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## SOME NEW AND KNOWN CAMALLANID PARASITES OF MARINE FOOD FISH FROM PAKISTAN

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### MATERIAL AND METHODS

Heavy infection with *Camallanus chorinemi* sp. n. was observed in the intestines of 'Leather-Jacket' (*Chorinemus toloo*) from Karachi, W. Pakistan. Almost a hundred percent of the fish were infected during the year 1959-60 when this collection was made. On one occasion a 'silver-bar-fish' (*Chirocentrus dorab*) also harbored a male and a female specimen apparently belonging to this species. Numerous specimens of *Camallanus surmai* sp. n. were obtained from *Cybium interruptum* a mackerel locally known in Karachi as 'Surmai'.

So far only one species of *Spirocamallanus* (*S. Pereirai*) is found to infect a variety of food fish belonging to distinct families. These are *Mugil speigleri*, *Pristipoma hasta* and *Otolithus ruber*.

All the nematodes were collected from freshly killed fish in the usual way and were preserved in hot 15% glycerine-alcohol. Depending on the kind of structure to be studied the worms were cleared in glycerine, lactophenol or beechwood creosote. Permanent mounts were made in glycerine jelly.

*Camallanus chorinemi* sp. n.

(All measurements in millimeters)

Description: Spiruroidea Railliet & Henry, 1915,  
*Camallanidae* Railliet & Henry, 1915,  
*Camallanus* Railliet & Henry, 1915.

The freshly collected parasites are red changing to dull brown color after preservation. The body tapers towards the posterior and only. The anterior end is subglobular due to the presence of a bivalve buccal capsule. The wall of the latter is raised into 36-45 longitudinal "thickenings" or ridges which are short and continuous in the anterior region and broken posteriorly. These broken pieces sometime appear as "spines". A small cuticular ring or disc connects the capsule with the esophagus. The total length of the buccal capsule including the disc is equivalent to the maximum diameter including the walls. A pair of heavily cuticularized tridents are attached dorsoventrally to the corners of the mouth. The cephalic papillae comprise four large submedians and a pair of lateral amphids in the external circle. The papillae of the internal circle are not distinct.

*Male*: The caudal alae are broad, joining ventrally, anterior to cloaca, at their commencement, and the papillae are all pedunculated, being longest near the middle of the alae. Seven pairs of precloacal, two pairs of paracloacal and five pairs of postcloacals are in groups of two each and the 5th is somewhat isolated. A pair of phasmids is also seen near the posterior extremity. Most characteristic feature of these parasites is the presence of a thick, single spicule and unlike other species of the genus *Camallanus*, it is heavily cuticularized. No gubernaculum or gubernaculum-like structure could be seen even under an oil immersion lens. This was confirmed by dissecting the tail ends under the microscope.

*Female*: The vulva is in the anterior half of the body and there are two prominent lips 0.037-0.074 mm length hanging over the vulval aperture. In few specimens the longest lobe reaches a size of 0.100 mm. The long, vagina runs posteriorly to open into the uterine sac. In some females it travels anteriorly before turning towards the tail end. The uterus continues anteriorly into a much coiled ovary but ends blindly near the posterior end. It is tightly, packed with fully developed uncoiled embryos.

A thin cuticular sheath surrounds them throughout their length and the head bears two minute lips, one of them with a small tooth. The tail of the embryo is long and subulate, but that of adult is short, tapering and slightly bifid at the tip, bearing a pair of small phasmids at 0.100 mm from the tip.

*Discussion*: The literature on the genus indicates only five species as having a single spicule. These are *C. magathi* Sprehn, 1932, *C. parvus* Caballero, 1939, *C. mazabukae* Kung, 1948, *C. unispiculus* Khera, 1954 and *C. johni* Yeh, 1960. *C. parvus* Caballero, 1939 and *C. unispiculus* Khera, 1954 are considered by Yeh (1960) as synonyms of *Serpinema magathi* (Sprehn, 1932) Yeh (1960) and *Zylanema anubatus* (Pearce, 1939) Yeh, 1960 respectively.

