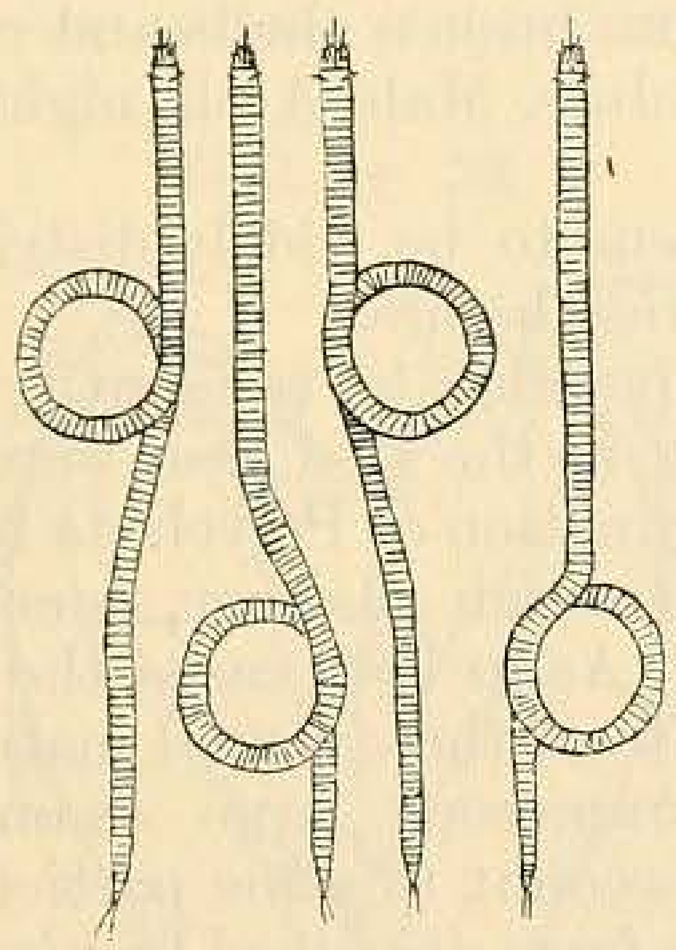
* I owe the discovery of this synonym to the examination of a specimen lately lent to me by Prof. McIntosh, which was labelled by Prof. Grube himself and recorded from the Bass Straits. See note on *E. bassensis*, page 318.

berg's collection from the Red Sea but one fragment occurred, in Gravier's three specimens, all small, while only one specimen is contained in the collections made by Semper in the Philippines.

The worm presents distinct variations in correspondence with its habitat. The five largest specimens, measuring 100 mm. by 5 or 6 inclusive of the feet, were obtained by digging in the beach of clean and rather coarse sand, just below the British Agency at Zanzibar, which appeared to be habitable to them and to *Diopatra neapolitana* alone. These were of a pink or flesh-colour with sparsely scattered specks of brown pigment. Many specimens of all sizes up to that given above were found on the shore, and dredged from among sponge and Alcyonaria &c., at a depth of 10 fathoms in Wasin Harbour. Of these some were similarly coloured, but in many others the brown pigment was more or less uniformly developed, so that the body was of a metallic brown with white spots, of which one in the middle of each segment dorsally was especially prominent. The gills were white even in life, but this loss of colour may have been accidental owing to the de-oxidation of the water in which they were kept before examination.

At low spring-tide level in Chuaka Bay the worm is very common, living in the dense tufts of *Halimeda* which are so abundant there, and in the cavities of sponges. All have

Text-fig. 56.



E. antennata, in the act of swimming.

developed more or less green tint, in some only about the head, but in the majority the whole body is of a fine dark green colour harmonising well with that of the *Halimeda*. None of the specimens found here attain to the size of those from the sand at Zanzibar, the largest of these measuring 80 mm. × 4. When disturbed the worms swim by coiling the body in the way shown in text-fig. 56, the coil passing down to the tail and being then formed afresh at the head, a peculiar mode of motion also observed in the Wasin specimens. On taking hold of the worm it wriggles violently, and if not promptly liberated into the collecting-jar the free end breaks away and is lost among the seaweed. Though it is necessary thus to use care and deftness in handling the living specimens, the worm does not undergo autotomy when dropped into spirit or corrosive sublimate solution, as would be the case with *e.g.* some Nemertines. It seems very probable that both colour and the possession of this faculty are protective, though opportunity was lacking of testing this experimentally.

This variety appears to be sufficiently distinct to merit a name, *E. antennata* var. *viridis*.

A fragment of a large specimen was collected on the shore near Mombasa, concerning which, however, I have no notes.

The Maldivan specimens were collected as follows:—

One complete specimen, 65 mm. × 3 mm., from 5–7 fathoms in the lagoon of Minikoi Atoll, a fragment of a rather smaller specimen from 7–9 fathoms at the northern side of the same lagoon, and a third from breaking up stones on the reef.

The remaining numerous specimens are very small, but one or two millimetres in breadth.

Off Mahlos Atoll, from 23 fathoms, bottom of sand, stone, and weed, one small specimen 2·5 mm. broad.

Off Fadiffolu, from 12 fathoms, bottom hard sand and sponge, two small fragments.

Off North Male, two small fragments from 27 fathoms and one from 20 fathoms, bottom broken shells and rubble.

From the reef at Hulule, Male Atoll, eight complete specimens about 2 mm. wide.

Small specimens seem to be widely distributed in the Archipelago and to be of varied habitat.

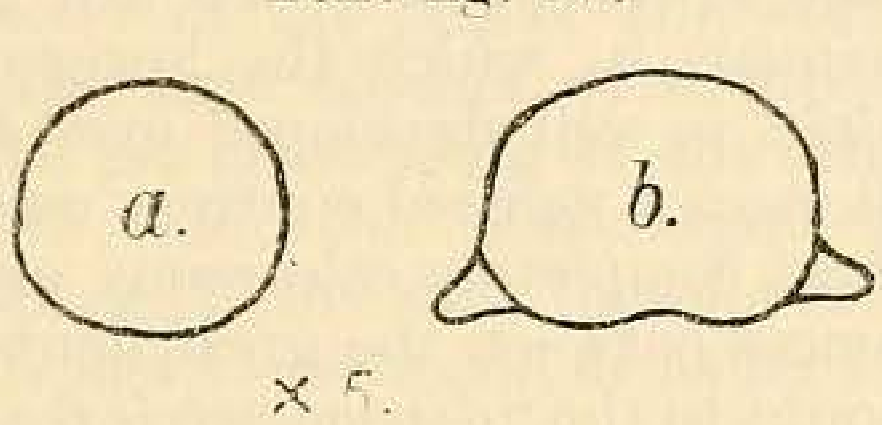
It would hardly be possible to re-identify this species as that collected by Ehrenberg in the Red Sea, were it not that Gravier (*l. c.* p. 255) in his examination of Polychæta from the same locality redescribes it in a thorough manner, mentioning some of its important variations. As in both cases the specimens examined were very small, in spite of their sexual maturity, the presence in these collections of numerous large examples enables me to supplement Gravier's account in some particulars.

In the first place, the form described by him as typical in having, like Grube's, smooth tentacular and dorsal cirri is exceptional, these appendages being generally distinctly annulated and occasionally quite moniliform. Of fifty African specimens of all sizes examined with special detail, 36 per cent. had these appendages very distinctly ringed, as in both those from the Maldives and in Savigny's species. In none of these specimens have I seen the peculiar prolongations of the eyes embracing the base of the middle paired tentacles as figured by Gravier. The eye-spots are of a characteristic form, like that of the half-moon.

The form of the body is characteristic, being almost cylindrical anteriorly, and though flattened posteriorly remains more or less highly arched on its dorsal surface throughout (see text-fig. 57): the long segments bear well projecting feet distinctly separated from one another, though many of the small Maldivan specimens form an exception in this respect.

