ON SOME SPECIES OF LERNAEA

(CRUSTACEA, COPEPODA:
PARASITES OF FRESHWATER FISH)

BY

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ON SOME SPECIES OF *LERNAEA* (CRUSTACEA, COPEPODA: PARASITES OF FRESHWATER FISH)

By J. P. HARDING

(*With ninety-five text-figures*)

SYNOPSIS

Twenty-eight species of *Lernaea* are recognized, of which fourteen are represented in the collections of the British Museum. Nine of these are new species. In addition there are seven names in the literature which are relegated to the synonymy. A key to the twenty-eight recognized species is given and the fourteen species in the Museum are described and figured.

One result of the renewed interest in the freshwater fisheries of Africa and other countries in recent years has been an accumulation of the parasites of these fish in the British Museum with requests for their identification. Attempts to name the species of *Lernaea* on the basis of existing descriptions and keys soon showed that a high proportion of them were new, and that Cunnington's (1914) and Wilson's (1917 & 1918) revisions and keys are out of date.

There is no need here to repeat recriminations against Wilson (1917) for transposing the names for the genera *Lernaea* and *Lernaeocera*. The inevitable confusion caused by this strict interpretation of the Rules of Nomenclature has fortunately been lessened by the fact that subsequent workers have, however unwillingly, nearly all agreed to follow.

As is often the case with degenerate parasitic forms, the characters used to distinguish between species are often ill-defined and not easily seen. Wilson often expressed the opinion that species of *Lernaea* and other parasitic copepods could readily be distinguished by reference to their appendages; but I have found extraordinarily little difference between the appendages of one species and those of another. The first four pairs of pereiopods, which will be referred to as legs 1 to 4 in this paper, are the only appendages that are easily examined as they are flat, and as each has a number of setae and spines I expected variations in their arrangements to provide useful characters for distinguishing species. Unfortunately I could find hardly any variations. The precise arrangement of the setae and spines was investigated in fourteen species, and in thirteen of them it was identical, only one of them could be separated on this basis. Table 1 gives the arrangement of the setae and spines in the thirteen species. *L. bistricornis* is included although I was able to see only legs 3 and 4; all four pairs of legs were seen in the other species. *L. haplocephala* differs from all these species in having four setae instead of five on the terminal segment of each exopod (Table 2, p. 19). *L. oryzophila*, according to Monod's (1932) description and figures, differs from the other species, having four instead of three spines on the last segment of the second exopod and two spines instead of three on the last segment of the fourth exopod. *L. dolabroides* (Wilson, 1918, figs. 77 and 78) seems to have a quite different setation of its legs.

TABLE 1

Arrangement of the setae and spines on the legs of *L. bagri*, *L. barbicola*, *L. barilii*, *L. barnimiana*, *L. bistricornis*, *L. cyprinacea*, *L. diceracephala*, *L. longa*, *L. lophiara*, *L. palatae*, *L. piscinae*, *L. tilapiae*, and *L. tuberosa*

		Leg 1	*Leg 2*	*Leg 3*	*Leg 4*
Exopod	spines	1.1.2	1.1.3	1.1.3	1.1.3
	setae	1.1.5	1.1.5	1.1.5	1.1.5
Endopod	spines	0.0.2	0.0.2	0.0.2	0.0.2
	setae	1.1.4	1.2.4	1.2.4	1.2.3

The other appendages are even less useful than the legs for separating one species of *Lernaea* from another. Wilson (1920, p. 7) claims that *L. haplocephala* may be distinguished by the 'small spherical terminal joint of the maxillipedes, with its four curved claws'. This may have been true of the specimen he examined, but I find that the maxillipedes of the type specimens of *L. haplocephala* have five claws like any other species and that the terminal segment does not appear to have any specific shape. Fig. 34 gives the arrangement of the mouth parts as far as I have been able to see these very minute appendages.

We are left with the shape of the body and with the internal anatomy for distinguishing species. Unfortunately it is difficult to study one without destroying, or at least distorting, the other, and I have neglected a study of the internal anatomy in favour of the shape of the body and its processes, and in particular that of the anchor. I am restricting the use of the word 'head' to that small, rounded part which bears the antennae and the mouth parts. The swollen part with processes which are usually described as 'cephalic processes', 'cephalic arms', or 'cephalic horns' I propose to call the anchor and its arms, as this describes both the appearance and the function of this part of the body. The anchor is often difficult to remove from the flesh of the fish without damage, and I have adopted the method of cutting out the part of the fish with the parasite embedded in it and placing it in a tube with a solution of potassium hydroxide to which a little chlorazol black has been added. If this is left for about twenty-four hours the tissues of the fish are usually softened sufficiently for the *Lernaea* easily to be removed; the chlorazol black stains the chitin of the parasite a dark blue. The external shape of the animal is well preserved by this method and the appendages can be examined without difficulty. The egg-sacs should be removed before placing the parasite in the hydroxide or they will be destroyed.

All drawings and measurements of specimens recorded in this paper have been made with the aid of a camera lucida. The total length of a specimen is understood to mean the length from the front of the head to the end of the abdomen, allowance being made for bends and curves in the body. Parts of the anchor which may project in front of the head and the furcal setae are not included in this measurement. The measurement and drawing of curved specimens was helped by the use of gimbals which enabled the specimen to be held in any position on the stage of the microscope. The gimbals, similar in principle to those of a ship's compass, but with sufficient

friction in the bearings to prevent free swinging, were made of concentric cylinders of perspex, as shown in Fig. 1. The whole is submerged in formalin in a glass vessel and the specimen is placed in the central cylinder, which is closed at the bottom to form a dish.

I have found the shape of the anchor and its arms to provide the most useful characters for taxonomic purposes. In spite of the fact that the shape of the anchor is liable to be distorted by meeting bones and other hard obstructions during its growth in the body of the fish, each species has a characteristic form which varies within limits which are usually definable provided sufficient material is available.

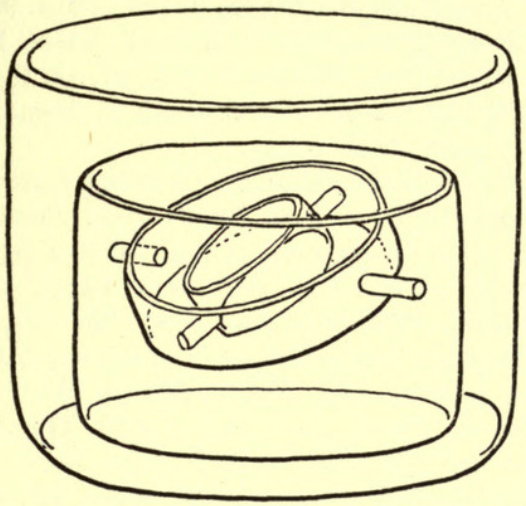


FIG. 1. Gimbals for tilting the specimen into positions required for drawing or measuring.

The abdomen and the pregenital prominences of each species examined have been drawn with some care from more than one aspect as I have found them useful in separating species. The shape of these parts is not so easily influenced by the site of attachment of the parasite, but on the other hand there is often a difference in the shape of these parts of a young individual and those of an old one. The characters of the immature specimens are often less well defined than those of adult specimens, and the adult female seems to continue to grow and develop specific form for some time after eggs are first produced.

The positions of the legs on the body have been recorded wherever possible with an estimate of the range of variability.

The amount of torsion and its direction is very variable; but worth recording because some species show little torsion and in others considerable torsion is the rule. In some species, such as *L. barnimiana*, the torsion is not only variable in direction and extent in different specimens but often changes its direction along the length of the one individual.

Cunnington (1914) remarks on the rarity of copepod parasites on the fish he collected from Lake Tanganyika. Lake Nyasa, however, seems to be very rich in species. More information is required about the seasonal distribution of the different species. Miss R. H. Low tells me that she found *Lernaea* on many of the specimens of *Bagrus* that she collected in August and that by November the *Bagrus* were free of parasites but the *Tilapia* were infected. She had the impression that the parasites

had transferred their attentions from *Bagrus* to *Tilapia*; but an examination of the specimens shows that there are two distinct species of *Lernaea* involved, *L. bagri* and *L. tilapiae*, described below.

Lernaea cyprinacea Linnaeus

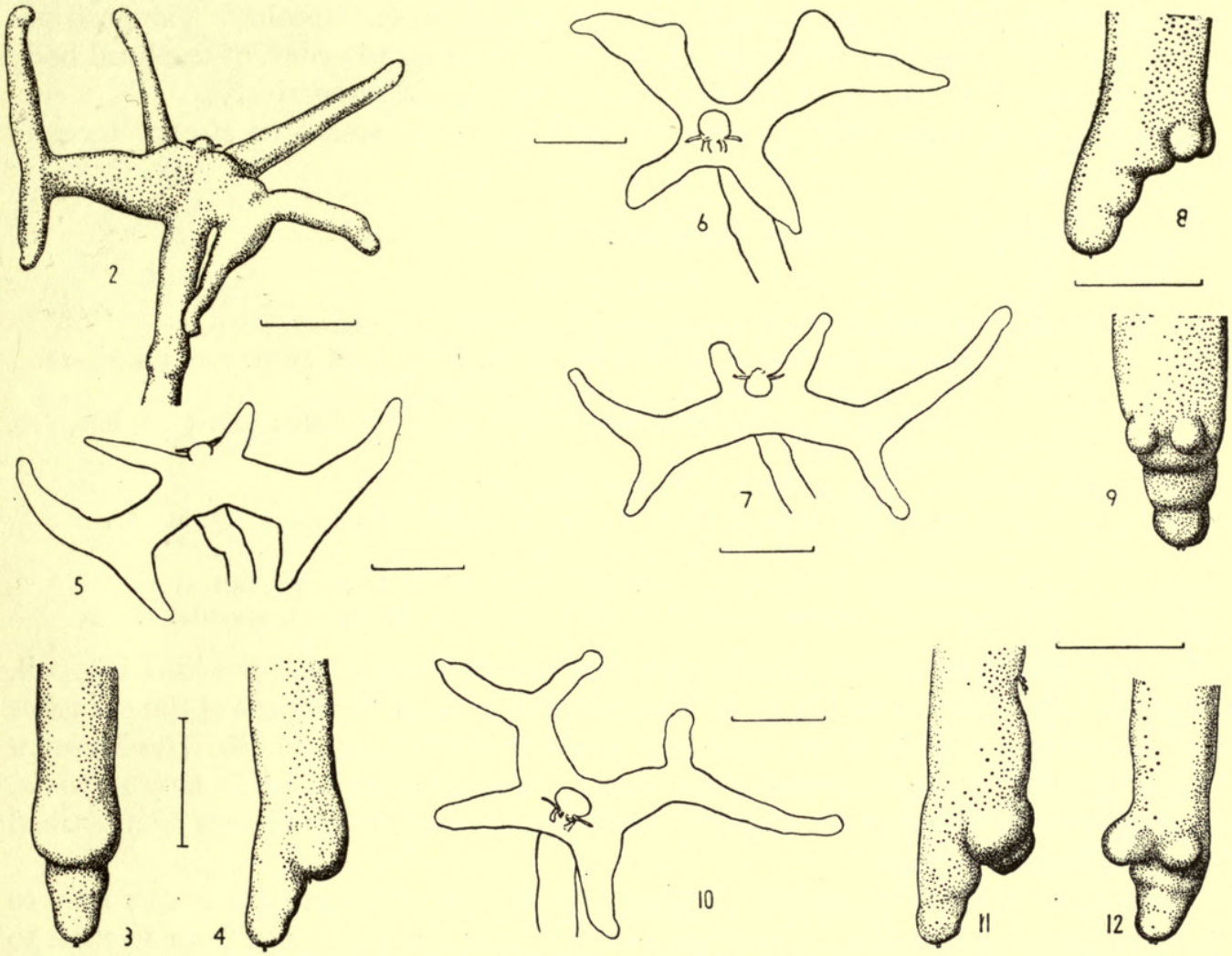
FIGS. 2–12.