*C. mazabukae* and *C. johni* are from the African frogs. Although the former shows some affinities with the present parasite in having a hooked single spicule it can be distinguished easily by the presence of following characters; smaller body size, female tail with y cuticular spines, 16-18 longitudinal ridges in the buccal capsule not broken posteriorly, much smaller tridents, and the number of caudal papillae in the males. Moreover, the vulva is behind the middle of the body in *C. mazabukae* but is definitely anterior in all the specimens in the present collection.

In *C. johni* a gubernaculum-like "left spicule" is described in addition to a "single" large spicule. This is absent in the present worms. The vulva in *C. johni* is also nearer to the tail end than to the middle of the body. The male tail in amphibian species is bifid and the female ends in 4 spikes, whereas there is a simple tapering tail in the males of the piscine species and an insignificant bifid tail tip in the females. In *C. johni* the male is

2 mm and the female 2.2-2.200 mm long, whereas the smallest males and females from *Chorinemus toloo* are 3-6 times respectively as large as the former. The tridents are also asymmetrical in the *C. johni*.

*C. magathi* (syn. *C. parvus*) also resembles the species under discussion in having the spicule bifurcated at the proximal end but it can be differentiated by the presence of 11 ridges in the buccal capsule, smaller size of the body and the tridents. Although the male of *C. magathi* is smaller than the present species, the spicule is larger in the former.

The worms from the marine fish of Pakistan can thus be differentiated from all the other species of *Camallanus* by having a single spicule together with the characters outlined above.

The type specimens are deposited in the Department of Parasitology, London School of Hygiene and Tropical Medicine.

*Camallanus surmai* sp.n.

These are large worms with slightly tapering extremities. A thick cuticle covers the body and bears five transverse striations set at intervals of about 0.011 mm in the males and 0.018 mm in the females.

The bivalve buccal capsule is large, chitinous and thickened internally by longitudinal lateral ridges. These are continuous, never found to be broken posteriorly as in *C. chorinemi* sp.n. and are only 20-26 in number on one valve of the capsule. The ring-like thickening or the disc at the base of the capsule is 0.037 mm long X 0.087 mm broad and has a small cavity of its own. The two tridents are very long. The cervical papillae are minute, bristlelike and are posterior to the nerve ring. The muscular and the glandular parts of the esophagus are more or less subequal in length.

*Male*: The caudal alae are 0.940-1 mm long by 0.270-0.300 mm wide. The single spicule is similar to that found in *C. chorinemi* but the hooked tip has almost equal prongs at the end. The caudal papillae could not be determined satisfactorily as the tails of all the males (about 10) have some globular structure similar to oil globules. Due to these all the papillae are obscured.\* Every possible effort to clear the caudal ends was in vain. Even the Ether which dissolves fats and oils did not have any effect on them. With great difficulty, 6 pairs of precloacal and 2 pairs of postcloacal papillae could be counted, but the total number of papillae is certainly greater than this.

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\*The presence of these globular structures is also observed in some of the specimens of *C. chorinemi* and *Spirocamallanus* described in this paper. It has been confirmed by some pathologist in our department that it is not a fungal or bacterial contamination. It may be an environmental effect on the parasite due to the food of the fish.

*Female*: The most striking feature of these worms is the presence of extremely large vulval lips. These are so conspicuous that they can be easily seen by the naked eye and measure up to 0.470 mm in length. There are three thick lobes, two ventral and one dorsolateral. The largest lobe overhangs the vulval aperture. Just behind the opening there is another thickening on the ventral surface. Structurally these look similar to those of *C. chorinemi* but they differ in size and the presence of an additional lobe. The phasmids are at 0.140 mm from the tail end which has two insignificantly small tips. The larvae are long with subulate tail ends.

*Discussion*: Morphologically these are very similar to the species described earlier from *Chorinemus toloo*. The differences outlined below, however, do not justify their inclusion in that species. The total length and breadth of the body in the present worms is more than double that of *Camallanus chorinemi*. This difference was first regarded as a simple variation due to a distinct host, but a few females, 23-30 mm long, are found to be totally immature; even the ovary is in the early stages of development and the vulva is not conspicuous. The presence of these females, which are at least one and a half times longer than the largest female of *C. chorinemi*, suggests that the present species is genetically influenced in its length. Moreover, these parasites were collected on different occasions throughout the year, and each time the worms from one host were alike. The fish *Cybius* never harbored the smaller species or *Chorinemus toloo* the larger variety.