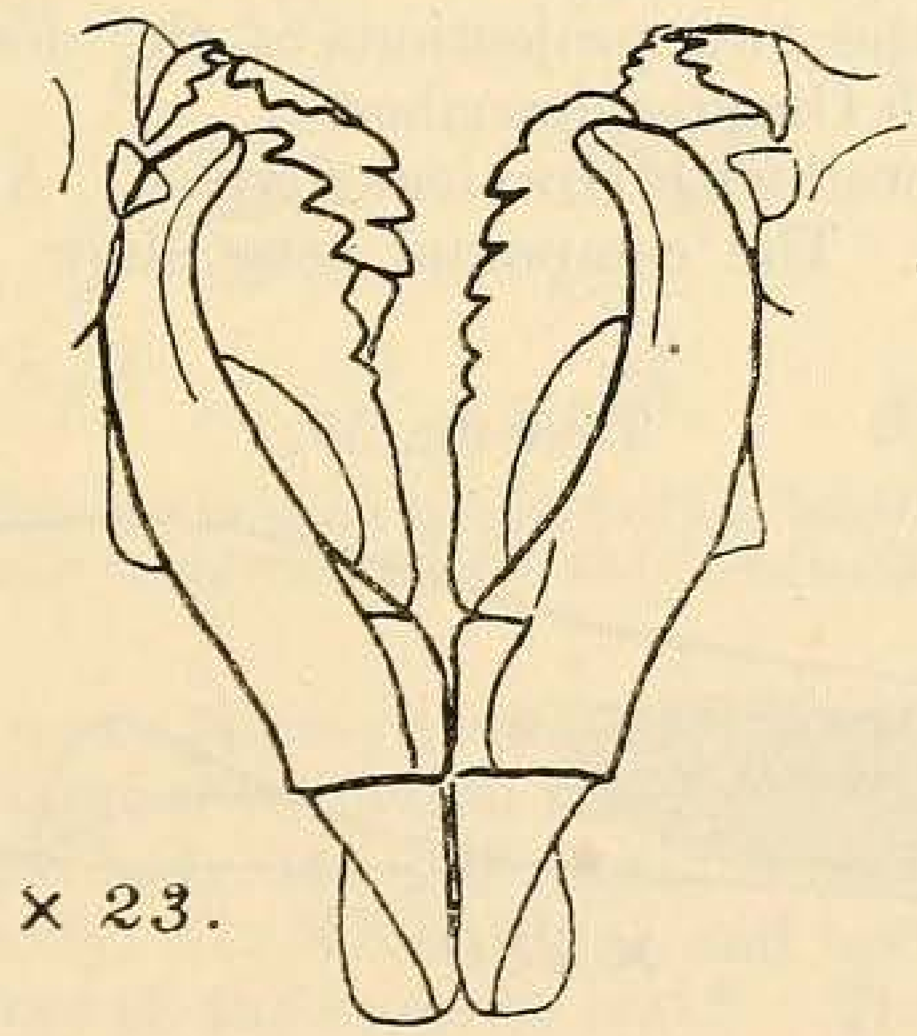
The prostomium, at least in adult specimens, is broad and usually deeply notched in front in 72 per cent. of the specimens (compare the figures 1 & 2, Pl. XXII.), in contradistinction to the allied species, *E. indica* (Pl. XXI. fig. 9). The palps are, in 46 per cent. of those examined, grooved diagonally below, as shown in Pl. XXII. fig. 3, and in a few cases so deeply as to make the prostomium quadripartite when seen from above, as in Kinberg's division of the genus, *Eryphyle*, which for this reason is not recognised in the preceding table of species.

Text-fig. 57.



Sections of body of *E. antennata*.
a. Through buccal segment. | *b*. Position of largest gills.
Hind part of body remains as *b*.
From a large specimen of var. *viridis*. × 5.

Text-fig. 58.



Upper jaw-plates of *E. antennata*, a large specimen. × 23.

The buccal and succeeding segments are nearly as thick as the broadest in the body (Pl. XXII. fig. 1), an important and constant character of the species.

The jaw-apparatus in my specimens does not agree well with

Gravier's figure, and as that of Savigny is not very intelligible, I append a representation of it in text-fig. 58, p. 315, and fig. 4, Pl. XXII. The most striking feature is the strong development of the left unpaired lateral, which lies alongside the great dental in a way which recalls the arrangement of these parts in the Onuphidinæ. This arrangement, carried still further, is found, however, in several species of the genus, e. g. *E. indica.* The following are some formulæ of the teeth, which form a contrast to the larger numbers found in *E. indica*:—

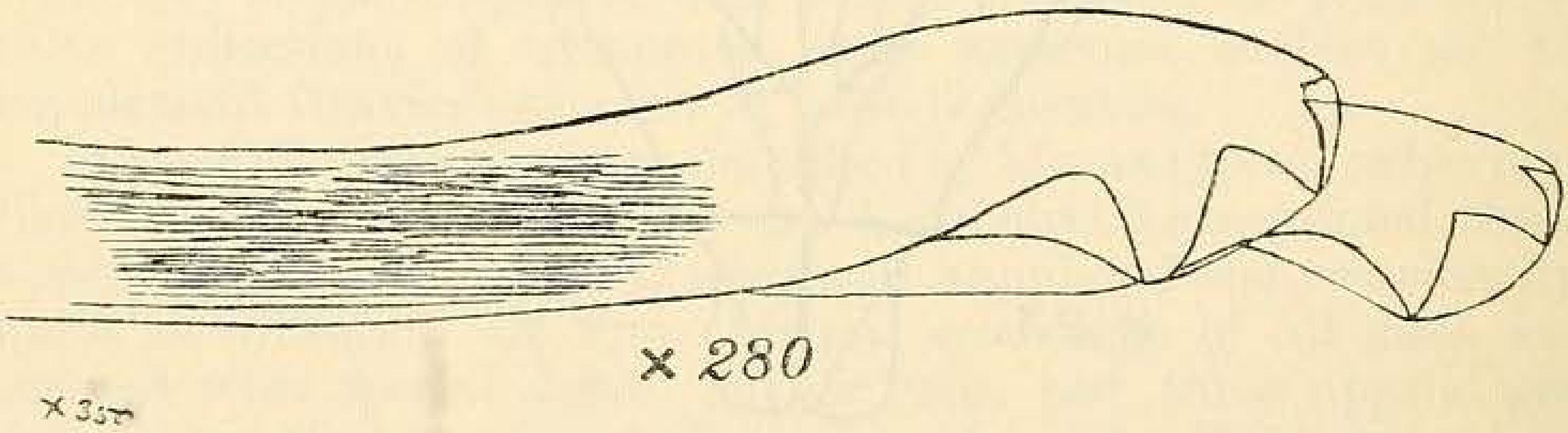
6–7 : 10+9–8 ;	5–7 : 7+7–12 ;
5–7 : 7+7–8 ;	5–6 : 5+8– 9.

In large specimens the plates are strongly made, dark brown throughout, and but sparingly bordered with white matter, except the end-pieces of the lower jaws, which are purely calcareous. Even in small specimens, in which the lower plates are white throughout, the chitin is well developed over the whole of the upper, so that in all cases a marked contrast exists between these and the feeble, almost completely calcareous plates of *E. indica.* There are no differences between the great dental plates of either side which could amount to the "*dissymmetrie frappante*" described by Gravier (*l. c.* p. 257), whose description and figure recall rather these parts in *E. indica* (see p. 320). As usual in most species, the left plate bears slightly fewer teeth, of which the uppermost is better developed than that on the right, but this is all. The maxillary forceps are very strong and broad, and in the older specimens bear a ridge dorsally near their points, as indicated in text-fig. 58 (p. 315).

I do not find the two projections of the dorsal cirrus in the anterior feet which Gravier describes.

The setæ agree well with Gravier's figures. All are smooth and of a light colour. The compound setæ show no, or but little,

Text-fig. 59.