1746 *Lernea tentaculis quatuor* Linnaeus, *Fauna Svecica*: 367, pl. 2.
1758 *Lernaea cyprinacea* Linnaeus, *Syst. Nat.*: 655.
1783 ,, ,, : Barbut, *Gen. Vermium*: 67, pl. 7, fig. 3.
1822 *Lerneocera cyprinacea* (Linnaeus) Blainville, *Journ. Phys.* **95**: 377.
1835 *Lernaeocera* ,, : Burmeister, *Nova Acta Leop. Carol.* **17**: 309, pl. 24 A, figs. 1–3.
1850 ,, ,, : Baird, *Brit. Entomost*: 343, pl. 35, fig. 13.
1904 ,, ,, : Hofer, *Handb. Fischkrankheit*, München: 144, fig. 95 and p. 119 [fide Pesta 1934].
1909 ,, ,, : Neresheimer, Brauer: *Süsswasserfauna Deutschl.* **11**: 77, fig. 326.
1913 ,, ,, (part): T. and A. Scott, *Brit. Parasit. Cop.*, Ray Soc. London: 154, pl. 50, figs. 4–5 [not figs. 1–3].
1917 *Lernaea cyprinacea*: Wilson, *Proc. U.S. Nat. Mus.* **53**: 4, 39.
1918 ,, ,, : Wilson, *Bull. U.S. Bur. Fish.* **35**: 193, 196, pl. 15, fig. 86.
1925 ,, (*Lernaeocera*) *elegans*: Leigh-Sharpe, *Parasitology*, **17**: 245, text-figs. 1–5.
1927 ,, *elegans*: Nakai, *J. Fish. Inst. Tokyo*, **23**: 39, pls. 2–4, text-figs. 1–7.
1927 ,, *cyprinacea*: Okada, *Annot. Zool. Jap. Tokyo*, **11**: 185, text-figs. 1–2.
1928 ,, *elegans*: Matsui and Kumada, *J. Fish. Inst. Tokyo*, **23**: 101, pls. 5–7.
1932 ,, *cyprinacea*: Monod. *Ann. Parasit. hum. comp.* **10**: 362, text-figs. 8 H, 11, 12.
1933 ,, ,, : Gurney, *Brit. Fresh-water Cop*, Ray Soc. Lond. **3**: 338 ,text-figs. 1969, 1971–1983.
1933 ,, *carassii* Tidd, *Ohio J. Sci.* **33**: 465, pl., figs. 1–8.
1934 ,, *cyprinacea*: Markewitsch, *Ann. Mus. zool. polon.* **10**: 234, pl. 45, fig. 8.
1934 ,, ,, : Pesta, *Tierwelt Deutschl.* **29**: 42, text-fig. 25.
1937 ,, ,, : Markewitsch, *Cop. Parasit. Binnengewäss. U.S.S.R.*, Kiev: 98, pl. 8.
1937 ,, ,, : Wagler, *Tierwelt Mitteleuropas*, Crust. **2**, 2a: 179, text-fig. 542.
1939 ,, ,, : Yamaguti, *Vol. Jubil. Prof. S. Yoshida* **2**: 475, pl. 30, figs. 156–165.

The material in the British Museum consists of two specimens found by Dr. Gurney on a specimen of *Carassius carassius* (L.) from Sweden in the Museum fish collection; a specimen from Canon Norman's collection which was labelled '*L. esoscina* from Prof. Heller' (this specimen is unfortunately without record of host or locality); thirty or more specimens from Japan presented by Dr. Gurney, and finally a few microscope slides of the type specimens of *L. elegans* presented by Mr. Leigh-Sharpe.

I have little to add to the excellent descriptions and figures given by many of the authors listed above, Gurney (1933) in particular; the shape of the anchor is, however, rather more variable than these descriptions indicate. The most typical arrangement is that of the Swedish specimen (Fig. 2), if the right dorsal arm which is distorted is ignored; the arms are all rather long and slender and the dorsal arms are T-shaped. This is the arrangement shown in nearly all figures of European specimens from Linnaeus, 1746 to Monod, 1932, and Gurney, 1933. Very few of the Japanese specimens are quite like this, there is a tendency for the dorsal arms to be Y-shaped (Figs. 5–7), and the posterior fork of the Y is often reduced. Prof. Heller's specimen (Figs. 10–12) of unknown origin is very like the Japanese specimens . The pregenital

prominence of *L. cyprinacea* is generally described as 'simple or only slightly indented' (Wilson, 1918, p. 193, key). It is simple in the Swedish specimens (Figs. 3 and 4). The Japanese specimens have a distinctly double pregenital prominence (Figs. 8 and 9). Prof. Heller's specimen again agrees with the Japanese specimens



FIGS. 2–12. *Lernaea cyprinacea* Linnaeus

Figs. 2–4, specimen from Sweden; Fig. 2, dorsal view of anchor; Fig. 3, ventral view of pregenital prominence and abdomen; Fig. 4, lateral view of the same; Figs. 5–9, specimens from Japan; Figs. 10–12, specimen from Prof. Heller. The line near each figure is 1 mm. drawn to the same scale.

rather than with the Swedish ones. Markewitsch (1937) also gives a figure of a specimen with a bilobed pregenital prominence, but he does not say from what part of the U.S.S.R. it came. None of the characters of *L. elegans* given by Leigh-Sharpe are valid for distinguishing between the Japanese form and the European. No 'auricular expansions' are now visible on the specimen from which Leigh-Sharpe's Fig. 3 was based; possibly the artist saw some folds of chitin. In this figure are shown what are called 3-segmented uncinate thoracic appendages, but an examination of the specimen shows that these are not appendages at all but are the badly fixed internal tissues which can be seen only by focusing well below the surface of the body, as Monod (1932) has already pointed out. Leigh-Sharpe's types of *L. elegans* are the same form of *L. cyprinacea* as the Japanese specimens I have seen.

I have looked at the appendages of the Swedish and Japanese specimens with some care, but have been unable to find any difference, the setation of the legs is precisely the same in both (Table 1). The positions of the legs on the body of five Japanese specimens were measured; there was considerable variation, particularly of the anterior legs, but the positions of the five pairs of legs do not enable the Japanese and European specimens to be separated from one another. The positions of the five legs were 6–9, 16–20, 42–45, 73–74, and 90–92 per cent. of the total body length distant from the most anterior part of the head, respectively.

There is little doubt that *L. carassii* Tidd is the Japanese or *elegans* form of *L. cyprinacea.*

Lernaea barnimiana (Hartmann)

FIGS. 13–28

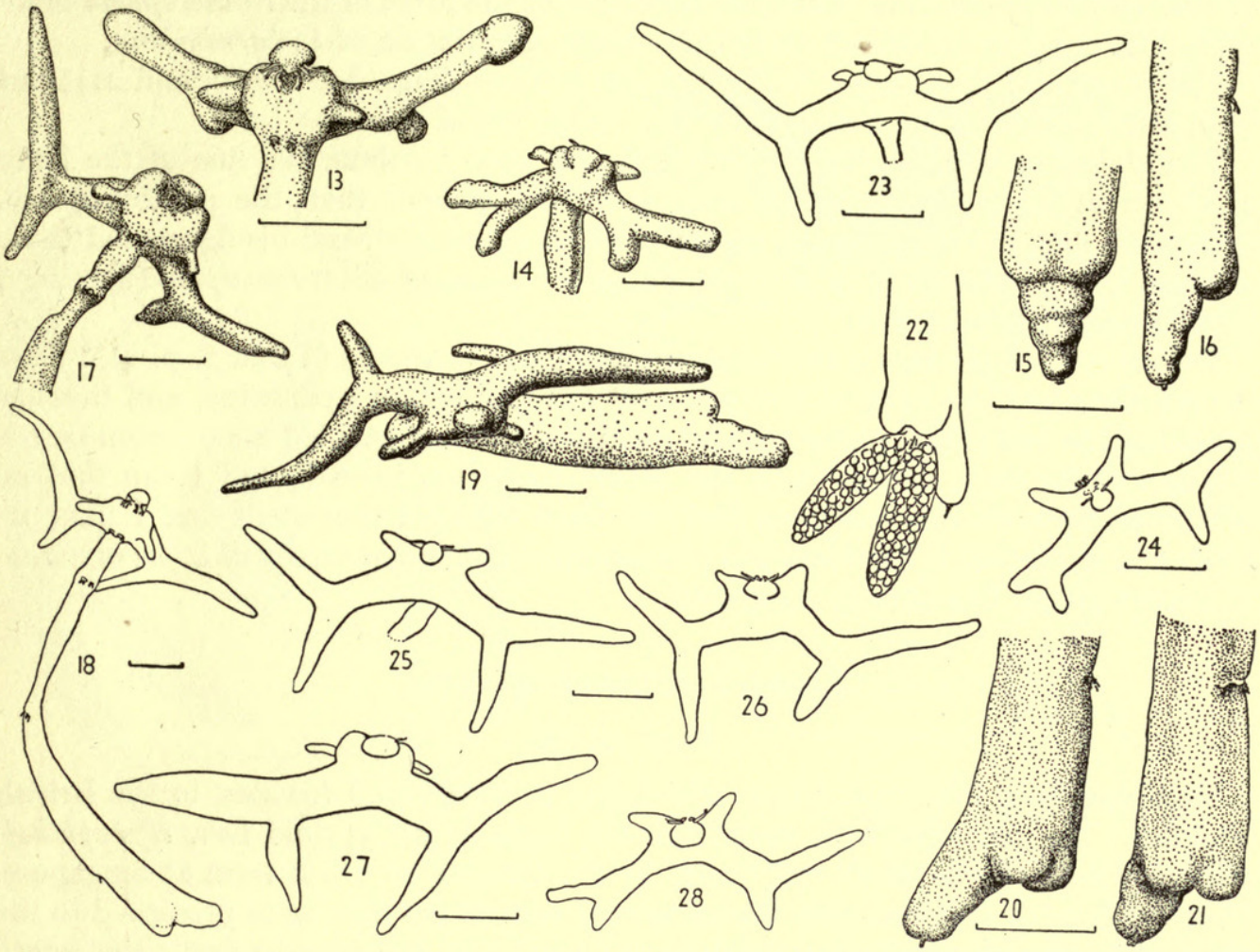
1865 *Lernaeocera barnimiana* Hartmann, *Naturges.-med. Skizze Nillander*: 206.
1870 ,, *barnimii* Hartmann, *Arch. Anat. Phys. Wiss. Med.* **1870**: 726, pls. 17–18.
1871 ,, ,, : Hartmann, *S. B. naturf. Fr. Berl.*: 60.
1914 ,, *temnocephala* Cunnington, *Proc. Zool. Soc. Lond.* **1914**: 827, pl. 1, figs. 8–9, text-fig. 1 c.
1917 *Lernaea barnimii*: Wilson, *Proc. U.S. Nat. Mus.* **53**: 38.
1918 ,, *temnocephala*: Wilson, *Bull. U.S. Bur. Fish.* **35**: 193, 196, pl. 15, fig. 87.
1918 ,, *barnimii*: ibid.: 193, 196, pl. 15, fig. 94.
1940 ,, *temnocephala*: Brian, *Boll. Idrobiol. Caccia Pesca*, **1**: 50, pl., figs. A–F.
1944 ,, *barnimiana*: Capart, *Bull. Mus. Hist. nat. Belg.* **20** (24): 2, text-fig. 1.