Apart from the difference in size, which may not be given so much importance, the major difference is noted in the buccal thickenings. Although *C. chorinemi* is smaller, the buccal ridges are greater in number and they are always broken posteriorly, whereas the present species never possesses broken thickenings. These are always continuous and are very few in each valve. Another striking difference is the length of the spicule in relation to the body it is up to 1: 46.6 in *C. chorinemi*, and 1:75.6 in the present worms. The tip has a small hook in *C. chorinemi* and equal prongs in this species. The large vulval lips are extremely conspicuous and the larvae are also more than double in length in the species under discussion.

On account of these differences it is not possible to include these nematodes in the species *C. chorinemi*, and hence they are regarded as a distinct species. The species is named after the vernacular name of the host.

The type specimens are deposited in the London School of Hygiene and Tropical Medicine and.

Systematic position of *Camallanus*  
*chorinemi* sp. n. and *C. surmai* sp. n.

Ali, 1956 regarded the presence or absence of the tridents as of generic value, whereas Yeh, 1960 (b&c) divided the original genus *Camallanus* into four distinct genera on the basis of the various forms of buccal thickenings and Yamaguti (1961) retained the old genus *Camallanus* as such.

The two species described here are represented by a large number of worms, collected on various occasions throughout the year. Thus, the forms ranging from pre-adult or immature to a completely gravid worm are available for a comparative study. As it is discussed earlier, these two species are extremely closely related and the enormous difference in the size of the body and various measurements could have been attributed to the age difference. Nevertheless, the presence of immature forms in both the types clarifies their specific distinction. Whereas all the characters by every criterion show that the two species should be placed in the same genus, the thickenings of the buccal capsule fall into two distinct genera according to Yeh's classification *Camallanus chorinemi* sp. n. shows constantly the presence of short anterior thickenings which are broken posteriorly and appear like "spines". This could be included in *Piscilania* Yeh, 1960. On the other hand, *Camallanus surmai* sp. n. has never been found to have broken thickenings in the posterior part of the buccal

capsule. The thickenings here are continuous and uniformly distributed throughout the capsule laterally and thus show affinities with the genus *Camallanus* (*sensu* Yeh, 1960). The two species are so similar in other morphological and anatomical features, such as tridents, esophagus, vulval lips, slightly bifid tail and a typical heavily cuticularized spicule, that their separation into two distinct genera appears to be quite unjustifiable. The writer therefore prefers to retain her two species in the genus *Camallanus* (*sensu latu*) till further evidence regarding the thickenings in the buccal capsule of other species is available.

TABLE I

Measurements of *C. chorinemi* sp.n. and *C. surmai* sp. n.  
(all measurements in mm)