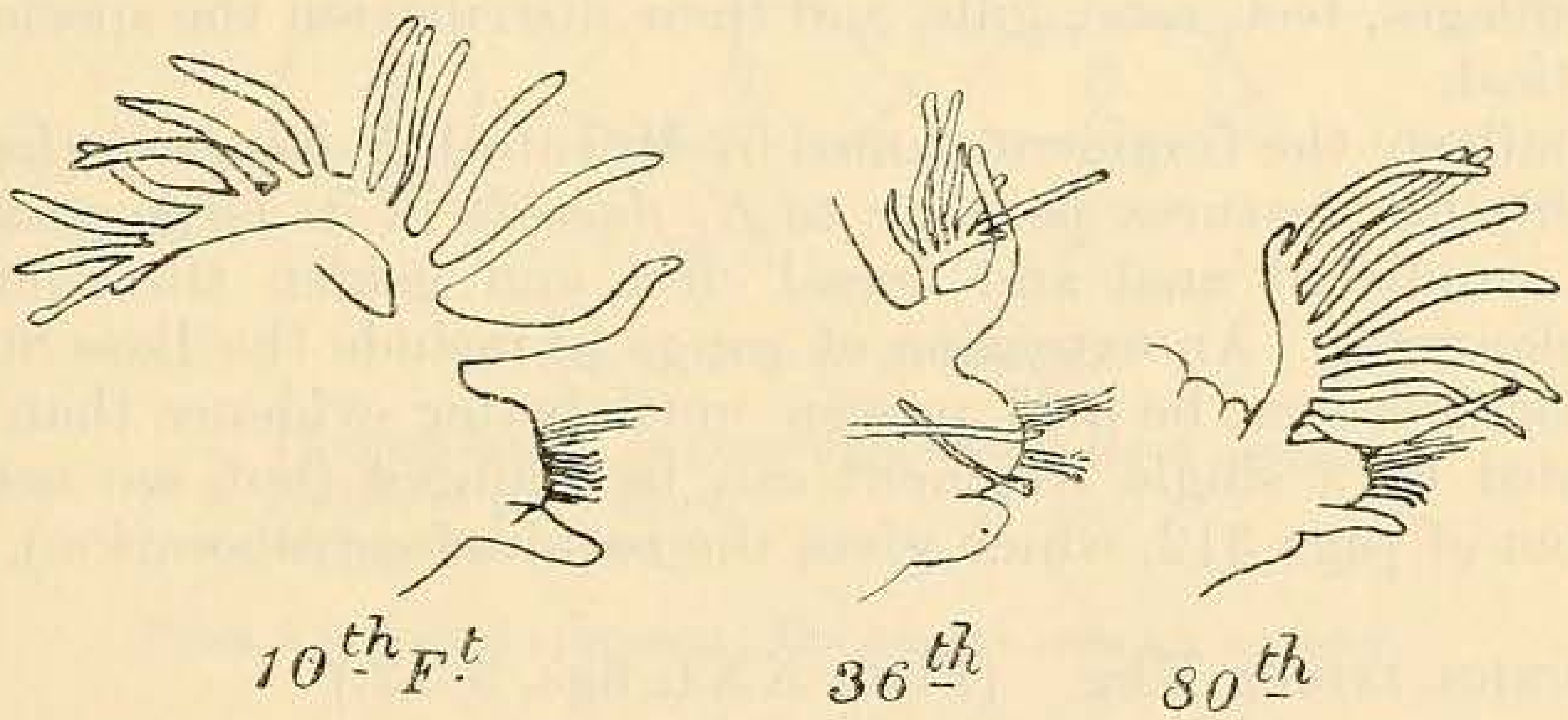
Two acicular setæ of *E. antennata* in their natural relative positions. Compare the shapes of their hooks.

striation, and the acicula are not black, though striated longitudinally. There is, however, no joint in the acicular setæ, which are invariably three-hooked, of a bright yellow colour, and generally considerably bent (text-fig. 59, p. 316). In the posterior feet this tendency to the addition of a third small hook often makes itself apparent in the ordinary compound setæ also, and even the aciculæ are sometimes bifid at their extremity, though the form of the projections they bear is not such that they could rightly be described as hooked, Pl. XXII. figs. 5 & 6. (Compare the species described below, and also *E. elseyi*, Baird, 'Challenger' Report, xii. pl. XX A. figs. 14, 15, 16.)

There are two aciculæ throughout, and only one or two acicular setæ posteriorly (cf. *E. indica*, where there may be as many as four).

The gills are well developed, very regular in form, and of stiff consistency, the name "*flaccida*" being equally a misnomer whether applied to them or to the body of any of these specimens, large or small. They vary in length and complication to some extent independently of the size of the worm, but never quite cover the back. The first appears with great regularity on the 6th foot, only in 16 per cent. being on the 5th, and only one case each on the 3rd, 4th, and 7th. The largest gills, which may be composed of 15 filaments, are only found anteriorly from the 7th to the 20th foot in small specimens, or as far as the 40th in large.

Text-fig. 60.



Three feet of *E. antennata* (a small specimen of var. *viridis*), showing the proportions of the gills in anterior, middle, and posterior parts of the body.

From this point to one approximately the same distance from the tail a variable amount of reduction takes place, after which, in the hinder third of the body, the gills again become large (see figure of hind end of body, Pl. XXII. fig. 7 and text-fig. 60), though never equal to those of the anterior end*. The reduction in the middle region may be sufficient to cause a striking difference in the appearance of the animal, or, in large specimens, be not apparent until a close examination is made. In a few specimens the gills are reduced to single filaments, or even disappear altogether in the

* A similar phenomenon is noted in the case of *E. torresiensis* by McIntosh 'Challenger,' xii. p. 271.

middle region, reappearing as combs of three or more filaments posteriorly. In very young specimens, 1 mm. or so wide, the gills are all small and simple and not developed at all posteriorly. It is thus sometimes difficult to determine a specimen of this species whose posterior part is missing, but generally the distinct annulations of the tentacles, and the breadth and deep notch of the prostomium, form a sufficient distinction from the allied *E. indica*.

This enlargement of the gills at the ends of the body is evidently connected with the habits of the worm, by which the head and tail, especially the former, are more frequently brought into contact with the fresher water outside the burrow.

The relationships of this species to those next following are shown in the table on p. 287. It is also nearly related to, if not synonymous with, *E. torresiensis* McI. (*loc. cit.* p. 270), with which it agrees in every particular, except that in the latter, though the jaw-apparatus is of quite similar form, the numbers of the teeth are smaller, and the gills in all his specimens begin at the fourth foot. These variations are not important, and by the inclusion of these specimens the range of the species is extended to the Torres Straits. The species which McIntosh doubtfully identifies with *E. elseyi* Baird (*loc. cit.* p. 286) from the Arafura Sea, North Australia, agrees in every detail except the shape of the mandibular or lower jaw-plates, which are here remarkably short in proportion to the length of the upper. In the head and its appendages, feet, setæ, gills, and their distribution the species are identical.

Similarly the fragment named by McIntosh *E. bassensis* (*loc. cit.* p. 298) has features peculiar to *E. flaccida* in its large posterior gills, annulated anal and dorsal cirri, and golden three-hooked acicular setæ. An extension of range to include the Bass Straits cannot, however, be held proven until better evidence than that afforded by a single fragment can be adduced (but see note at bottom of page 312, which gives the required corroboration).

EUNICE INDICA Kbg. (Plate XXI. figs. 9–12.)

Eunice congesta Marenzeller, "Südjapanische Anneliden," Denkschr. Akad. Wien, xli. 1879, p. 134.

This species, first recorded by Kinberg from Banks' Strait*, and later by Grube from the Philippines, Marenzeller from the south of Japan, and Gravier from the Red Sea, is represented in these collections by more numerous and larger specimens than in any of the above mentioned. The largest measures 75 mm. × 4 mm., and is one of the five of nearly equal size collected from among sponges &c. at low spring-tide level in Chuaka Bay. From the western side of Zanzibar come two specimens, one nearly as large as the large Chuaka Bay example and one smaller, while

* According to McIntosh, *loc. cit.* Presumably Straits of Banca to the west of Sumatra are meant, not the Banks' Strait off the Canadian north-west.

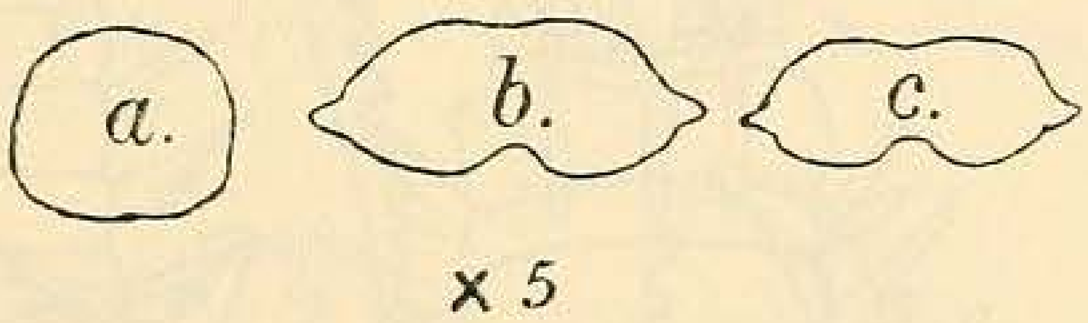
Wasin Harbour yielded seven, of which four are quite small (1 mm. or so broad) and the rest intermediate in size between these and the specimens from Zanzibar.

In the Maldives six very small incomplete specimens (measuring 1·5 mm. in breadth) were dredged from 30 fathoms off Suvadiva Atoll from a rough stony bottom. These are interesting in that they are sexually mature in spite of their size and the undeveloped state of their gills, of which the largest consist of three or four filaments and do not by any means cover the back. Three of these specimens are distended with large ova and three with sperm.