Several specimens of this species were taken from a fish, *Labeo forskalii* Rüppell, caught in Lake Edward by Dr. E. B. Worthington in 1931. The heads of the parasites were buried in the flesh of the head and inside the mouth of the fish. The Museum also possesses the single specimen on which Cunnington founded *L. temnocephala.* Thanks to the kindness of Dr. Capart I have seen three of the specimens he described from the Belgian Congo.

The length of the adult female, judging from the literature, ranges from 7 mm. to 12 mm. (Capart's 1944 figs.); Hartmann's 1870 record of a range of from 10 mm. to 14 mm. may include the anterior arms of the anchor in the length. The British Museum specimens range from 8·2 mm. to 10·8 mm. in length.

The positions of the five pairs of legs of seven of the Lake Edward specimens give the following ranges measured in percentages of the total body length: 7·2–9·8, 19–24, 41–51, 73–79, and 89–92 per cent. respectively. The positions of the legs on the specimens kindly lent me by Dr. Capart agree, but two other specimens which he figures (Capart, 1944, fig. 1, A and E) appear to have the first and second legs a little farther forward; this may, however, be owing to the foreshortening which is inevitable when curved specimens are drawn. Hartmann's (1870) drawings are not very reliable and I attach no importance to the fact that the position of the fourth pair of legs in his Fig. 1 is only 65 per cent. of the body length from the anterior. The positions for Cunnington's type of *L. temnocephala* are 8, 18, 44, 79, and 92 per cent. respectively. The variations in the positions of the legs seems to be quite independent of the size of the specimen, i.e. there is no heterogony with respect to this character.

The torsion of the specimens I have seen was variable; that between successive pairs of legs never exceeded 90° and was usually much less. It could be either sinistral or dextral and frequently changed its direction. The total torsion of the whole body was not more than 120° in any of the twelve specimens examined.



FIGS. 13–28. *Lernaea barnimiana* (Hartmann).

Figs. 13–16, Cunnington's specimen from L. Tanganyika, named by him *temnocephala*; Fig. 13, ventral view of anchor; Fig. 14, dorsal view; Fig 15, ventral view of abdomen and pregenital prominence; Fig. 16, lateral view of the same. Figs. 17–28, specimens from L. Edward. Fig. 17, ventral view of anchor; Fig. 18, ventral view of another specimen; Fig. 19, anterior view of the latter; Figs. 20 and 21, posterior end of this specimen; Fig. 22, posterior end of a specimen with egg-sacs; Figs. 23–28, anchors of other specimens from L. Edward, all from the same fish. The line near each figure is 1 mm. drawn to the same scale.

The arms of the anchor are rather variable in shape and arrangement, as Capart (1944) has shown. The most usual arrangement is for the part between the head and the first legs to be swollen and more or less globular. The ventral arms are simple in shape and very short. The usual arrangement is for the ventral arms to be directed outwards; this was so in all the Lake Edward material, in Cunnington's specimen from the Nile, and in most of Capart's material from the Belgian Congo. In some of Capart's specimens and also in the figure accompanying Hartmann's description (Hartmann, 1870, fig. 1), on the other hand, the ventral processes are directed anteriorly. With regard to the bifurcating dorsal arms, Hartmann's figure shows both branches equal to one another and both diverging slightly away from the body; but in his description he says that the anterior branch is the longer of the two and

is the more outwardly directed. The normal condition seems to be for the anterior branch to diverge widely from the body while the posterior branch is directed slightly inwards (Figs. 17, 18, 23, &c.). The angle between the two branches is normally an open and continuous curve; but sometimes as in Figs. 25, 27, 28, &c. there is a more or less distinct angle. The Y-shaped condition of the arms of the *temnocephala* holotype (Fig. 14) is unusual but within the range of variation of *L. barnimiana*.

The pregenital prominence is distinct and bilobed (Figs. 15, 16, 20, and 21); but from some aspects it may appear to be a single broad process.

The abdomen is distinctly 3-segmented and may continue the line of the body or be set at an angle. Each segment is a little smaller than the preceding one. Hartmann does not describe the abdomen of his specimens, and his figure and those of Brian (1940) are of little value in this respect. Cunnington's *temnocephala* specimen (Figs. 15 and 16) is normal.

The setation of the legs is the same as that of *L. cyprinacea* (Table 1, p. 4). I have cleared Cunnington's type of *temnocephala* with potassium hydroxide, and this has got rid of the twists and distortions he mentions and has enabled me to examine the setation of its legs; and as with the other characters investigated I can find no difference between this specimen and the Lake Edward specimens and I have no hesitation in placing *L. temnocephala* (Cunnington) in the synonymy of *L. barnimiana*, as Capart (1944) has already suggested.

Lernaea piscinae sp. nov.

FIGS. 29–34

Holotype, Reg. No. 1949.8.14.1, and many paratypes, all females, in the British Museum. The parasites were found heavily infesting a Cyprinid fish, *Hypophthalmicthys nobilis* (Richardson) cultivated by the Chinese on a fish farm at Singapore. Four fish heavily infested with the parasites, over 50 per fish, were presented to the Museum by Mr. W. Birthwhistle in 1929. Length of holotype 10·4 mm.; the length of 10 paratypes ranged from 9·7 mm. to 12·4 mm. The positions of the five pairs of legs of these eleven specimens were 5–7, 13–14, 31–38, 69–74, and 91–93 per cent. of the total length from the most anterior part of the head. All the specimens of this species were very much alike; seven out of the eleven specimens had a curve between legs 2 and 3 as in Fig. 29. Three of the remainder were straight and the other had an additional bend between legs 1 and 2.

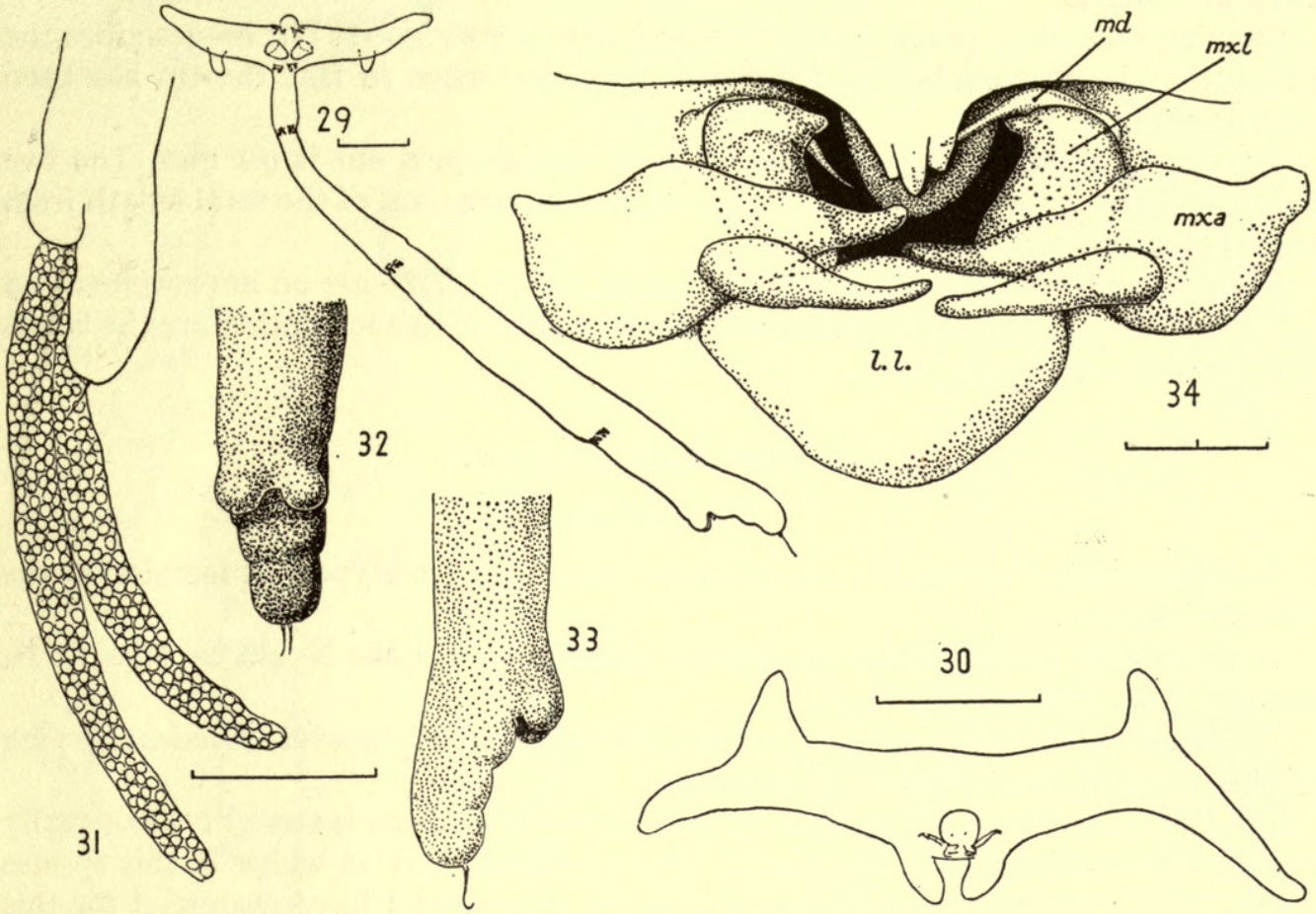
The main part of the anchor forms a bar set at right angles to the body like the cross-bar of a T (Figs. 29 and 30). The middle of the bar is considerably thicker than the part of the body joined to it, and tapers gradually towards the ends, which are also curved slightly in an antero-ventral direction. From about the middle of each half of the cross-bar there is a short dorsal process. There is also a pair of ventral processes between the head and the legs 1; these are separated by a distance about equal to the width of the head and are directed slightly inwards towards one another.

Except for slight swellings at the positions of the legs the body increases in thickness very gradually from before backwards.

The abdomen (Figs. 32–33) makes a slight angle with the body; it is nearly 1 mm.

long and less than ½ mm. wide. Ventrally it is distinctly 3-segmented; but the dorsal profile forms an even, continuous curve.

The pregenital process is double, the two lobes being small but well defined and quite separate from one another.



FIGS. 29–34. *Lernaea piscinae* sp. nov.