| Characters                     | <i>C. chorinemi</i>      |                | <i>C. surmai</i> |                     |
|--------------------------------|--------------------------|----------------|------------------|---------------------|
|                                | Male                     | Female         | Male             | Female              |
| Length                         | 6 -14                    | 13 -20         | 23 -28           | 35 -45              |
| Breadth                        | 0.1 - 0.17               | 0.16- 0.2      | 0.27- 0.3        | 0.37- 0.45          |
| Tridents (length in middle)    | 0.09- 0.13               | 0.1 - 0.15     | 0.17             | 0.17                |
| Buccal capsule                 | 0.1 - 0.1                | 0.13- 0.13     | 0.15             |                     |
| Buccal ridges                  | Broken posteriorly       |                | continuous       |                     |
| No. of buccal ridges           | 36                       | 45             | 20               | 26                  |
| Cervical papillae              |                          | 0.36- 0.45     | 0.46- 0.48       | 0.48- 0.52          |
| (from anterior and)            | 0.34- 0.38               | 0.22- 0.24     | 0.3              | 0.45                |
| Never ring (from anterior and) | 0.18- 0.19               | 1.2            | 1 - 1.5          | 1.5 - 2             |
| Excretory pore                 | 0.7                      | 0.79- 0.96     | 1.1 - 1.3        | 1.1 - 1.5           |
| Oesophagus muscular            | 0.69- 0.86               | 1 -1.7         | 1.58- 1.6        | 1.8 - 2.05          |
| oesophagus glandular           | 0.94- 1.2                | Two 0.1 long   |                  | three 0.47          |
| Position of vulva              |                          | pre-equatorial |                  | Pre-equatorial      |
| Tail tip                       | Simple                   | Slightly bifid | simple           | Very slightly bifid |
| Spicule length                 | 0.2 - 0.3                |                | 0.31- 0.37       |                     |
| (forked tip)                   |                          |                | (forked tip)     |                     |
| Gubernaculum-like structure    | Absent                   | Absnt          | Absent           | Absnt               |
| Caudal papillae (in pairs)     |                          |                |                  |                     |
| precloacal                     | 7                        |                | ? 6              |                     |
| paracloacal                    | 2                        |                | ?                |                     |
| postcloacal                    | 5                        |                | ? 2              |                     |
| phasmids                       | 1                        |                | ?                |                     |
| Host                           | <i>Chorinemus tolooo</i> |                | <i>Cybium</i>    | <i>Interruptum</i>  |
| Locality                       | (Marine Fish)            |                |                  |                     |
| West Pakistan                  |                          |                |                  |                     |

Genus *SPIROCAMALLANUS* Olsen, 1952

*S. pereirai* (Annereaux, 1946)

Large number of male and female specimens were collected from various food fish belonging to distinct families. Anatomically and morphologically all these worms belong to the same species and so far this appears to be the only species parasiting the fish of the coastal waters of Karachi.

Yellowish-brown, medium sized worms, with tapering extremities. The cuticle is somewhat thick near the middle of the body and bears fine transverse striations set at intervals of about 0.003 mm. Although the mouth is rounded, laterally it bears two small thickenings, seen distinctly in an *en face* view. Due to these, two small "pseudolabia-like" structures appear in a dorsoventral view of the head. There are 4 large submedian papillae and a pair of amphids in the external circle and 6 bud-shaped smaller papillae in the inner circle. A thick walled barrel-shaped buccal capsule in the anterior end, is strengthened internally by the spiral thickenings. This is a continuous structure without interruption and without any other form of additional thickening on it. A maximum of 8-10 spirals are found in the males and about 11-13 in the females. The walls of the capsule are 0.011-0.015 mm thick and a small disc-shaped ring connects it to the muscular portion of the oesophagus. The cervical papillae are close to the base of the capsule and the excretory pore behind the nerve ring.

*Male*: The posterior end of the body is supported by large caudal alae measuring about 0.620 mm in length 0.200 mm in the greatest width from one end to the other. The spicules are similar but unequal evenly tapering into pointed tips. The caudal papillae are pedunculated, 3 pairs of precloacals, 2 pairs of paracloacals and 6 pairs of postcloacals. The first pair of the latter is very close to cloaca and could be regarded as a paracloacal. The two pairs which surround the cloaca are stoutly built and cuticularized.

There are strong muscles in the precloacal region supporting the posterior end of the body. The caudal alae of most of the males are filled with a granular substance appearing at times like a cluster of oil globules and spreading all over in various shapes. In some it takes the shape of a hors shoe (fig. 29) which is extremely misleading. However, this is not a constant feature and appears to be some sort of contamination also found in other camallanid worms described earlier. The tail is short and tapers to end into portions; the anterior is muscular, 0.450 mm and 0.100 mm broad and the posterior part is a thin tube measuring 1.9-2 mm in length and 0.025 mm in thickness. The uteri are divergent and filled with fully developed embryos. The posterior limbs of the uterus ends blindly. In common with some related species of this genus, the tail is supported by strong muscles and ends abruptly in a digitiform process. The latter has a cuticular structure bifurcated at the tip in the form of minute spikes.

*Discussion*: In all probability, the present specimens belong to *Spirocamallanus pereirai* (Annereaux, 1946) Olsen, 1952, from *Atherinopsis californiensis* in Bolinas Bay (California). Sogandares Bernal, 1955 established a new host record for this species from Louisiana. Five more species of fish were added to this record by Noble and King (1960) from California.