Four, 1 mm. wide, from 20 fathoms off North Mahlos Atoll, with small gills and an abundance of yellow-brown pigment. Another, still smaller and with gills of only two filaments, was dredged in the northern part of Minikoi lagoon from 7–9 fathoms of water, and two very small fragments were dredged off Mahlos from 23 fathoms, bottom sand, stone, and weeds, and off Fadiffolu, 12 fathoms, bottom hard sand and sponge.

The form of the body is, as usual, characteristic, and notably different from that of *E. antennata* and *E. murrayi* in the smallness of the prostomium and narrowness of the buccal and first two

Text-fig. 61.



Sections of body of *E. indica*.

a. Through buccal or succeeding two or three segments.
b. Middle of gill-region.
c. At $\frac{3}{4}$ length of body.

From a full-sized specimen; the smaller ones are rounder.

abranchiferous segments. The only cylindrical portion of the body being thus inconspicuous, the whole appears flattened. The broadest and flattest part of the body is not far behind the head, near the beginning of the branchiferous region. These proportions are shown in Pl. XXII. fig. 9 and text-fig. 61, which represent the condition of a preserved specimen *. It was noted at the time of killing that the slender anterior end is especially contractile in this species.

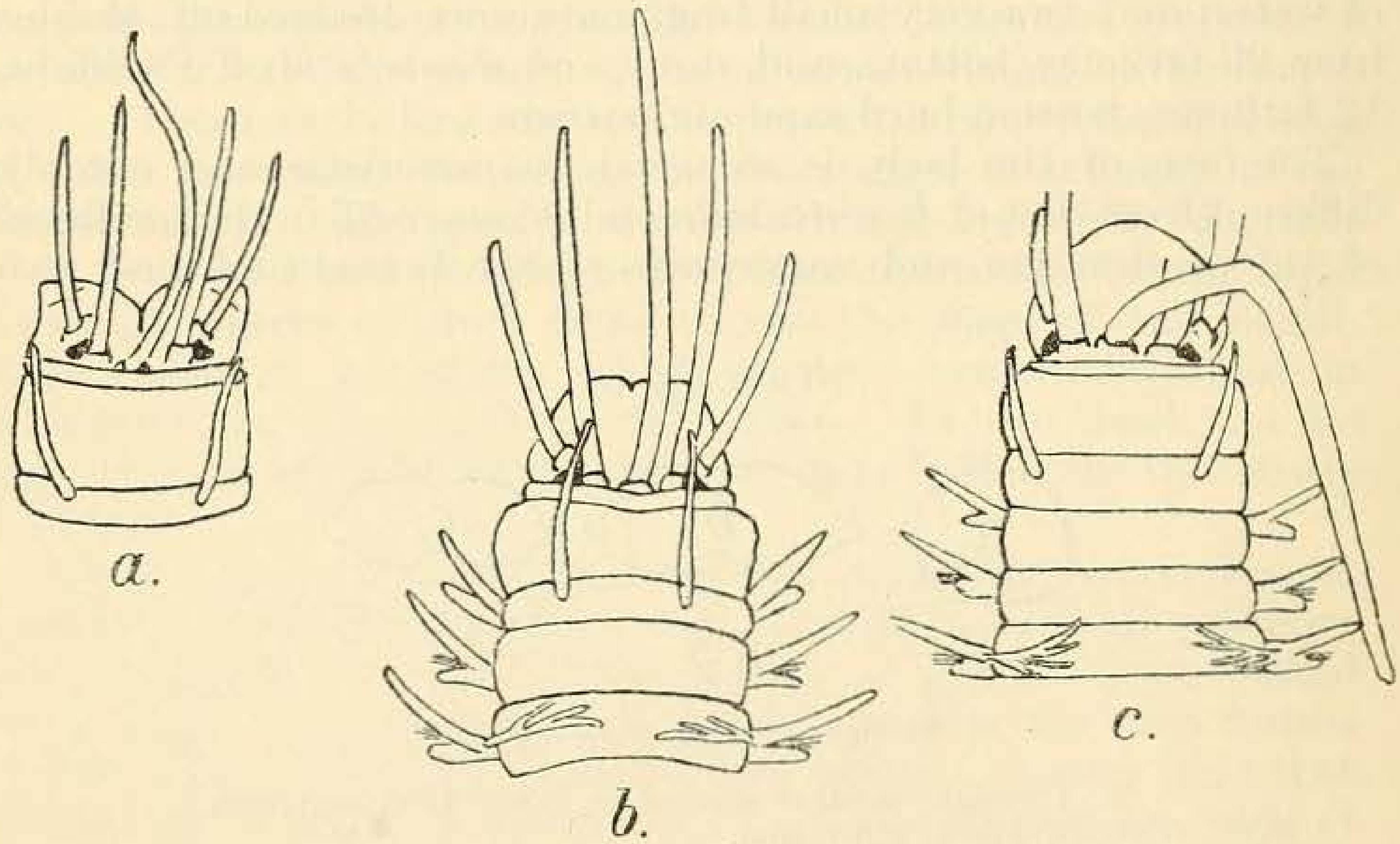
As regards colour, notes made from the living animals give the following variations:—A fair-sized specimen from Chuaka was

* In comparing these figures with that given by Gravier (*l. c.* pl. xiii. fig. 70), it must be borne in mind that very small specimens such as the one he examined are far less contractile on killing than are the adults.

nearly colourless but for the red gills and blood-vessels and, posteriorly, the gut. Others, including specimens from Wasin Harbour, of nearly the same size, were of a light brown colour anteriorly, somewhat darker in the intersegmental grooves, but nearly all the preserved specimens are now practically colourless. One specimen shows mottling of brown pigment anteriorly as far back as the middle of the gill-region.

The prostomium is normally somewhat conical in shape, with a very small notch in its anterior border, though it is deeply grooved below (Pl. XXI. figs. 9 & 10 and text-fig. 62, *b*). In two out of the ten large African specimens specially examined it was, however, as broad distally as at its base, and in two others, as in one of the

Text-fig. 62.



Heads of three specimens of *E. indica*, two of which (*a* and *c*) are of abnormal shape.

The figure shows also variations in the peristomium and in the thickness of the tentacles.

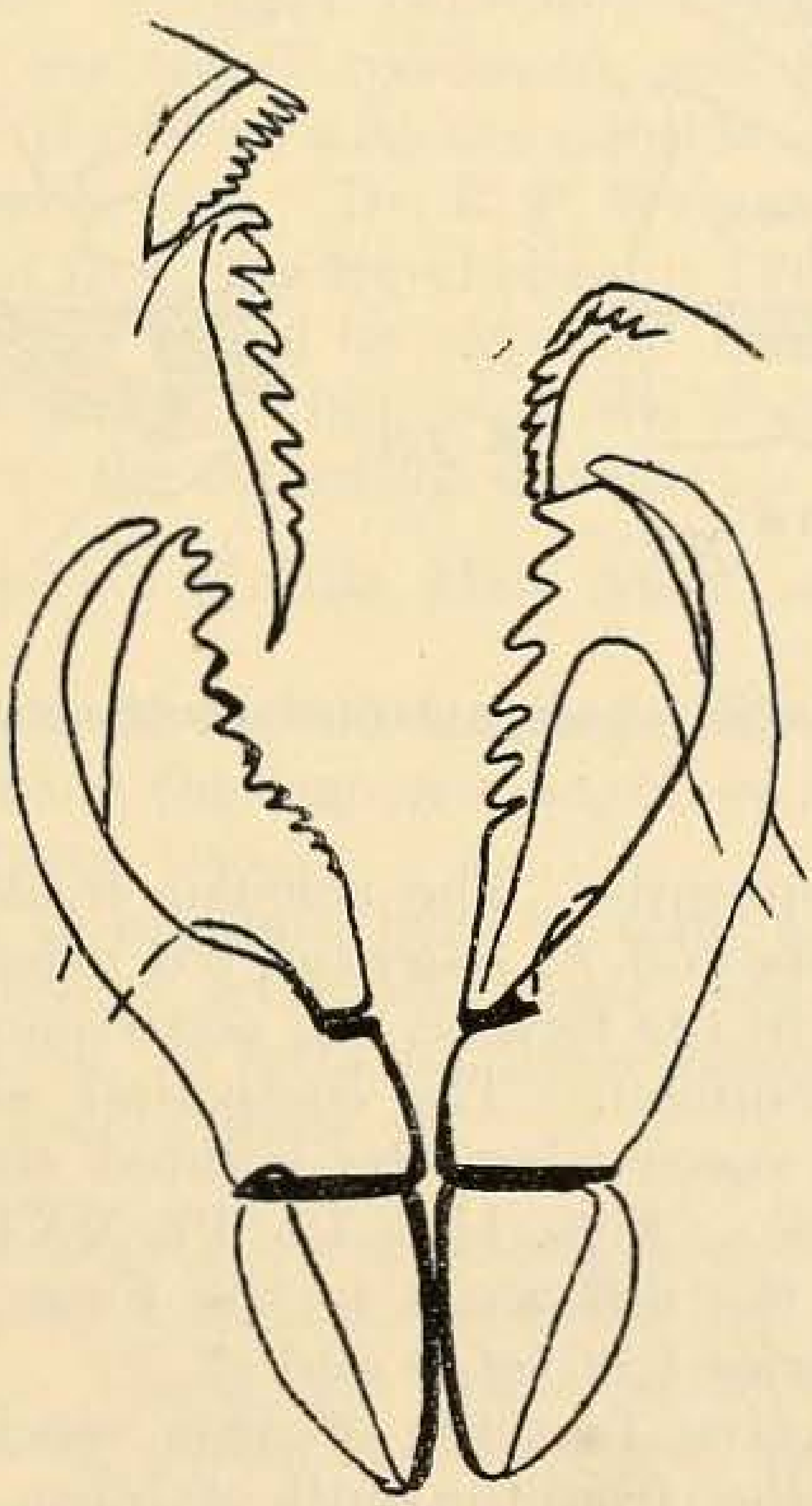
small Maldivan examples, its margin was quite entire. Compare the drawings in text-fig. 62. The eyes are large and of the form of a rounded triangle. The tentacles in all examples are quite smooth, without trace of ringing. The smooth tentacular cirri are remarkably long, extending usually beyond the anterior border of the buccal segment, and in some cases even to the front of the prostomium. These proportions are shown in text-fig. 62 and in Pl. XXI. fig. 9.