Fig. 29, ventral view of holotype; Fig. 30, anterior view of anchor; Fig. 31, lateral view of posterior end of a paratype with egg-sacs; Fig. 32, ventral view of abdomen and pregenital prominences of holotype; Fig. 33, lateral view of the same; Fig. 34, mouth and associated appendages. *l.l.*, lower lip; *md.*, mandible; *mxa.*, maxilla; *mxl.*, maxillule. The line near each figure is 1 mm. drawn to the same scale except that near fig. 34 which is 0·02 mm.

The egg-sacs (Fig. 31) are very long, about 4 mm., three-quarters of their length projecting beyond the tip of the abdomen.

The setation of the legs is the same as in *L. cyprinacea* (Table 1).

The mouth parts (Fig. 34), as far as I was able to make out, are the same as for other species.

Lernaea diceracephala (Cunnington)

FIGS. 35–39

1914 *Lernaeocera diceracephala* Cunnington, *Proc. Zool. Soc. Lond.* **1914:** 824, pl. 1, figs. 1–3, text-fig. 1 A.
1917 *Lernaea diceracephala*: Wilson, *Proc. U.S. Nat. Mus.* **53:** 38.
1918 ,, ,, : Wilson, *Bull. U.S. Bur. Fish.* **35:** 192, 194, pl. 15, fig. 90.
1944 ,, ,, : Capart, *Bull. Mus. Hist. nat. Belg.* **20** (24): 7.

Holotype, Reg. No. 1914.12.2.1, and one paratype in the British Museum; I have

selected the more perfect of the two specimens as the holotype. These are the only specimens known and were taken from the gill arches of a large *Clarias mossambicus* Peters, caught at Sumbu, Lake Tanganyika, by Dr. Cunnington in 1904. Capart (1944) includes the species in his paper because part of Lake Tanganyika lies in the Belgian Congo.

Cunnington's description of the two specimens is very good; but he describes the left arm as being complete in the better specimen when in fact the tip has been broken off.

The length of the holotype measured as if straightened out is 9·1 mm. The five pairs of legs come in positions 10, 23, 50, 71, and 92 per cent. of the total length from the most anterior part of the head.

I have made drawings of the two specimens which I hope are an improvement on Cunnington's photographs, and which show how similar to one another are the bends and constrictions in the body.

Lernaea bagri sp. nov.

FIGS. 40–43

Holotype, Reg. No. 1949.8.14.9, and over two dozen paratypes, all females, in the British Museum.

The copepods were taken from *Bagrus meridionalis* in Lake Nyasa by Miss R. H. Low, 14 Aug. and 22 Sept. 1946.

The length of the holotype is 12·1 mm.; that of twenty-four adult females carrying egg-sacs ranged from 9·9 mm. to 14·2 mm.

The body of a few of the slender, young-looking specimens is straight, but usually it is curved as shown (Fig. 40), and in these there is a torsion which in this species nearly always changes its direction. In all the specimens I have examined for this purpose the torsion is first sinistral and then dextral. In the holotype, for example, the torsion between legs 1 and 2 is 40° sinistral, between legs 2 and 3 it is 80° dextral, and between legs 3 and 4 it is a further 50° dextral, after which there is no further torsion. The resultant torsion between the head and the abdomen is about 90° dextral.

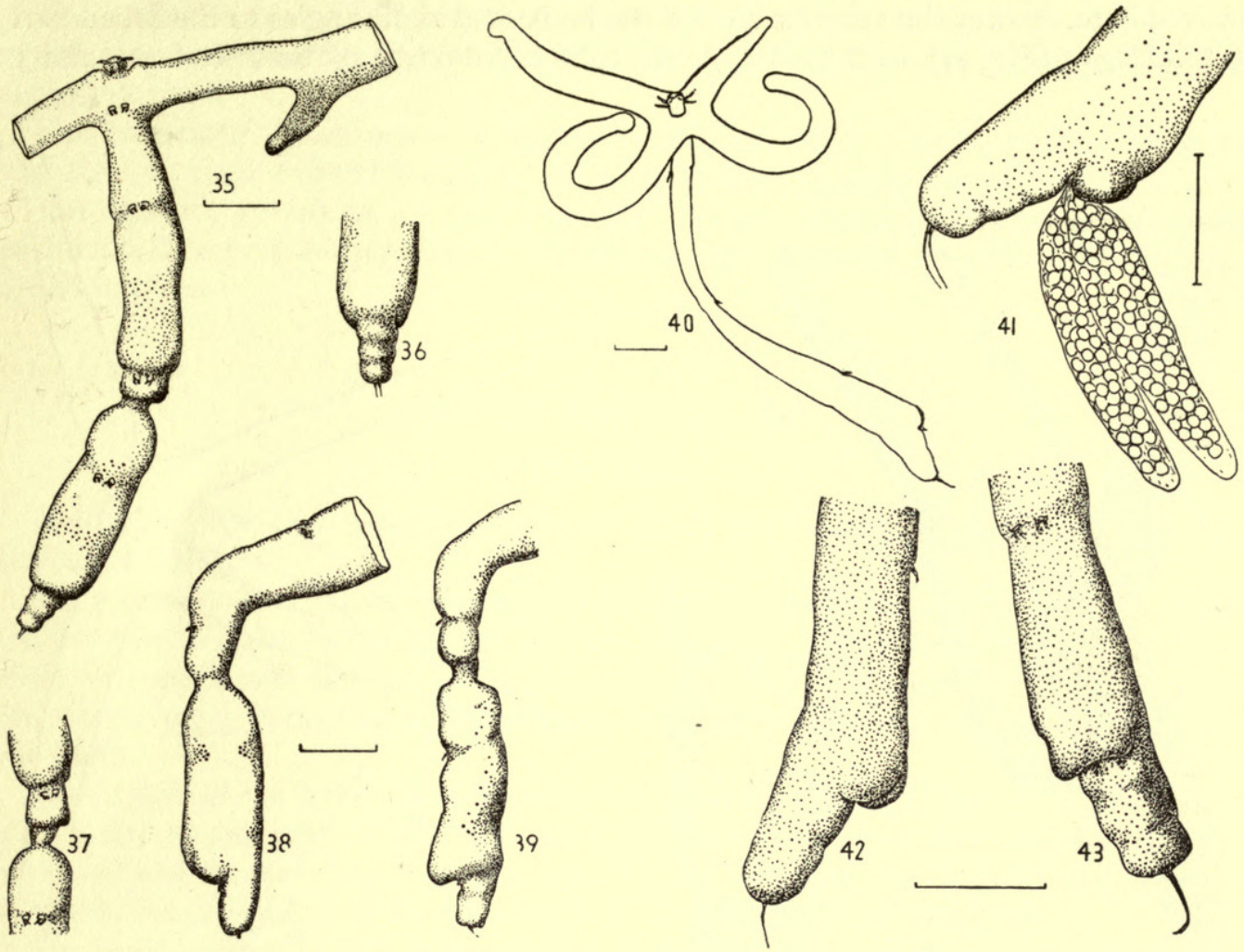
The arms of the anchor are heavily chitinized, in contrast to those of the next species to be described, *L. tilapiae*, and lie in a plane approximately at right angles to the body. The head is placed centrally over the cross formed by the four arms. The ventral arms are straight and the dorsal ones are curved towards them. There is a tendency for each arm to end with a rounded knob.

The positions of the legs are rather variable in this species. Six specimens were examined, and the positions of legs 1 to 5 gave the following ranges respectively: 7–10, 18–22, 42–52, 73–78, and 90–93 per cent. The setation of the legs is the same as that of *L. cyprinacea* (Table 1).

The abdomen (Figs. 41–3) is set at a slight angle to the line of the body; it is straight and slightly tapering; the three segments are very indistinctly separated.

The pregenital prominence is bilobed. Sometimes the lobes are prominent and bulge laterally beyond the greatest width of the body, but usually, as in the holotype, they are not very prominent from the ventral aspect (Fig. 43).

The egg-sacs (Fig. 41) are about $2\frac{1}{2}$ mm. long and $\frac{1}{2}$ mm. wide at their greatest width, which lies at about the proximal third of the length.



FIGS. 35–39. *Lernaea diceracephala* (Cunnington).

Fig. 35, ventral view of holotype; Fig. 36, dorsal view of abdomen; Fig. 37, constriction between legs 3 and 4 from a slightly different aspect from that of Fig. 35; Fig. 38, lateral view of paratype; Fig. 39, similar view of part of holotype.

FIGS. 40–43. *Lernaea bagri*, sp. nov.

Fig. 40, dorsal view of holotype; Fig. 41, lateral view of abdomen and egg-sacs of a paratype; Fig. 42, lateral view of abdomen and pregenital prominences; Fig. 43, ventral view of the same. The line near each figure is 1 mm. drawn to the same scale.

Lernaea tilapiae sp. nov.

FIGS. 44–46

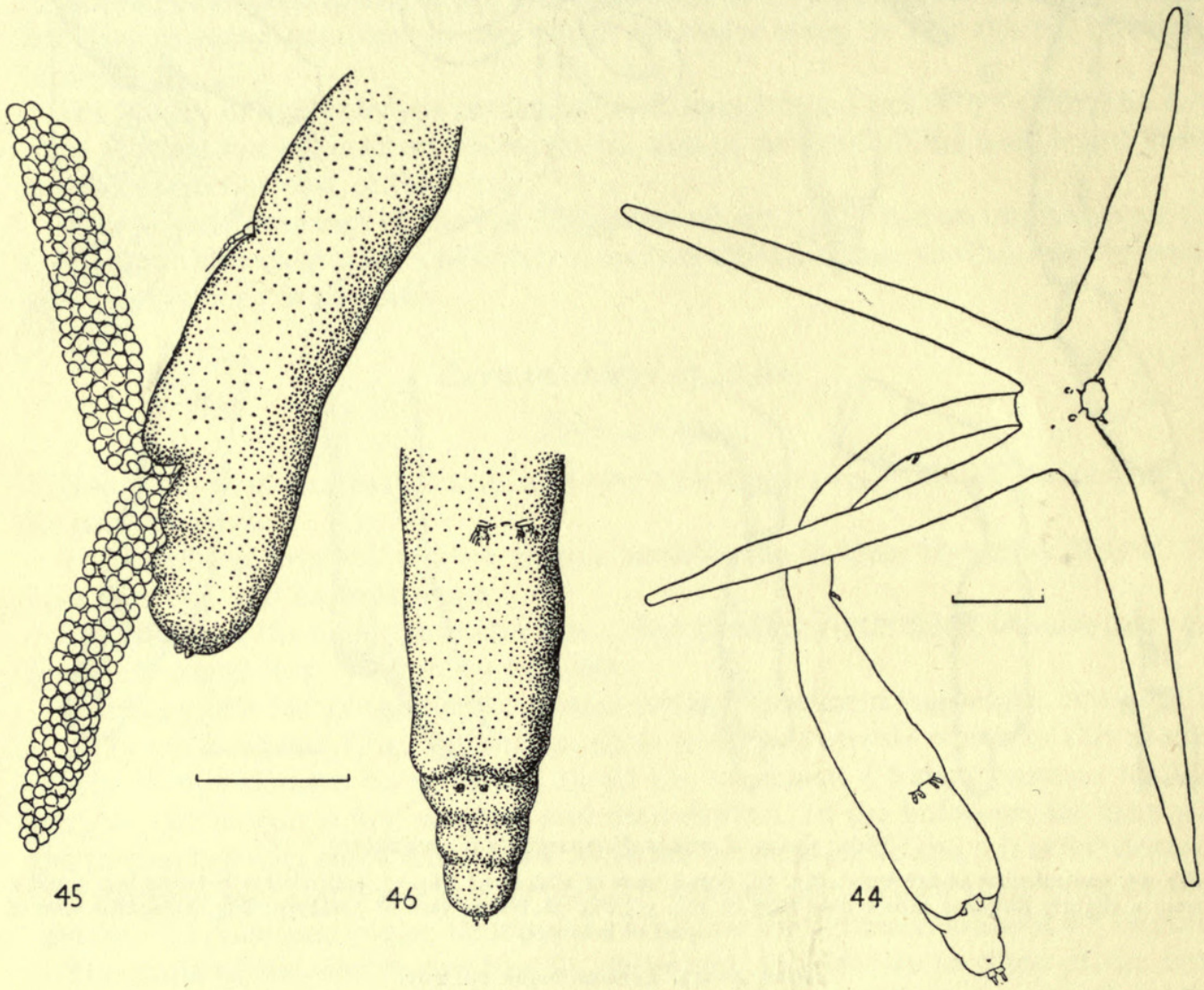
Holotype, Reg. No. 1949.8.14.17, and a few paratypes, all females, in the British Museum.