Annereaux (1946) had only a single male and three not fully gravid females at his disposal and hence his description is somewhat incomplete. Noble and King (1960) described this species in detail and defined its characters more accurately. They also reported the two pairs of paracloacal papillae which were not described by Annereaux (1946). These papillae are also recorded by the writer.

*Spirocamallanus S. pereirai* (Annereaux, 1946)  
(all measurements in mm)

|  | Male           | Female         |
|--|----------------|----------------|
| Length of the body                       | 10.5-14        | 10.5-20        |
| Breadth of the body                      | 0.31-0.35      | 0.52-0.71      |
| Buccal capsule                           | 0.038-0.046 mm | 0.071-0.081 mm |
|  | by             | by             |
|  | 0.074-0.075 mm | 0.077-0.092 mm |
| Cervical papillae<br>(from anterior end) | 0.12-0.15      | 0.12-0.13      |
| Nerve ring from<br>anterior end          | 0.27-0.28      | 0.28-0.31      |
| Excretory pore from<br>anterior end      | 0.5-0.53       | 0.5-0.53       |
| Esophagus muscular                       | 0.41-0.49      | 0.45-0.53      |
| Esophagus glandular                      | 0.76-0.85      | 0.55-0.86      |
| Vulva from anterior end                  |                | 6.9-9.3        |
| Embryos                                  |                | 0.26-0.26      |
| Tail                                     | 0.2-0.23       |                |
| Length of spicules                       | 0.23-0.29      |                |
|  | and            |                |
|  | 0.41-0.47      |                |
| Caudal papillae:                         |                |                |
| Precloacal                               | 3              |                |
| paracloacal                              | 2              |                |
| postcloacal                              | 6 the first    |                |

pair of these  
could be regarded  
as "adanal"

Although two minute thickenings are shown laterally in the camera-lucida drawing of the anterior end by Noble and King (1960), no reference has been made to these in the text. An examination of an *en face* view of this parasite however, shows these thickenings very clearly.

*Spirocamallanus mazabukae* Yeh, 1957 from fresh water fish of Northern Rhodesia shows closer affinities with these parasites in various body measurement and arrangement of the caudal papillae in the males, but the tail tips in both the sexes appear to be simple, while these are bifid in *S. pereirai* (Annereaux, 1946).

TABLE II  
*CAMALLANUS* spp. with one spicule  
(All measurements in mm)

| Characters                  | <i>C. johni</i> Yeh, 1960        |           | <i>C. mazubukae</i> Kung, 1948 |          | <i>C. magathi</i> Sprehn, 1932                                      |           | <i>C. parvus</i> , Caballero, 1939                    |                 |
|-----------------------------|----------------------------------|-----------|--------------------------------|----------|---|-----------|---|-----------------|
|                             | Male                             | Female    | Male                           | Female   | Male  | Female    | Male  | Female          |
| Length                      | 2.                               | 2.2       | 2.51                           | 3.47     | 7.65  | 8.8 -10.5 | 3.78  | 7.1 -7.9        |
| Breadth                     | 0.12                             | 2.23      | 0.2                            | 0.27     | 0.38  | 0.5       | 0.29  | 0.37-0.39       |
| Tridents (length in middle) | 0.04-0.05                        | 0.05-0.09 | 0.039                          | -        | ?   | ?         | 0.061   | -               |
| Buccal capsule              | 0.06.0.09                        | 0.1 0.14  | 0.069 0.075                    | 0.095    | 0.12 0.13   | 0.14 0.16 | 0.10-0.11   | -               |
| Buccal ridges               | Continuous                       |           | Continuous                     |          | Continuous  |           | Continuous  |                 |
| No. of buccal ridges        | 21                               | 30        | 16                             | 18       | ?11   |           | 11  | -               |
| Vulval lips                 | No lips                          |           |                                |          |   |           |   |                 |
| Position of vulva           | Posterior to middle of body      |           |                                |          |   |           |   |                 |
| Tail tip                    | Bifid                            | 4 spikes  | Behind the middle of body      |          | Simple  | Bifid     | Simple  | Present         |
| Spicule length              | 0.29                             |           | simple                         | 5 spines |   |           | 0.52  | Posterior en of |
| Gubernaculum-like structure | 0.04                             |           | (hooked tip)                   |          | 0.65  |           | (hooked)  | body 3 papillae |
| Caudal papillae (in pairs)  |                                  |           | Absent                         | -        | Absent  |           | Absent  |                 |
| Precloacal                  | 7                                |           | 6                              |          | ?   |           | 7   |                 |
| Paracloacal                 | 2                                |           | 2 or 3                         |          | ?   |           | -   |                 |
| Postcloacal                 | 6                                |           | 3(+1or2<br>small)              |          | ?   |           | 4   |                 |
| Phasmids                    | -                                |           | -                              |          | ?   |           | -   |                 |
| Host                        | <i>Xenopus</i> sp.<br>(Amphibia) |           | Bull-frog                      |          | <i>Cinosternum scorpioides</i><br>integrum<br>(Freshwater tortoise) |           | <i>Chinosternum hirtipes</i><br>(Freshwater tortoise) |                 |
| Locality                    | Tanganyika                       |           | South Africa                   |          | Bolivia   |           | Mexico  |                 |