The jaw-apparatus is characterised by the small size, delicacy and calcareous composition of its plates, and by the asymmetry of the great dentals. As in *E. antennata*, *E. vittata*, and certain others, the posterior left crescentic plate lies alongside and approximates to the size and shape of the great dental. The numbers of the teeth are fairly large, they being especially small and numerous on the crescentic plates. The following formulæ give their variation :—

$$
\begin{array}{rcl}
9-9 & : & ?+7-?\\
10-8 & : & 8+9-13\\
9-11 & : & 11+10-13\\
11-11 & : & ?+9-?
\end{array}
$$

The asymmetry of the great dentals exists even when the numbers of the teeth they bear are the same, as was the case in the specimen from which text-fig. 63 was prepared. The lower jaws are almost entirely calcareous in composition and their end-plates are indented.

Text-fig. 63.

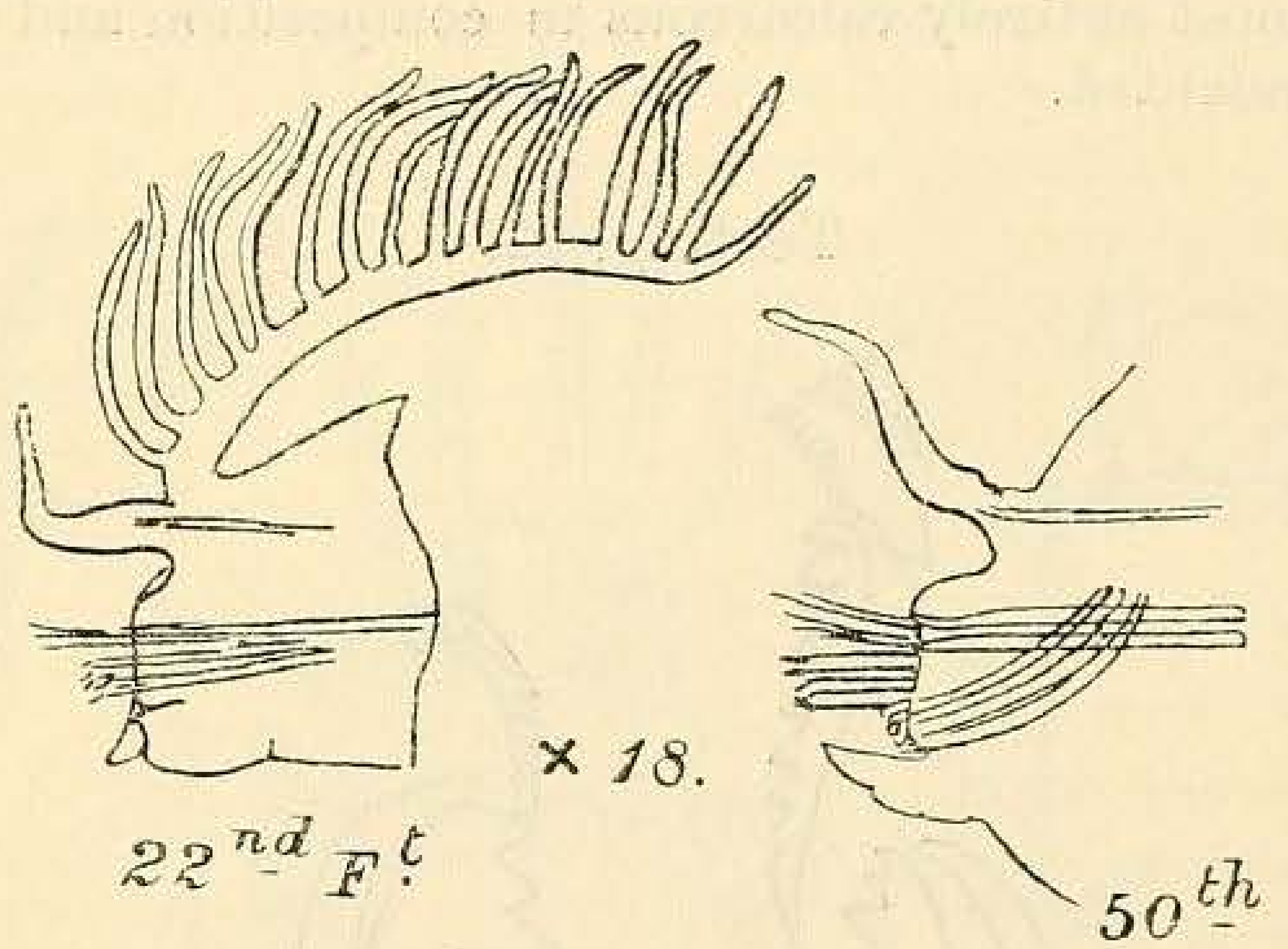


Upper jaws of a full-grown specimen of *E. indica*.

Left anterior plates moved upwards from the natural position.

The feet are comparatively long and slender with long setæ, and are well separated from each other. The dorsal and ventral cirri are well developed, but not annulated. Large gills cover the anterior third of the body (Pl. XXI. fig. 9), commencing in all these specimens on the third foot, except in the case of three small specimens from the Maldives, in which the first branchiferous foot is the fourth. In fair-sized specimens the gills extend from the 34th up to the 50th foot, and in one case sixteen pairs of rudimentary gills followed this latter point. The maximum number of filaments is from ten to twenty, this variation being normal in large specimens, but one, also of fair size, had gills abnormally small and composed of only seven filaments. In all the smaller specimens the gills are simpler, as mentioned above and as in Gravier's specimen. The setæ are as described by Gravier and other authors, the acicula being simple at the point

Text-fig. 64.



Feet of *E. indica*, showing maximum development of gill.

and slightly bent upwards. The acicular hooks are exactly like those of *E. antennata* and *E. murrayi*, but often occur in greater numbers than ever in the former, the occurrence of four in one foot being quite common. The compound setæ never have a third hook in this species, but the pointed ending of the wing is very characteristic. Figs. 11 & 12, Pl. XXI., illustrate these features and show the difference in the form of the compound setæ from the posterior feet (*cf. a* and *c*).

The most distinctive features of this species are shared by *E. congesta* Marenzeller, from the south of Japan. The differences are that the prostomium of the latter is "moderately deeply indented," the jaw-apparatus shows slight differences in having fewer teeth, and the gills do not appear until the seventh or eighth foot. Such differences are easily accounted for as individual variations, and do not compare at all with the importance of their points of resemblance. The species are alike in the colour and form of the body (so far as these are described by Marenzeller), the length and smoothness of the tentacles, and every detail of the feet and setæ. The jaw-apparatus shows characteristic resemblances in its yellow colour, in the size and position of the left azygos plate, and in the whole structure and composition of the lower jaws, of which Marenzeller's representation cannot be surpassed as a likeness of the same parts in the present examples of *Eunice indica.*

This extension of the range of the species from the Red Sea to the south of Japan is striking but not without precedent.