The parasites were collected by Miss R. H. Low from Lake Nyasa and were taken from the mouth and gills of *Tilapia squamipinnis* Günther and *T. lidole* Trewavas caught in Lake Nyasa 22 Nov. 1946.

The length of the holotype measured from the front of the head to the tip of the

abdomen is 9·2 mm. Five other females bearing egg-sacs ranged from 7·5 mm. to 11 mm. in length.

The body is comparatively slender from the head to as far as legs 3 and is usually curved here, so that the anterior part of the body is at right angles to the broad part behind legs 3 (Fig. 44). In the holotype the torsion is dextral 45° between legs 2 and 3,



FIGS. 44–46. *Lernaea tilapiae* sp. nov.

Fig. 44, dorsal view of holotype; Fig. 45, lateral view of abdomen, pregenital prominence, and egg-sacs; Fig. 46, ventral view of the same without egg-sacs. The line near each figure is 1 mm. drawn to the same scale.

dextral 90° between legs 3 and 4, and dextral a few degrees beyond legs 4, the total torsion being dextral through about 140°. The only torsion in one of the paratypes is a sinistral one of 45° between legs 3 and 4.

The anchor bears four long straight slender arms as figured (Fig. 44); these lie in a plane nearly parallel to that of the body; the posterior pair are directed backwards and are only slightly divergent; the anterior pair diverge widely, with the head placed in the angle between them. The four arms of the anchor are about equal in length to one another and more than half the length of the body. They are only lightly chitinized and are much softer than those of the last species described, *L. bagri*.

The legs come in positions 8, 25, 50, 77, and 90 per cent. of the body length from the anterior end. The setation of legs 1 to 4 is the same as for *L. cyprinacea* (Table 1, p. 4).

The abdomen is divided into three segments by transverse ventral constrictions which give it a characteristic profile (Fig. 45). The dorsal profile of the abdomen is slightly arched.

The pregenital prominence is bilobed; the two lobes overhang the abdomen slightly, but their ventral surface is in line with that of the body in front (Fig. 45).

The egg-sacs are about 2·5 mm. long and 0·5 mm. wide, slightly tapering towards each end. Miss Low records that in life the parasite is brown in colour and the eggs are jade-green.

Lernaea barilii sp. nov.

FIGS. 47–60

Holotype, Reg. No. 1949.8.14.21, and about 10 paratypes, all females, in the British Museum.

The parasites were taken on a large specimen (500 mm. long) of *Barilius microlepis* Günther from Lake Nyasa by Dr. Christy in 1925, a piece of the flank of the fish with the copepods embedded being preserved together with a note to the effect that there were more parasites on the tongue, &c. I have only seen the specimens from the flank.

The length of the holotype is 8·3 mm. with the positions of legs 1 to 5 at 8·4, 20, 47, 77, and 92 per cent. of the total body length from the anterior end respectively. The positions on paratype Reg. No. 1949.8.14.24 are 8, 19, 47, 77, and 93 per cent. The setation of the legs is the same as in *L. cyprinacea* (Table 1, p. 4).

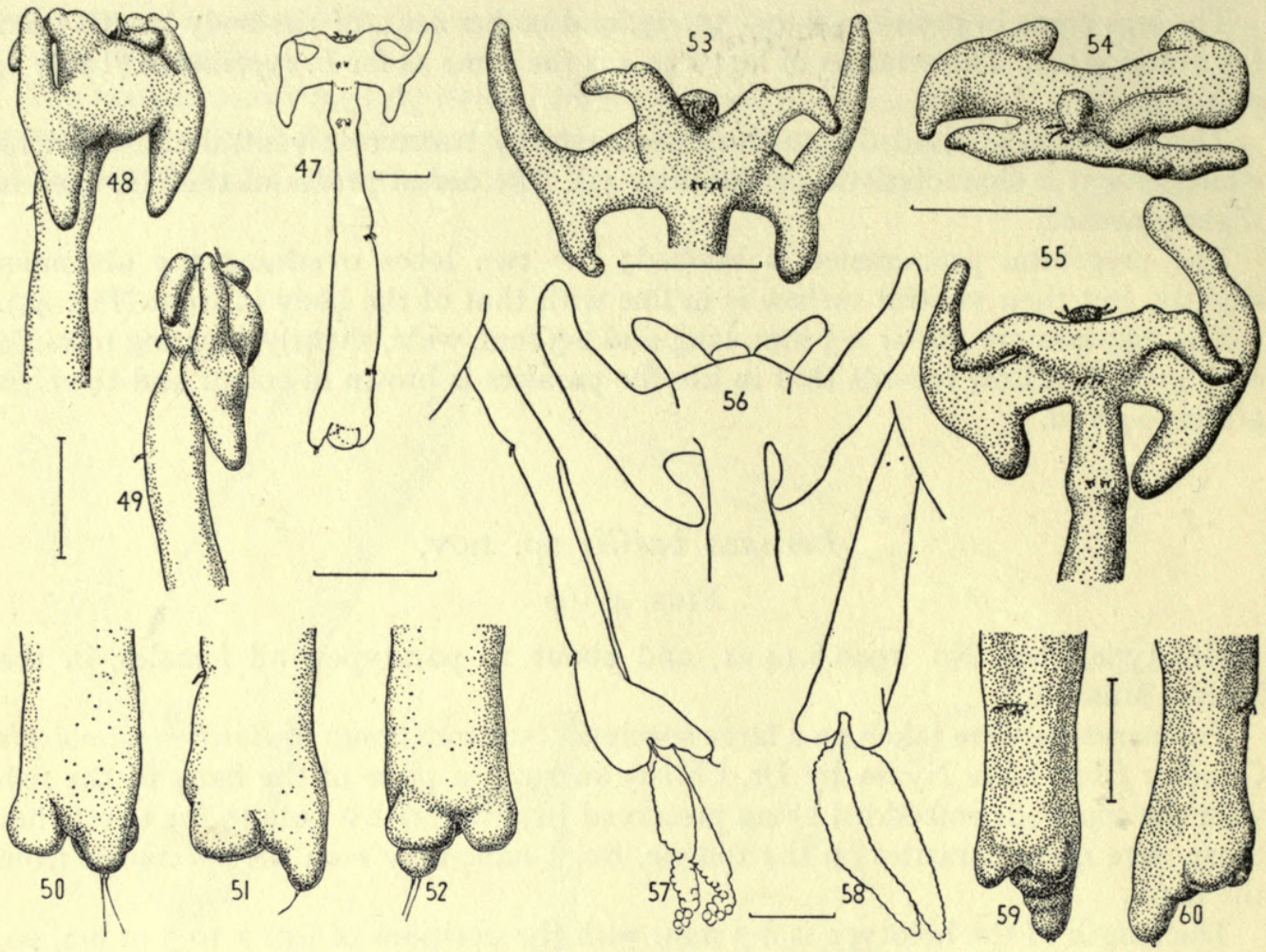
The body is straight and short, widest at the posterior end. In the two specimens which were examined in detail the torsion was about 80°. In the holotype most of the torsion was between legs 2 and 3, and in the paratype examined it was between legs 3 and 4; it was sinistral in the holotype and dextral in the paratype.

The arrangement of the anchor is best understood with reference to Figs. 47–49 and 53–55. There are a pair of lateral T-shaped arms with the cross-bar of the T running more or less parallel to the body; the basal part of these arms is short and thick. Anterior and ventral to the dorsal arms are a pair of simple arms directed outwards, with in nearly all cases a small knob facing anteriorly.

The pregenital prominences are very large and distinctly separated from one another; they reach almost to the end of the abdomen in some specimens (Figs. 40, 50–52, 57–60).

The abdomen, particularly the part composed of the last two segments, is very small and set at an angle to the body. All three segments are clearly marked off from one another ventrally; the first is very much broader than the other two (Figs. 51 and 60).

The egg-sacs of the holotype were about 2.75 mm. long, broadest in the middle and tapering towards each end (Fig. 58).



FIGS. 47–60. *Lernaea barilii* sp. nov.

Fig. 47, ventral view of holotype; Fig. 48, dorso-lateral view of anchor; Fig. 49, lateral view of the same; Fig. 50, dorsal view of posterior end of holotype; Fig. 51, lateral view of the same; Fig. 52, ventral view of the same; Fig. 53, ventral view of anchor of a paratype; Fig. 54, anterior view of another paratype; Fig. 55, ventral view of the same; Fig. 56, anchor of a specimen drawn *in situ* by clearing in benzyl alcohol; Fig. 57, lateral view of specimen with egg-sacs before removing from the fish (the specimen has shrunk and collapsed dorsally); Fig. 58, ventral view of holotype with egg-sacs before treatment with hydroxide; Fig. 59, ventral view of the posterior end of a paratype; Fig. 60, lateral view of the same. The line near each figure is 1 mm. drawn to the same scale.

Lernaea palati sp. nov.