Campana-Rouget (1961) proposed a new name, *S. tornquisti*, for *S. spiralis* (Baylis, 1923) (= *Procamallanus spiralis sensu* Tornquist, 1931) on the basis of biologically distinct hosts and the relative proportions of the two portions of the esophagus. In the writer's opinion, Tornquist's species shows more resemblance to *S. pereirai* than to *S. spiralis*, but this can only be established after the examination of Tornquist's material.

Noble and King (1960) while discussing *S. pereirai* state, "This parasite is world wide in distribution... etc. This appears to be an error, and should read", This *genus* is world wide... etc.\*\*

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\* The writer is grateful to Professor E. R. Noble of the university of California for this information.

It will be seen that the species *S. pereirai* is so far only reported from the American continent. The present specimens show so many similarities with this species that the two are apparently indistinguishable. The species is therefore recorded here for the first time from three new marine fish of Pakistan.

It may be mentioned here that the majority of the species reported in the genus from the Indo-Pakistan subcontinent are from fresh water fish. A single female (*Spirocamallanus*) was identified as *Procamallanus kerri* by Pearse, 1933 from *Glossogobius giurus* in Siam. The tip of the tail is similar to *S. pereirai* but the description is inadequate to compare with this species.

Campana Rouget and Razarihelisoa (1965) described *S. olseni* sp.n. from three marine fish from Nossi-Be, Madagascar. This is an extremely closely related species and a comparison shows clearly that this is very similar to *S. pereirai*. The minor differences like the tail tips and others are so insignificant that the erection of a new species does not seem to be justifiable. However, as the original specimens of *S. olseni* are not at hand its synonymy with *S. pereirai* is difficult to make.

The specimens are deposited in writer's collection in the Department of Parasitology, London School of Hygiene and Tropical Medicine.

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#### SUMMARY

The Camallanid parasites of the marine food fish of Pakistan are investigated for the first time and *Camallanus chorinemi* and *C. surmai* are described as new species. These are differentiated from the other species on the basis of the structure of the buccal ridges, body size, vulval lips, length of larvae spicules and many other anatomical and morphological features. Specimens of both the species were collected and compared throughout the year (whenever available) to confirm the size of the body which in these two species appears to be genetically affected rather than by age. So far the two species are also found to be very host-specific.

The systematic position of these species is discussed in the light of Yeh's classification of the Camallanid parasites (1900).

*Spirocamallanus pereirai* (Anneraux, 1946) Olsen, 1952 is also reported for the first time from the Indo-Pakistan subcontinent from three new fish hosts. A detailed account of the species is given.