EUNICE SICILIENSIS Gr. (Plate XXII. figs. 8, 9.)

Eunice valida, Gravier, *op. cit.*

This highly specialised and almost cosmopolitan species is found apparently wherever limestone suitable for its borings occurs, and so especially in the coral regions of the tropics, where its abundance must be an important item in the list of causes tending to the disintegration of living coral and coral-rock. In East Africa it occurs wherever coral grows, and so is recorded from every locality where I collected, including the shore of Mombasa Island (one small specimen), and from a depth of 10 fathoms in Wasin Harbour, with the notable exception of Chuaka Bay, where no coral occurs. Dr. E. P. Wright brought fragments of a large specimen from the Seychelles in 1868.

In the Maldives, as would be expected from the abundance of soft reef-limestone and growing coral, the worm is very common, being recorded from the following stations:—

Reef and sand-flats of Hulule, Male Atoll; seven specimens and fragments.

North Male Atoll, 25 and 35 fathoms; three specimens.

Minikoi Atoll, from the lagoon sand, three; and from the reef under boulders, two.

South Nilandu, 25 fathoms, hard bottom; one specimen.

Suvadiva, 28 fathoms, from dead coral; one specimen.

From Mahlos Atoll, 20 fathoms, were collected fragments from among sand and rubble.

On splitting a block of growing coral, or blocks formed by recent growth, in very many cases two or three dull green cords stretch across the fissure. There are portions of a specimen of this species, the burrow of which is so long and tortuous as to be cut across two or three times by any split though the block. The burrow has a delicate parchment-like lining, at least in some cases. The worm is also able to burrow in the soft surface of the reef-edge on the east coasts of Zanzibar.

It is remarkable that none of the Maldivan specimens attain to the large size of several of those from East Africa, and the majority of them are about half this size. The largest East African examples measure 5 or 6 mm. in breadth, and such a specimen would attain to a length of 600 mm. at least, though accurate measurements were rendered difficult by the impossibility of extracting a complete specimen from so long and tortuous a burrow. An incomplete specimen in spirit measured 3 mm. in width and 150 mm. (comprising about 225 segments) in length, and yet none of the gill-region is present.

The colour of the living animal, but roughly noted by Claparède and Ehlers, is somewhat variable. The first third or so of the body-length is of a dirty opaque white, the gill-region is slaty-blue or dull green, a tint which appeared to be due to that of the gut, and finally the posterior part is white again. The tentacles are white, but the prostomium and peristomium are light brown, which tint usually soon dies out. There is often a band of opaque white pigment between the bases of the nuchal cirri, and the brown parts may or may not be covered with small white dots. In a large specimen dredged in Wasin Harbour, the brown coloration, in life, was quite uniform, and extended over nearly the whole of that part of the body which is usually whitish. In some specimens the prostomium and buccal segment are very dark brown, almost black. As noted by Ehlers, the white body-pigment becomes a yellow-brown in spirit; but some specimens, large and small, are now nearly colourless.

A complete account of the anatomy and principal variations of this form may be found in Ehlers's 'Borstenwürmer' and Claparède's 'Annélides du Golfe de Naples.' Grube, in the 'Annulata Semperiana,' remarks on the variation in distribution and size of the gills (which in some of the Philippine specimens were longer than in those of the Mediterranean) and in the proportions of pro- and peristomia, these facts being the same for the specimens from the eastern side of the Indo-Pacific Ocean. Finally, Gravier redescribes the species under the two names *siciliensis* and *valida*; and Ehlers describes very fully a very nearly allied species *E. leucodon* *, giving figures, of which nos. 1, 4, and 10, of the general body form and the lower jaws, serve excellently for this species.

Gravier separates his Red Sea specimens into two species, naming a single small example *E. siciliensis*, while for the rest he institutes the new name *E. valida*. The differences upon which this distinction is based are (1) the length of the gills, which is proportionately about three times as great in the latter as in the former; (2) the proportions of the head; (3) the presence of pigment in the anterior part of the body of *E. valida*. All the specimens seem to have been small, the single colourless *siciliensis* individual having a maximum breadth of only 2 mm. The feet, setæ, and jaws are absolutely identical in both. An examination of the large number of specimens contained in these two collections shows conclusively that these points are variable in the species,

* Polychæten des magellanischen und chilenischen Strandes, p. 128, figs. 1–10.

all stages occurring between the '*valida*' and *siciliensis* types. Indeed, this was noted long ago by Grube in the case of the features (1) and (2), and variations in the colour of living examples are given above. In spirit, colourless specimens are not common, but shades of light and dark brown are numerous.

Gravier's figures (pl. 13. figs. 71–82, and text 130 and 134) are excellent illustrations of the species and the extremes of its variation.

Ehlers's South American species *E. leucodon* differs in (1), as the name implies, the broad white band surrounding the plates of the upper jaw and the almost completely calcareous composition of the lower; (2) the shortness and ringing of the tentacles. The mottling of the body-pigment and other small differences may be found as variations in *E. siciliensis*; but I do not find in these collections any specimens the tentacles of which are shorter than one and a half times the length of the prostomium, or the upper jaw-plates of which are not quite black with but a narrow and inconspicuous white edging. Ringing of the tentacles may or may not be developed. The points of agreement between the two species so preponderate over these small, but constant differences, that it seems best to follow out Ehlers's own suggestion and to regard his specimens as belonging to a local variety of the cosmopolitan species *E. siciliensis*.

Claparède and Ehlers (Borstenwürmer) figure compound setæ with elongated articulated pieces, whereas Gravier's figures (of both varieties) show short triangular hooks as in Ehlers's figures of the *leucodon* variety. These setæ vary considerably, those from anterior segments differing from those found posteriorly in the way shown by figs. 8, *a* & *b*, Pl. XXII., which represent the extremes of the forms met with. Those of the hinder feet are much the stouter, as here commonly one compound seta is found alone. Comb and acicular setæ are entirely absent from all these specimens, even in cases where two acicula occur in a few feet. Their absence forms a very definite distinction between this and others which have simple gills, e. g. *E. schizobranchia* Clap.*, *E. marenzelleri* Gravier†, and *E. cirrobranchiata* McI.‡. These three species indeed show none of the other features of specialisation which make *E. siciliensis* so well marked a form.

Several specimens, *e. g.* four from Hulule, Male Atoll, and one from Minikoi reef, show remarkable papillæ distributed over the three middle tentacles, as shown in fig. 9, Pl. XXII. Possibly these are connected with the "papilles en forme de dômes sur-

* *Op. cit.*, Supplement, 1870, p. 30, and pl. ii. fig. 6. This species has been regarded as synonymous with *E. siciliensis* by later workers. Though Claparède says nothing about its jaw-apparatus and lays emphasis upon probably variable features such as colour and proportions of the buccal segment, the presence of these setæ remains an indubitable distinction of quite specific importance.

† *Op. cit.* p. 230.

‡ 'Challenger' Reports, vol. xii. p. 277. It is remarkable that no specimen of so common and widely distributed a species as *E. siciliensis* occurred in the 'Challenger' collection.

baissés" which Claparède mentions and figures (pl. 2. fig. 5 D). Perhaps these organs are eversible, or have here become hypertrophied.

The means by which the long and tortuous burrows are made are still unknown; the principal suggestions being (1) by aid of an acid secretion, (2) by the mechanical action of the jaws. While in the Maldives, Gardiner repeatedly tested the effect of the bodies of boring annelids upon litmus-paper without finding any acid reaction, a result identical with McIntosh's observations on *Polydora* *. Indeed, it is not easy to see how an acidity of the body could produce any effect beyond enlarging the diameter of the burrow, which is never found larger than the body of the worm it contains. The supposition that an acid secretion aids the action of the jaws is negatived by the calcareous composition of the lower plates, the only parts the action of which could conceivably produce the results seen. The size and gouge-like shape of these strongly suggest their use in cutting out the canal by a rotary motion of the head. The softness of ordinary reef-rock and the porous nature of coral make this hypothesis a possible one.

The mode of life of this species would, if known, be of great interest. Is it usually possible for the head to come to the surface to seek food, or does it, as seems physically necessary, and as is indicated by the absence of gills anteriorly, remain usually at the deep end of the burrow? Can the boring sponges and algæ parasitic in corals afford an appreciable amount of nutriment to the worm?