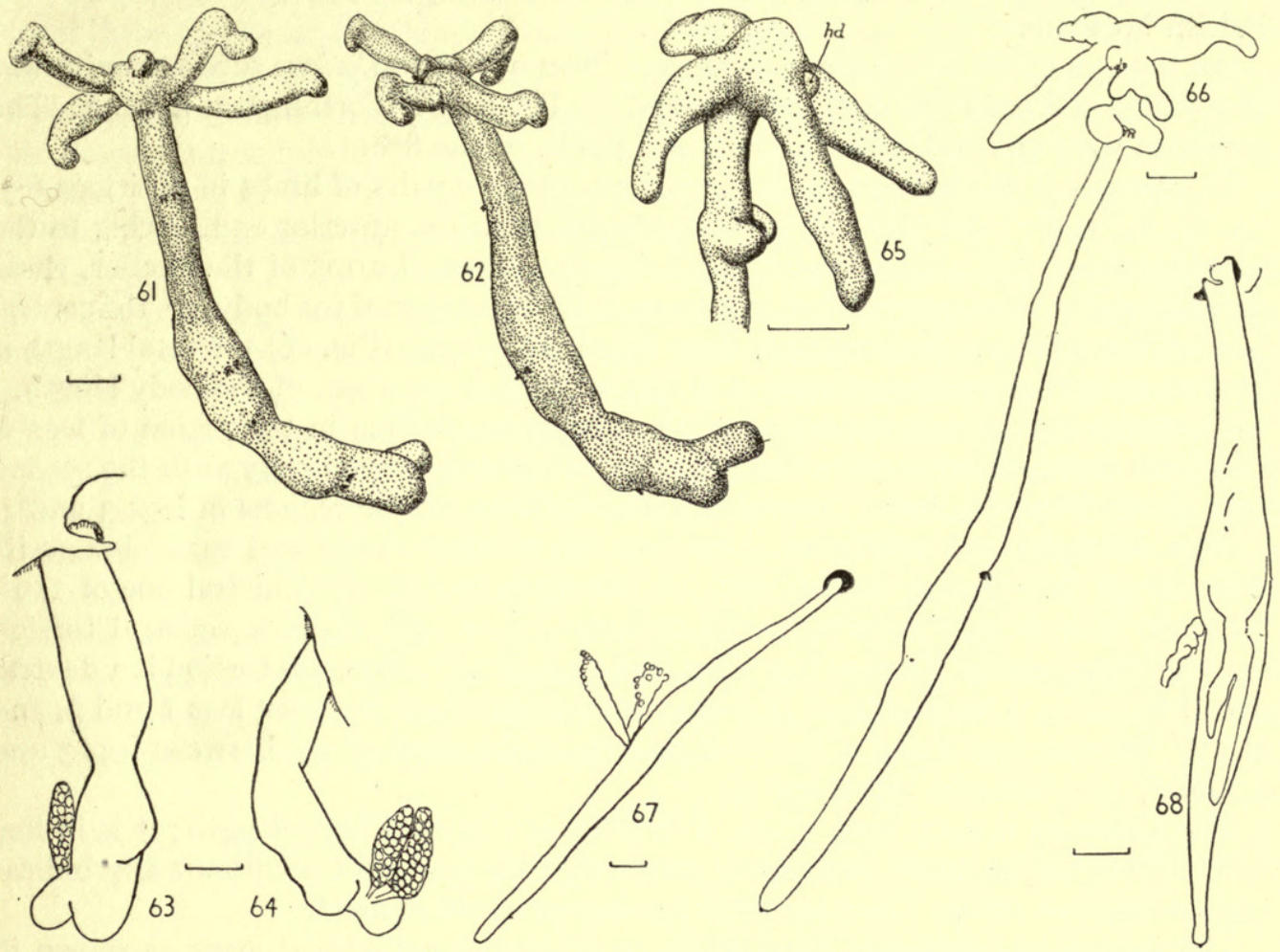
FIGS. 61–64

Holotype, Reg. No. 1949.8.14.26 in the British Museum. The single specimen on which this species is based was from the roof of the mouth of a fish, *Haplochromis chrysonotus* (Boulenger) from Vua on Lake Nyasa, collected by Dr. Christy in 1925. The hind end of the parasite projected through a gill slit and was visible externally.

The length of the specimen, allowance being made for bends, is 12·7 mm. The body from the first pair of legs to half-way between legs 2 and 3 is cylindrical, about 0·7 mm. thick; the section containing legs 3 is broader, about 1·2 mm. across; there is a waist between legs 3 and 4; the body bends backwards and to the left here and bulges again to a thickness of 1·2 mm. in front of legs 4.

The abdomen is tilted dorsally at an angle of about 45°; it is a simple cylinder rounded at the end about 1 mm. long and 0·7 mm. broad without any sign of segmentation.

The five pairs of legs are placed in positions 8·7, 26, 55, 80, and 93 per cent. of the body length from the anterior end. The setation is the same as that of *L. cyprinacea* (Table 1, p. 4). There is little torsion.



FIGS. 61–64. *Lernaea palati* sp. nov.

Fig. 61, ventral view of holotype; Fig. 62, lateral view; Fig. 63, holotype embedded in roof of mouth of fish; Fig. 64, another view of the same showing egg-sacs.

FIGS. 65–68. *Lernaea longa*, sp. nov.

Fig. 65, lateral view of holotype showing anchor and swelling by legs 2. *hd*, head; Fig. 66. A paratype with the left ventral arm of the anchor distorted; Figs. 67 and 68, the externally visible parts of two other specimens embedded in the fish. The line near each figure is 1 mm. drawn to the same scale.

The anchoring arms (Figs. 61 and 62) are four in number, of medium length and uniform thickness, each with a bend or a kink near the end. The ventral pair is directed slightly forwards and the dorsal pair backwards to the same extent.

The head is not in line with the body, but inclined towards the angle between the ventral arms of the anchor.

The egg-sacs are comparatively short and broad, being about 1·5 mm. long and 0·5 mm. broad (Figs. 63 and 64).

Lernaea longa sp. nov.

FIGS. 65–68

Holotype, Reg. No. 1949.8.14.27, and half a dozen paratypes, all females, in the British Museum.

All the specimens were from a single specimen of *Lates niloticus* subsp. *longispinus* Worthington from Lake Rudolf, collected by Dr. E. B. Worthington in 1931. The parasites were embedded in the head and flanks of the fish.

The length of the holotype is 19 mm., with the five pairs of limbs in positions 6·3, 14, 36, 64, and 77 per cent. of the body length from the anterior end. Owing to the fact that the head is held ventrally between the ventral arms of the anchor, these measurements have been made from the most anterior part of the body, i.e. the central boss of the anchor. In paratype, Reg. No. 1949.8.14.29 (Fig. 66) the total length is 22 mm. with the legs in positions 5, 11, 32, 59, and 71 per cent. of the body length.

The body is long and slender with a conspicuous swelling in the region of legs 2, and from this swelling a pair of rounded processes project ventrally with the second pair of legs between them. There are slight swellings in the regions of legs 3 and 4.

Two examples will suffice to show how the torsion varies and may change its direction in this species. In the holotype the total torsion is a sinistral one of 110°, made up of a dextral torsion of 10° between legs 2 and 3 and a sinistral torsion between legs 3 and 4. In paratype Reg. No. 1949.8.14.29 the total torsion is a dextral one of 20°; this is the resultant of a sinistral torsion of 45° between legs 1 and 2, and of 135° between legs 2 and 3, followed by a dextral torsion of 90° between legs 3 and 4, and of 110° between legs 4 and 5.

The abdomen is very long, about a quarter of the total body length; it is in line with the rest of the body and tapers gradually to a rounded tip without any indications of segmentation. The pregenital prominence is ill defined.

The anchor has normally four simple more or less cylindrical arms as shown in Fig. 65. One of the ventral arms of specimen Reg. No. 1949.8.14.29 is branched, but this is evidently an abnormality probably caused by its meeting an obstruction during its growth into the flesh of the fish (Fig. 66). The ventral arms are about 5 times as long as they are broad and are directed backwards at an angle of about 45° to the body. The dorsal arms are a little shorter and are directed more nearly at right angles to the body.

The head is placed on the ventral side of the anchor in the fork between the ventral pair of arms.

None of the specimens had complete egg-sacs; the most complete was 3 mm. long, with a maximum width of 0·6 mm.

Lernaea haplocephala (Cunnington)

1914 *Lernaeocera haplocephala* Cunnington, *Proc. Zool. Soc. Lond.* **1914:** 826, pl. 1, figs. 4–7, text-fig. 1 B.

1917 *Lernaea haplocephala*: Wilson, *Proc. U.S. Nat. Mus.* **53:** 38.

1918 ,, ,, : Wilson, *Bull. U.S. Bur. Fish.* **35:** 193, 195, pl. 15, fig. 92.

1920 ,, ,, : Wilson, *Bull. Amer. Mus. Nat. Hist.* **43** (1): 5, pl. 3, figs. 20–22.

1923 *Lernaeocera bichiri* Kurtz, *S. B. Akad. Wiss. Wien.* **131**, Abt. 1: 332, pl. 2, figs. 1–11.
1927 *Lernaea haplocephala*: Brian, *Faune Colon. Fr.* **1**: 581, figs. 26–34.
1944 ,, ,, : Capart, *Bull. Mus. Hist. nat. Belg.* **20** (24): 7.

The British Museum possesses the twenty-seven specimens listed by Cunnington, from three species of *Polypterus* from Lake Tanganyika and the White Nile. I select as holotype the single specimen, Reg. No. 1914.12.2.3, taken from *Polypterus congicus* Boulenger collected from Lake Tanganyika by Cunnington himself and on which his description is largely based. *L. haplocephala* is probably the best known of the African species of *Lernaea* and has been found on several species of *Polypterus* in the White Nile, Belgian Congo, and Cameroons.

The species is easily recognized by the shape of the anchor and by the peculiar swelling in the region of legs 2; and it is unfortunate that Wilson (1920), in his eagerness to find characters in the appendages, should have added as a distinguishing character 'the small spherical terminal joint of the maxillipedes, with its four curved claws'. I have examined the maxillipedes of the holotype and of some of the paratypes and can find no distinguishing feature in them; they have five claws like every other species I have looked at. Wilson may have had a specimen with only four claws Brian describes and figures only three, but they are not easy to see and are difficult to count. There is, however, a character in which the appendages of *L. haplocephala* differ from those of all other species of *Lernaea* that I have been able to examine: there are only four setae on the terminal joints of the exopods of the first four pairs of legs (Table 2); other species have five setae here. The setation of these legs has been correctly figured by Kurtz and by Brian.