Genus NICIDION Kbg.

As Eunice *but without gills.*

The species of this genus are but few in number, and several of the names apply to species not yet properly described. Of Kinberg's three species upon which the genus was founded, two are very probably, as Grube notes, specimens of *E. siciliensis*; but the third *N. cincta*, which possesses acicular setæ, is probably a true *Nicidion*, and the shortness of its tentacles indicates the probable identity of this Pacific form with that from East Africa.

The species of which certain identification is possible are but four in number, viz.:—

N. kinbergi H. E. Webster, Bull. U.S. Nat. Mus. 25, 1884.
N. balfouriana McI., 'Challenger Reports,' xii. 1885.
N. brevis Ehl., 'Florida Anneliden,' 1887.
N. edentulum Ehl., Die Polychæten des magell. und chil. Strandes, 1901.

Of these *N. edentulum* is distinguished from all the other species

* Annals & Mag. N. H. ser. 4, vol. ii. p. 276 (1868).

in the character of its jaws, whose structure approximates to those of *Eunice siciliensis*.

NICIDION GRACILIS, sp. n. (Plate XXII. figs. 10, 11.)

Body slender, divided into two parts, which differ in the proportions of their segments and the characters of the feet they bear. Prostomium broad, slightly notched in front; tentacles short, the middle one projecting very little beyond the anterior border of the prostomium. Eyes large, half-moon shaped. Jaws of the usual form, great dental plates with about six teeth each.

Setæ of the usual type.

Allied to N. brevis *Ehl.**, *but differs in slenderness of body, shortness of tentacles, and other characters.*

Three specimens, of which the two largest want the hind end, were dredged in Wasin Harbour.

The body is very slender in proportion to its length, the longest fragment measuring 15 mm. by 1·5 mm., and consisting of sixty-five segments. The single complete specimen is unfortunately undergoing regeneration of the hind end, and so is useless as a comparison. All three are of approximately the same breadth.

In life the anterior half of the body is coloured red-brown by dots of colour on a whitish or pink ground, the posterior part being nearly colourless but for the black gut. In one specimen two white collars were formed by the peristomium and setigerous segments three and four, and a white spot occurred in the middle of each segment just behind the intersegmental groove. In spirit the specimens are a uniform dull light brown, but one is darker and redder anteriorly.

Two of the specimens were infested with a parasitic Syllid, the first by one, the second by seven examples; this species was found also on a Nemertine and a Polynoid, and will be described in due course. The head of the Syllid is buried in the space between two adjacent parapodia.

The head is nearly as broad as the rest of the body, the broadest part of which is about 4 mm. behind it. Both rings of the buccal segment are fairly long, the second being about half as long as the first. These and the next four or five segments are nearly cylindrical in section, but the next twenty-five † are flattened dorsally and especially ventrally, and become very short. These thirty anterior segments form a contrast to the succeeding, both in their own proportions and in the feet they bear (see text-fig. 66, p. 329). The remaining segments are highly arched dorsally, though the ventral flattening extends to the anus, and are from two to three times as long as those of the anterior region. The broadest part of the body is about the middle of the

* 'Florida Anneliden.' Results of dredging by U.S. Fish Comm. SS. 'Blake.' Harvard, 1887.

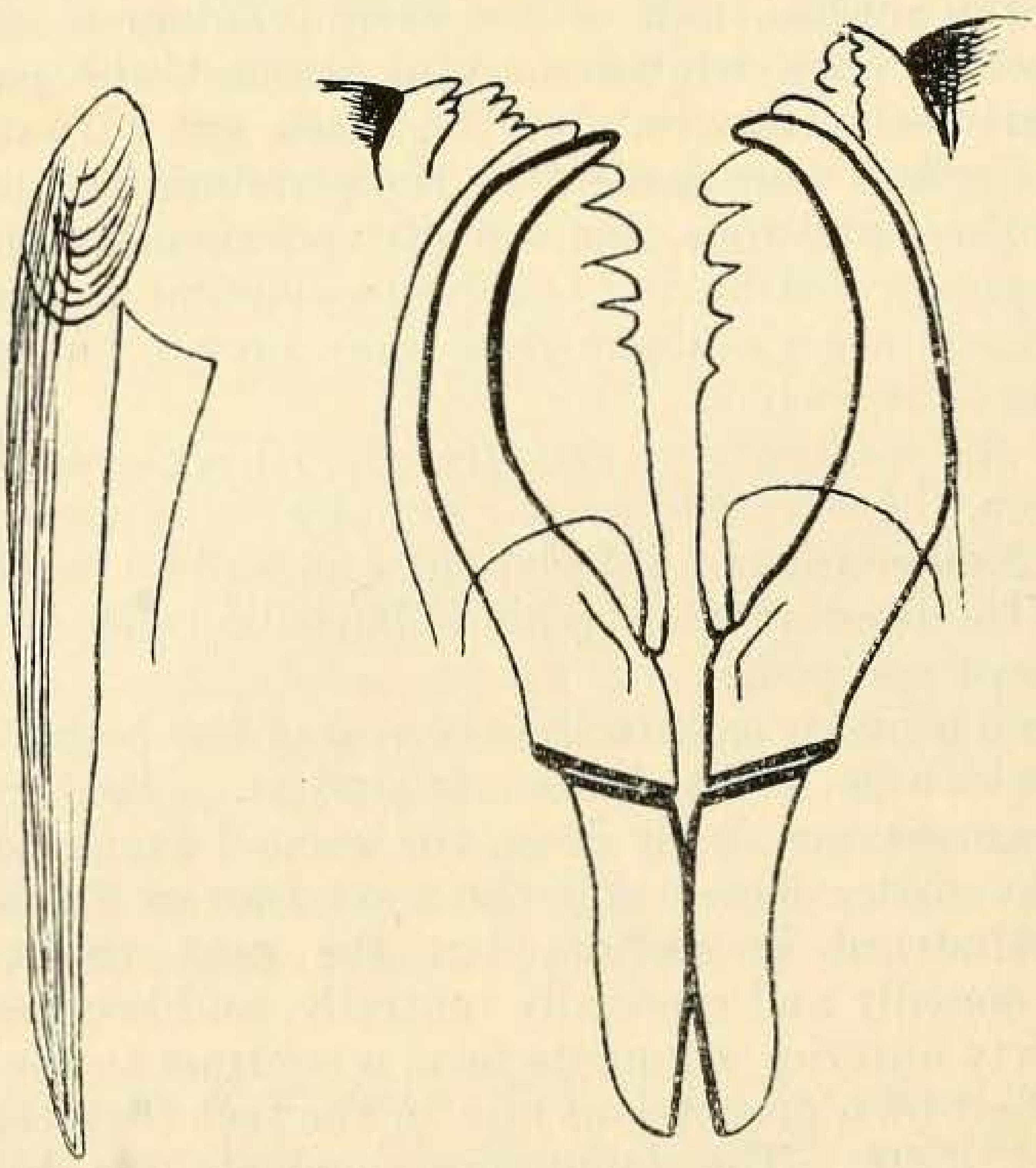
† This number is nearly constant in all three examples.

first region, which narrows slightly to its posterior end, and the rest of the body retains this slightly decreased breadth to near the anus. The figure of the worm (Pl. XXII. fig. 10) gives these proportions and illustrates the differences between the two parts of the body. As here shown, the change is quite sudden at the point given.

The prostomium (Pl. XXII. fig. 10) is nearly as broad as the buccal segment and slightly notched anteriorly in the usual way. The tentacles are smooth, short and thick, the longest projecting but very little beyond the edge of the prostomium. The eyes are large and densely black, of a half-moon shape, or slightly crescentic from some points of view. The tentacular cirri are remarkably small and slender.

The upper jaw-plates are of the usual type, the only noticeable features being the bluntness of the teeth and the length of the supports at the base of the great dental plates. As would be expected from the small size of the worm, the plates are delicate and of a light brown colour, but calcareous matter is not visible.

Text-fig. 65.

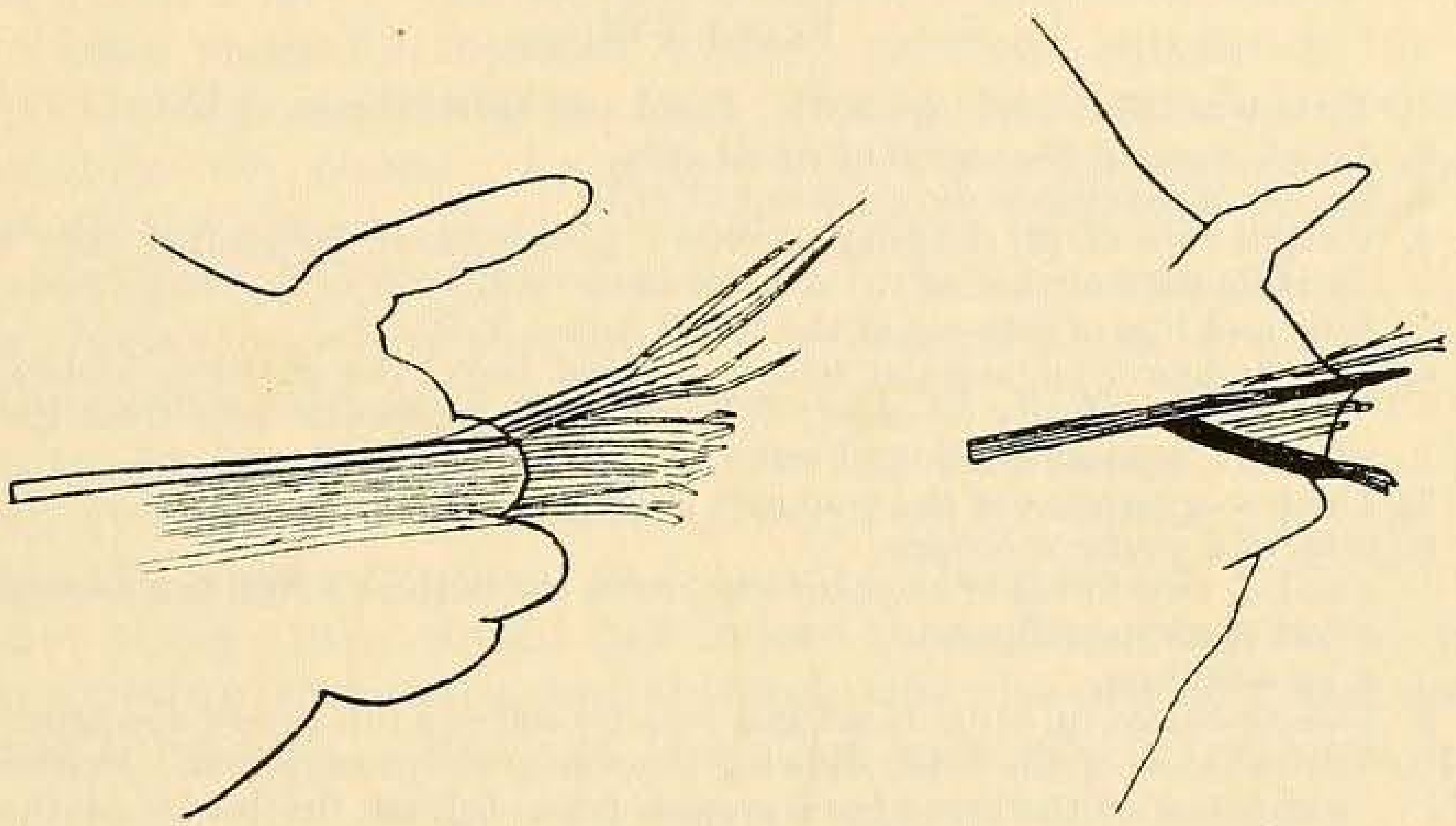


Upper and lower jaw-plates of *Nicidion gracilis*. × 60.

There are two black crescentic paragnaths, one on either side above and exterior to the crescent plates. The lower jaws can scarcely be called plates, they are so delicate and flexible. The shapes of all these parts are shown in text-fig. 65.

The feet of the anterior part of the body project considerably, those of the posterior very little. The former appear to be thicker distally than at their bases, owing to the breadth and thickness of the lips of the seta-sac and to the swelling of the ventral cirri to an egg-shape, the broad end being the distal. The posterior feet are as usual pointed at their tips and have small, scarcely visible ventral cirri. In this way is caused the more striking of the differences between the anterior and posterior parts of the body, the change taking place quite rapidly at the point mentioned, at which also a two-hooked acicular seta first appears. In the anterior feet the dorsal cirrus is long, projecting beyond the end of the seta-sac; posteriorly it is very small (compare the figures of the feet in text-fig. 66).

Text-fig. 66.



Anterior and hinder feet of *Nicidion gracilis*. × 60.

The setæ are numerous and project well anteriorly when not, as is frequently the case, broken off level with the end of the seta-sac. This is the case almost always posteriorly, where usually only a few comb-setæ are found projecting. All are of the usual form and their details are given in fig. 11, Pl. XXII.

There is a single pair of short and slender anal cirri.

This species is very closely related to *N. brevis* Ehlers, from which it is distinguished at once, however, by the slenderness and anterior compression of its body, the shortness of its tentacles, and form of its teeth. The resemblances between the two species are certainly more striking than the differences, comprising the smallness of the tentacular cirri, broad features of the jaw-apparatus (including apparently the remarkable delicacy of the lower jaws), structure of the feet and setæ, and the characteristic differences between those of the anterior and posterior portions of the body.

EXPLANATION OF THE PLATES.

Plate XX.

Fig. 1. *Eunice afra* (p. 289). Dorsal view of the anterior end of a medium-sized Chuaka specimen. × 3·5.
2. Side view of the same, showing positions of the anterior feet and relations of pro- and peristomia.
3. Outline of head and its appendages of a larger specimen showing the comparatively smaller size of these parts, to same scale.
4. Lower jaw-plates of a young specimen, which are transparent enough to show the structure of the chitinous parts, the calcareous end-plates are well developed. *Cf.* text-fig. 44, p. 293, which is from an older specimen.
5. The bases of the tentacles and eyes, as seen when the anterior border of the peristomium is drawn back. *e.*=eye, *gr.*=groove, *t.*=tentacle.
6. A large complete Maldivan specimen of *E. coccinea* (p. 297), seen from the side to show proportions of body &c. × 2.
7. Lower jaw-plates of a small Wasin specimen (p. 300), showing the characteristic structure of the end-plates.

Plate XXI.

Fig. 1. *Eunice tubifex*, adult (p. 303). Head and anterior part of body.
2. About segment 85, region of small gills.
3. Region of maximum development of gills.
4. Ventral view of (2) showing secretory pads formed by ventral cirri of the middle part of the body. All the above × 3.
5. Setæ and lips of seta-sac of the 100th foot. × 50.
6. Setæ in detail. *a*, acicular seta from hind body, the guard is broken away as in the majority of cases; *b*, knife-ended compound seta from the 20th foot; *c*, hooked compound seta; *d*, two comb-setæ.
7. The jaw-apparatus of the youngest specimen. × 18.
8. Setæ of a young specimen.
a and *d*, two forms of acicular setæ, from the 35th and 20th foot respectively.
b and *c*, compound setæ.
e, an aciculum.
9. *Eunice indica* (p. 318). Head and anterior end of a full-grown specimen. × 4.
10. Ventral view of the head, showing grooves of the prostomium. Parts of the end-plates of the lower jaws project from behind the border of the prostomium.
11. Group of setæ of the 50th foot *in situ*, showing the relative positions of the different kinds. × 37.
12. Isolated setæ: *a*, compound seta from 80th foot; *c*, compound, and *b*, comb-seta from the 20th.

Plate XXII.

Fig. 1. *Eunice antennata* (p. 312). Anterior end of a large Zanzibar specimen which was less contracted than usual. × 3.
2. Head of another specimen in which the prostomium and peristomium differ in form from the above and the dorsal cirri are not moniliform. × 6.
3. Ventral view of the head, showing the grooved palps (Chuaka specimen, var. *viridis*). × 8.
4. Lower or mandibular jaws, showing partly calcareous composition &c.
5. An aciculum with bifid distal end. × 280.
6. Compound seta from a posterior foot (the 80th), in which the end-piece has three hooks. × 280.
7. Posterior view of a Chuaka specimen (var. *viridis*), showing large posterior gills, annulated anal cirri, &c. × 10.
8. *Eunice siciliensis* (p. 323). Compound setæ, showing the extreme shapes met with: *a*, from an anterior (5th) foot; *b*, from a posterior foot.
9. A tentacle covered with papillæ distally.
10. *Nicidion gracilis* (p. 327). The anterior and part of the posterior division of the body.
11. Setæ of the same:—*a*, capillary; *b*, compound; *c*, comb; *d*, acicular hook-seta, projecting from foot.