TABLE 2

Arrangement of the setae and spines on the legs of *Lernaea haplocephala*

		Leg 1	*Leg 2*	*Leg 3*	*Leg 4*
Exopod	spines	1.1.2	1.1.3	1.1.3	1.1.3
	setae	1.1.**4**	1.1.**4**	1.1.**4**	1.1.**4**
Endopod	spines	0.0.2	0.0.2	0.0.2	0.0.2
	setae	1.1.4	1.2.4	1.2.4	1.2.3

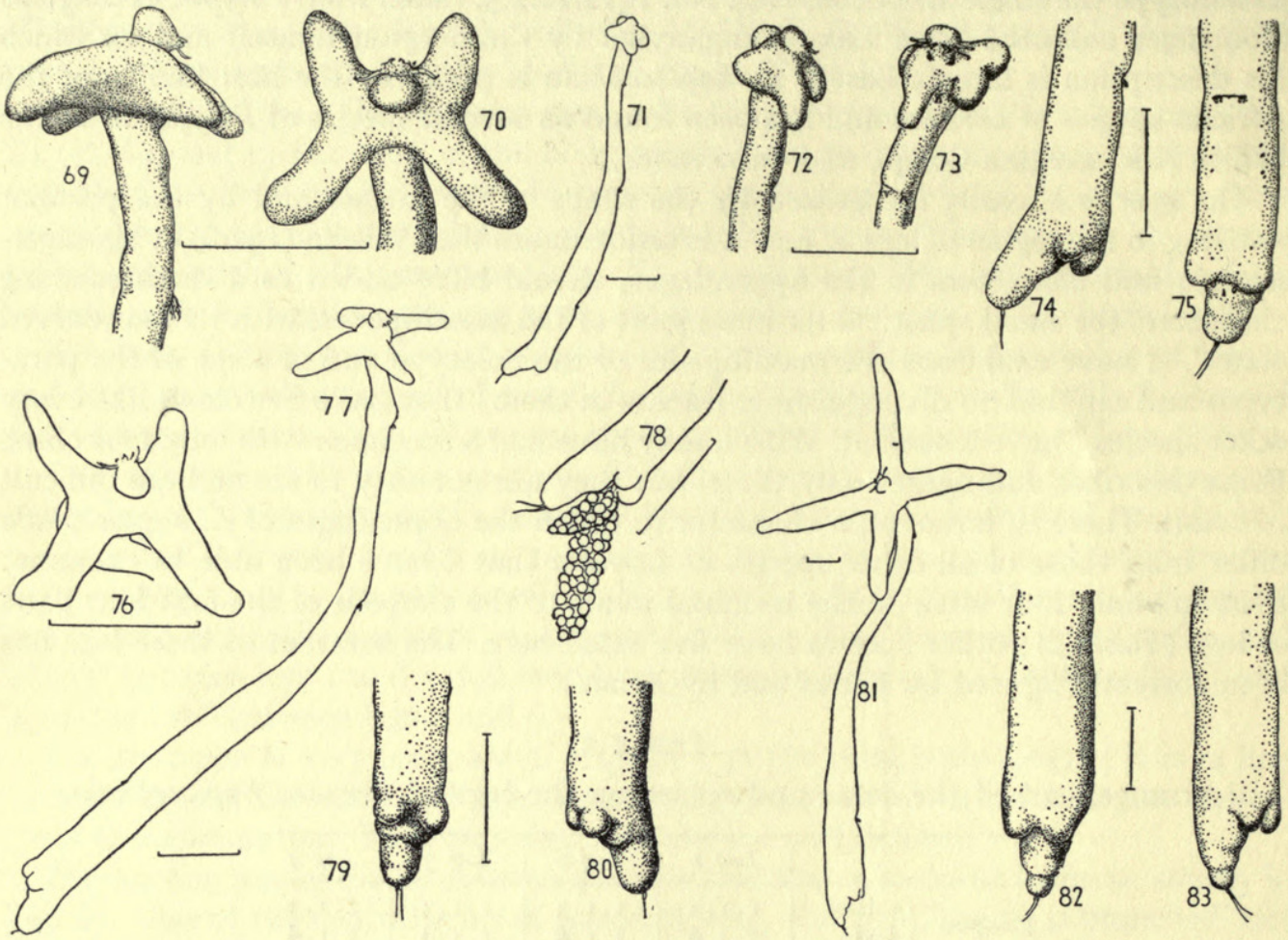
Lernaea lophiara sp. nov.

FIGS. 69–80

Holotype, Reg. No. 1949.8.14.34, and several paratypes, all females, in the British Museum. The holotype was from the dorsal fin of *Lethrinops lethrinus* (Günther) from Lake Nyasa. The paratypes included very similar specimens from the dorsal fins of the following species of fish, all from Lake Nyasa: *Haplochromis prostoma* Trewavas, *H.* sp. cf. *micrentodon* Regan, *Rhamphochromis lucius* Ahl, *Pseudotropheus tropheops* Regan, *Diplotaxodon argenteus* Trewavas, and also buried in the edge of the operculum of *Lethrinops praeorbitalis* Regan. Other paratypes which differ from the holotype only in having very short arms to the anchor were found in the dorsal fins of *Haplochromis breviceps* Regan and *Tilapia melanopleura* Dumeril. Specimens which I have left *in situ* and not examined but are presumably the same species were found in

the dorsal fins of *Haplochromis argyrosoma* Regan, *H. incola* Trewavas, *H. johnstoni* (Günther), and *H. nigritaeniatus* Trewavas.

The length of the holotype is 9·6 mm. with the legs in positions 6, 16, 42, 76, and 93 per cent. of the body length from the anterior end. The body is curved between legs 2 and 3, so that the axis of the anterior end of the body is approximately at



FIGS. 69–80. *Lernaea lophiara* sp. nov.

Fig. 69, lateral view of head and anchor of holotype from dorsal fin of *Lethrinops*; Fig. 70, anterior view of the same; Fig. 71, paratype Reg No. 1949.8.14.35 from dorsal fin of *Haplochromis*; Fig. 72, lateral view of anchor; Fig. 73, ventral view of the same; Fig. 74, lateral view of abdomen and pregenital prominences of the same paratype; Fig. 75, ventral view of the same; Fig. 76, anterior view of anchor of paratype Reg. No. 1949.8.14.45 from operculum of *Lethrinops*; Fig. 77, general view of this paratype; Fig. 78, posterior end with egg-sacs of paratype Reg. No. 1949.8.14.46 from operculum of *Lethrinops*; Fig. 79, ventral view of abdomen and pregenital prominences of paratype Reg. No. 1949.8.14.45; Fig. 80, lateral view of the same.

FIGS. 81–83. *Lernaea* cf. *lophiara*

Fig. 81, specimen from operculum of *Rhamphochromis* Reg. No. 1949.8.14.47; Fig. 82, ventral view of abdomen and pregenital prominences of this specimen; Fig. 83, lateral view of the same. The line near each figure is 1 mm. drawn to the same scale.

right angles to the posterior end. The total torsion of the holotype is a dextral one of about 145°; this is made up of a dextral torsion between legs 2 and 3 of 85° and a further dextral torsion of 60° between legs 3 and 4.

The lengths of seven paratypes range from 6·7 mm. to 9·8 mm., the positions of the five pairs of legs ranging from 5–6·5, 17–18, 42–47, 73–79, and 93–94 per cent. of the body length from the anterior end respectively. Only in two specimens, one of

them the holotype, is the torsion of the body more than 90°. There is nearly always some torsion, however, and also a curvature in the region of legs 2 and 3.

The anchor has four simple arms. In most of the specimens (Figs. 69, 70, 76, 77), including the holotype from the dorsal fin of *Lethrinops praeorbitalis* and paratype Reg. No. 1949.8.14.45 from the operculum of the same fish, the dorsal arms are a little longer than the ventral ones and tend to splay outwards towards the ends. In two other specimens (Figs. 71–73) from dorsal fins, one from *Haplochromis breviceps*, the other from *Tilapia melanopleura*, the arms of the anchor are very short.

The pregenital prominence is double in all specimens except one which is the smallest examined and measures 6·7 mm. in length.

The setation of the legs is the same as that of *L. cyprinacea* (Table 1, p. 4).

The egg-sacs are spindle-shaped and two or three times as long as the abdomen.

Lernaea sp. cf. *lophiara*

FIGS. 81–83

A fish of the species *Rhamphochromis lucius* Ahl bore three parasites: one on the fin is a typical example of *Lernaea lophiara*, the other two, one on the flank and the other on the operculum, are considerably larger than normal for that species and have very much larger arms to the anchor. The shape of the abdomen is also rather different. It may be found that these two specimens belong to a new species, but the comparatively well-developed condition of the arms of the anchor might be due to there being more space for them to grow in the body of the fish than there is in the fin. Against this, however, is the fact that the specimens of *L. lophiara* from the operculum of *Lethrinops praeorbitalis* do not differ in the size of the anchor or in other respects from specimens from the fins.

The lengths of the two specimens from the flank and operculum are 14·4 mm. and 13·7 mm. respectively. The anchor of the shorter specimen is damaged, that of the larger is shown in Fig. 81. The last segment of the abdomen is very small in these two specimens, the abdomen as a result being much more conical in shape than is typical for *L. lophiara* (Figs. 82–83). The positions of the five pairs of legs of the larger specimen are 5, 17, 46, 73, and 94 per cent. of the body length from the anterior end respectively. The setation of the legs is the same as that of the other specimens.

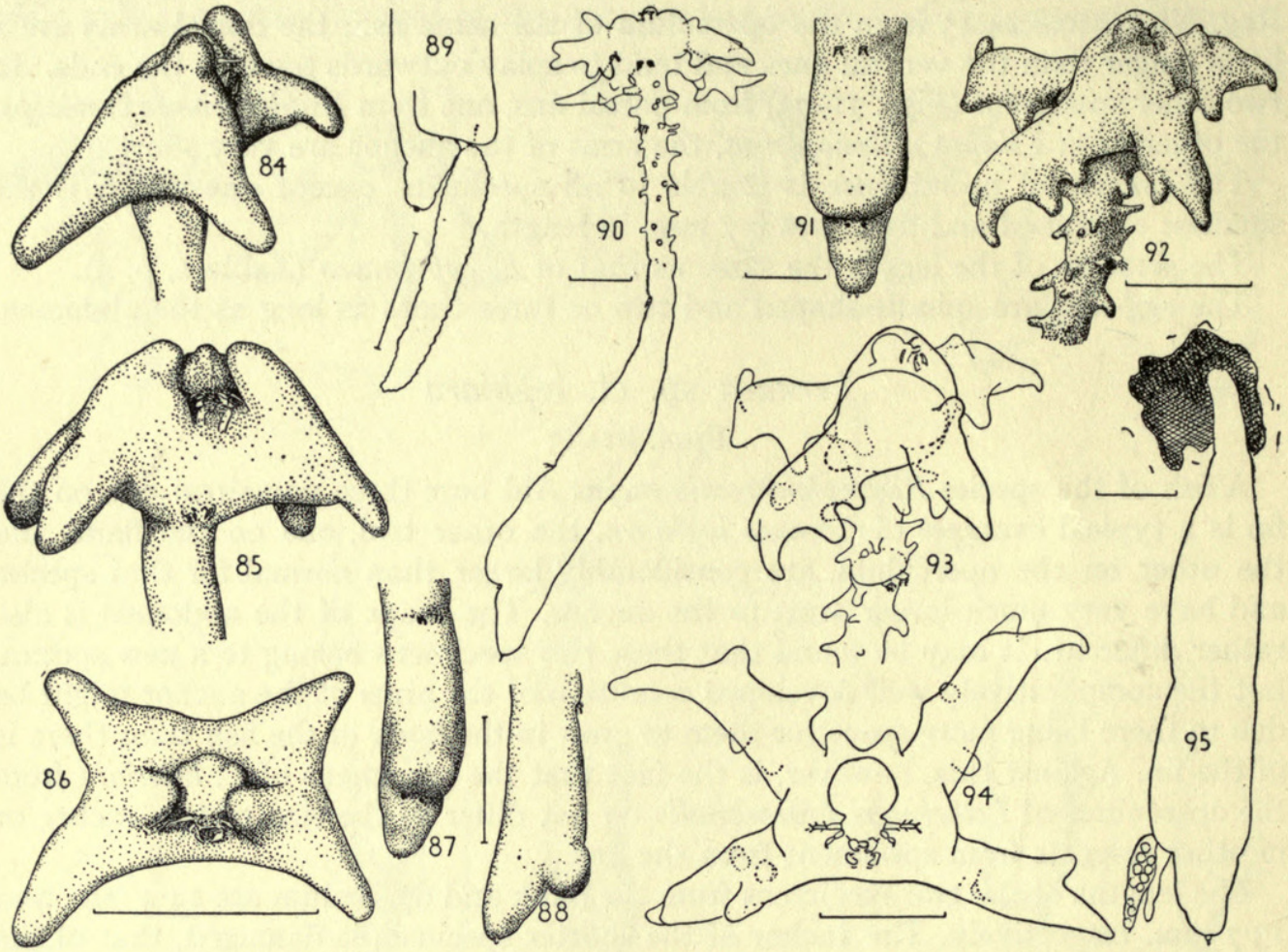
Lernaea bistricornis sp. nov.

FIGS. 84–88

Holotype Reg. No. 1949.8.14.49 in the British Museum. This species has to be described from a single specimen found at the base of a pelvic fin of *Cardio-pharynx schoutedeni* Poll from Lake Tanganyika.

The length of the holotype is 8·7 mm. The body is curved evenly into a semicircle, and there is a sinistral torsion of about 90°. The positions of the five pairs of legs are 8, 21, 45, 76, and 94 per cent. of the body length from the anterior end respectively. The setation of legs 1 and 2 cannot be seen, but that of legs 3 and 4 is the same as that of *L. cyprinacea* (Table 1, p. 4).

The anchor (Figs. 84–86) has six short, blunt processes, three on each side. There is a dorsal pair and a ventral pair, both of which are directed outwards and backwards. These are similar to those of some specimens of *L. lophiara*; but in addition



FIGS. 84–88. *Lernaea bistricornis* sp. nov.

Fig. 84, latera lview of anchor; Fig. 85, ventral view; Fig. 86, anterior view of the same; Fig. 87, ventral view of abdomen and pregenital prominence; Fig. 88, lateral view of the same.

FIG. 89. *Lernaea barbicola* Leigh-Sharpe. Abdomen, pregenital prominence, and egg-sac.

FIGS. 90–95. *Lernaea tuberosa* sp. nov.

Fig. 90, ventral view of holotype; Fig. 91, abdomen and pregenital prominence; Fig. 92, lateral view of anchor; Fig. 93, the same seen as a transparent object; Fig. 94, anterior view of anchor; Fig. 95, the visible part of the parasite protruding from the hole in the side of the fish. The line near each figure is 1 mm. drawn to the same scale.

there is a pair of small knobs on each side of the head which reach over as if to protect it.

The pregenital prominence is well defined (Figs. 87–88), but appears to be simple. The abdomen is of normal length, rather tapering, and without signs of segmentation.

The egg-sacs are spindle-shaped and about 1·3 mm. long.

Lernaea barbicola Leigh-Sharpe

FIG. 89

1930 *Lernaea* (*Lernaeocera*) *barbicola* Leigh-Sharpe. *Parasitology* **22**: 334, text-figs. 1–6.

Mr. Leigh-Sharpe has kindly presented the holotype Reg. No. 1949.8.14.50 of this species mounted on a microscope slide to the Museum. It was from the tail of a species of *Barbus* from the Transvaal.

Unfortunately the arms of the anchor have been broken and it is no longer possible to see their arrangement.

Owing to the fact that the specimen is flattened on a slide the precise shape of the abdomen and pregenital prominence must remain uncertain; but I have made a camera lucida drawing (Fig. 89) which I hope is a little more accurate than Leigh-Sharpe's Fig. 2. Leigh-Sharpe's figures of the first and second pairs of legs are evidently not intended to show the precise setation of these limbs. All four pairs are visible in the preparation, and with the help of an immersion lens I have been able to make out the setation, which is precisely the same as that of *L. cyprinacea* (Table 1, p. 4).

Lernaea tuberosa sp. nov.

FIGS. 90–95

Holotype, Reg. No. 1949.8.14.51, and one paratype in the British Museum. Both specimens were from the body of the fish *Engraulicypris sardella* (Günther) from Lake Nyasa. The holotype was from the flank of a specimen collected by Dr. Christy in 1925, and the paratype was from the mid-ventral line of a fish in the Museum collection, Reg. No. 1908.10.27.24–33 collected by Captain Rhoades.

The length of both specimens is 11·5 mm. The positions of the five pairs of legs are 7·8, 18, 42, 72, and 91 per cent. in the holotype and 7·8, 18, 44, 76, and 93 per cent. of the body length from the anterior end in the paratype.

The total torsion in both specimens is 100° in a dextral sense. In the holotype this is the result of dextral torsions between legs 1 and 2 of 45°, between legs 2 and 3 of 40°, and between legs 3 and 4 of 15°. In the paratype the torsion is at first sinistral through 45° between legs 1 and 2, followed by dextral torsions of 105° between legs 2 and 3, 35° between legs 3 and 4, and about 5° behind legs 4.

The neck of both the specimens, that is the part of the body from the anchor to nearly the third legs, is covered with little peg-like processes which immediately distinguish this species from any other known at present, and which have suggested to me the trivial name *tuberosa*.

The anchor has four arms arranged as shown in Figs. 90 and 92–94; each bears a number of small finger-like processes. In spite of the apparent irregularity there is a distinct bilateral symmetry in the arrangement of the processes, and the two specimens are very similar to one another.

The pregenital prominence is distinct but single or only indistinctly bilobed. The abdomen is of normal length and tapering, with the segments not marked off from one another.

The egg-sacs of the holotype (Fig. 95) were small and rather shrunk in appearance.

KEY TO ADULT FEMALES

In the following key to the species of *Lernaea* those which I have seen are printed in **bold** type and those I know only from descriptions or figures are in *italics*.

The following species are omitted as I consider them to be synonyms:

L. bichiri (Kurtz, 1922)	= **L. haplocephala** (Cunnington, 1914)
L. carassii Tidd, 1933	= **L. cyprinacea** Linnaeus, 1758
L. elegans Leigh-Sharpe, 1925	= **L. cyprinacea** Linnaeus, 1758
L. pectoralis (Kellicott, 1882)	= *L. catostomi* (Krøyer, 1864)
L. temnocephala (Cunnington, 1914)	= **L. barnimiana** (Hartmann, 1865)
L. tortua (Kellicott, 1881)	= *L. catostomi* (Krøyer, 1864)
L. werneri (Kurtz, 1922)	= *L. composita* Wilson, 1924

1. Neck with many peg-like protuberances. . . . **L. tuberosa** sp. nov.
   Neck smooth 2
2. Anchor with four unbranched arms, confluent at their bases . . . 3
   Anchor with some other arrangement of its arms 12
3. A localized swelling at least twice the width of the body present in the region of legs 2 4
   Body not conspicuously swollen in region of legs 2. 5
4. Abdomen of normal length, less than three times its breadth . . . **L. haplocephala** (Cunnington, 1914)
   Abdomen very long, about a quarter of the total body length **L. longa** sp. nov.
5. Arms of anchor long and straight and in a plane roughly parallel to body axis 6
   Arms not answering to this description 7
6. Pregenital prominence bilobed . . . . . **L. tilapiae** sp. nov.
   Pregenital prominence with three lobes . *L. pomatoides* (Krøyer, 1864)
7. Anchor with dorsal arms curved and ventral arms straight **L. bagri** sp. nov.
   Anchor not answering to this description 8
8. Abdomen short, little, if any, longer than pregenital prominence . . 9
   Abdomen distinctly longer than pregenital prominence 10
9. Dorsal and ventral arms of anchor of about equal size . . . . *L. cruciata* (Lesueur, 1824)
   Ventral arms much smaller than dorsal arms . *L. tenuis* (Wilson, 1916)
10. Pregenital prominence bilobed . . . . **L. lophiara** sp. nov.
    Pregenital prominence simple 11
11. Arms not tapering, each with a kink near the end . . **L. palati** sp. nov.
    Arms thick at base and tapering rapidly . . *L. composita* Wilson, 1924
12. Anchor of four simple flattened arms, an anterior pair in front of legs 1 and a posterior pair behind these legs . . *L. variabilis* (Wilson, 1916)
    Anchor not answering to this description 13
13. Main bulk of anchor at right angles to the body like the cross-bar of a T, with the length of cross-bar at least a third of body length . . . 14
    Anchor not answering to this description 17
14. Anchor with a median dorsal process bifid at the tip . . . . *L. dolabroides* Wilson, 1918

Anchor with no median dorsal process 15

15. Lateral arms of anchor unbranched . . *L. parasiluri* Yamaguti, 1939
Lateral arms of anchor each with a dorsal branch near the end . . 16

16. Anchor with a small pair of ventral arms near middle line, body without a conspicuous constriction . . . . . **L. piscinae** sp. nov.
Anchor without ventral arms. Body with conspicuous constriction between legs 3 and legs 4 . . . . **L. diceracephala** (Cunnington, 1914)

17. Anchor with six short, rounded protuberances, three on each side, a dorsal pair, a ventral pair, and also an anterior pair at the sides of the head . **L. bistricornis** sp. nov.
Anchor not answering to this description 18

18. Anchor set at right angles to body by a ventral flexure by legs 2, arms lateral with bulbous branches. Posterior part of body much swollen . . . *L. insolens* Wilson, 1919
Not answering to this description 19

19. Anchor with a median dorsal arm which may be branched, and lateral arms . 20
Anchor with arms in pairs, no median arm 22

20. Dorsal arm twice bifid, posterior half of body behind legs 4 swollen and spindle-shaped . . . . . *L. lagenula* (Heller, 1865)
Dorsal arm unbranched, or branched only once 21

21. Lateral arms simple . . . . **L. barbicola** Leigh-Sharpe, 1930
Lateral arms branched at least once . . . *L. catostomi* (Krøyer, 1864)

22. Arms of both dorsal and ventral pairs bifid . . *L. oryzophila* Monod, 1932
Either dorsal or ventral arms unbranched 23

23. Ventral arms simple, dorsal arms branched 24
Ventral arms branched, dorsal arms unbranched 28

24. Ventral arms very short, hardly longer than breadth of head . . . **L. barnimiana** (Hartmann, 1865)
Ventral arms distinctly longer than breadth of head 25

25. Ventral arms curved outwards, with a small swelling facing anteriorly about the middle of the curve . . . . . **L. barilii** sp. nov.
Ventral arms more or less straight, without a swelling 26

26. Legs 2 as well as legs 1 between the bases of ventral arms. Abdomen in line with the body . . . . *L. ranae* Stunkard & Cable, 1931
Legs 2 situated some distance behind the bases of ventral arms. Abdomen generally at an angle with body 27

27. Arms not more than three times as long as they are broad. Dorsal arms nearly as short as ventral ones. Egg-sacs oval *L. esoscina* (Burmeister, 1835)
Arms slender and cylindrical in form. Dorsal arms distinctly longer than ventral. Egg-sacs spindle-shaped . . **L. cyprinacea** Linnaeus, 1758

28. Branches of ventral arms unequal, main branch directed outwards and smaller one directed ventrally from it. Pregenital prominence bilobed . *L. phoxinacea* (Krøyer, 1864)
Ventral arms bifid at tip with resultant prongs equal and parallel. Pregenital prominence hemispherical. . . . *L. senegali* Zimmermann, 1923

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