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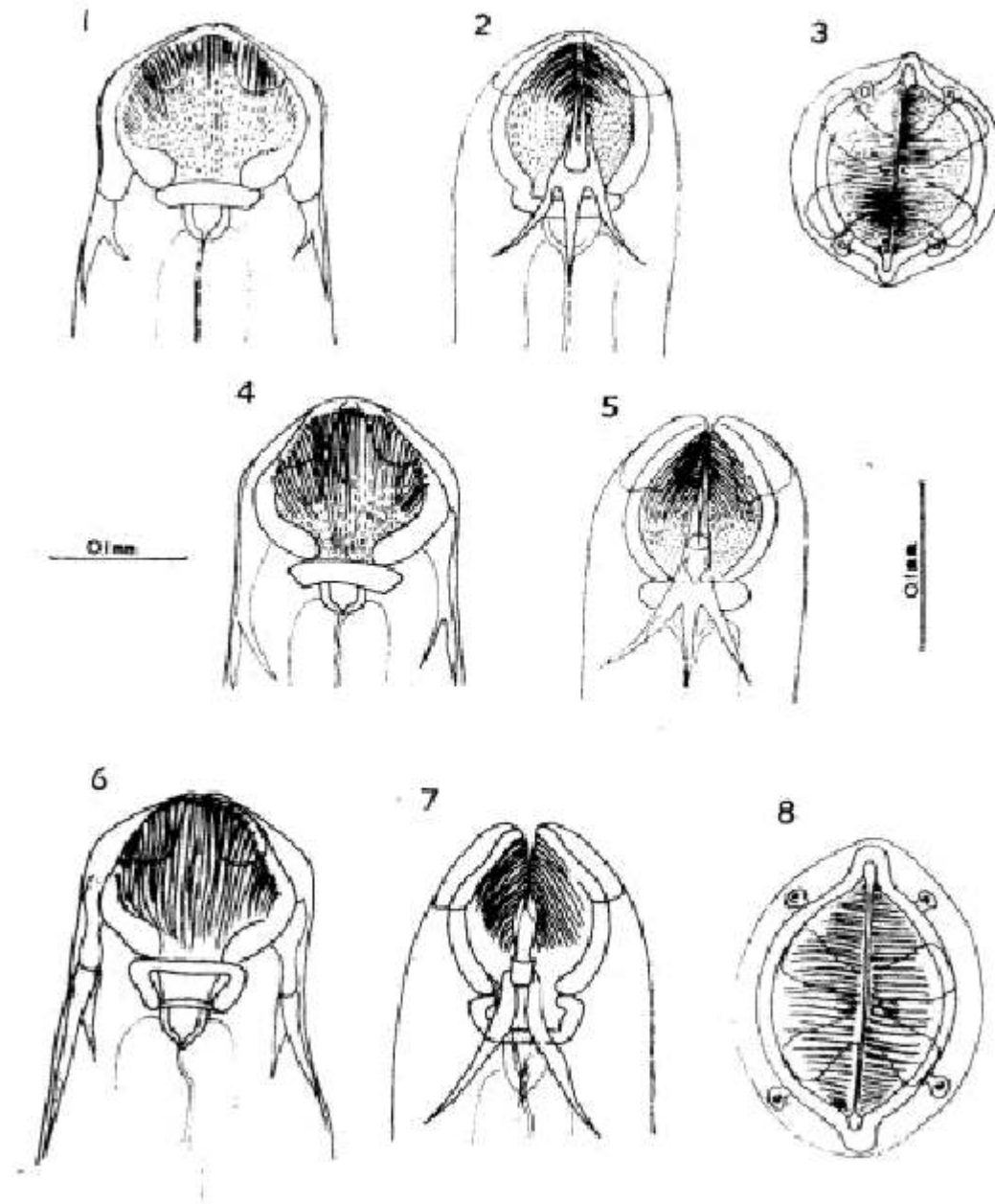


Plate 1. Comparative figures of the head ends of *Camallanus chorinemi* n. sp. and *C. surmai* n. sp.

Fig. 1, Lateral view of the head of *C. chorinemi* (young forms); Fig. 2, Head, ventral view; Fig. 3, Head, *en face* view; Fig. 4, Lateral view of the *C. chorinemi* (gravid worms); Fig. 5, Head, ventral view; Fig. 6, Lateral view of the *C. surmai*; Fig. 7, Head, ventral view; Fig. 8, Head, *en face* view. (Figs. 6-8, both gravid and young forms having the same head structure).



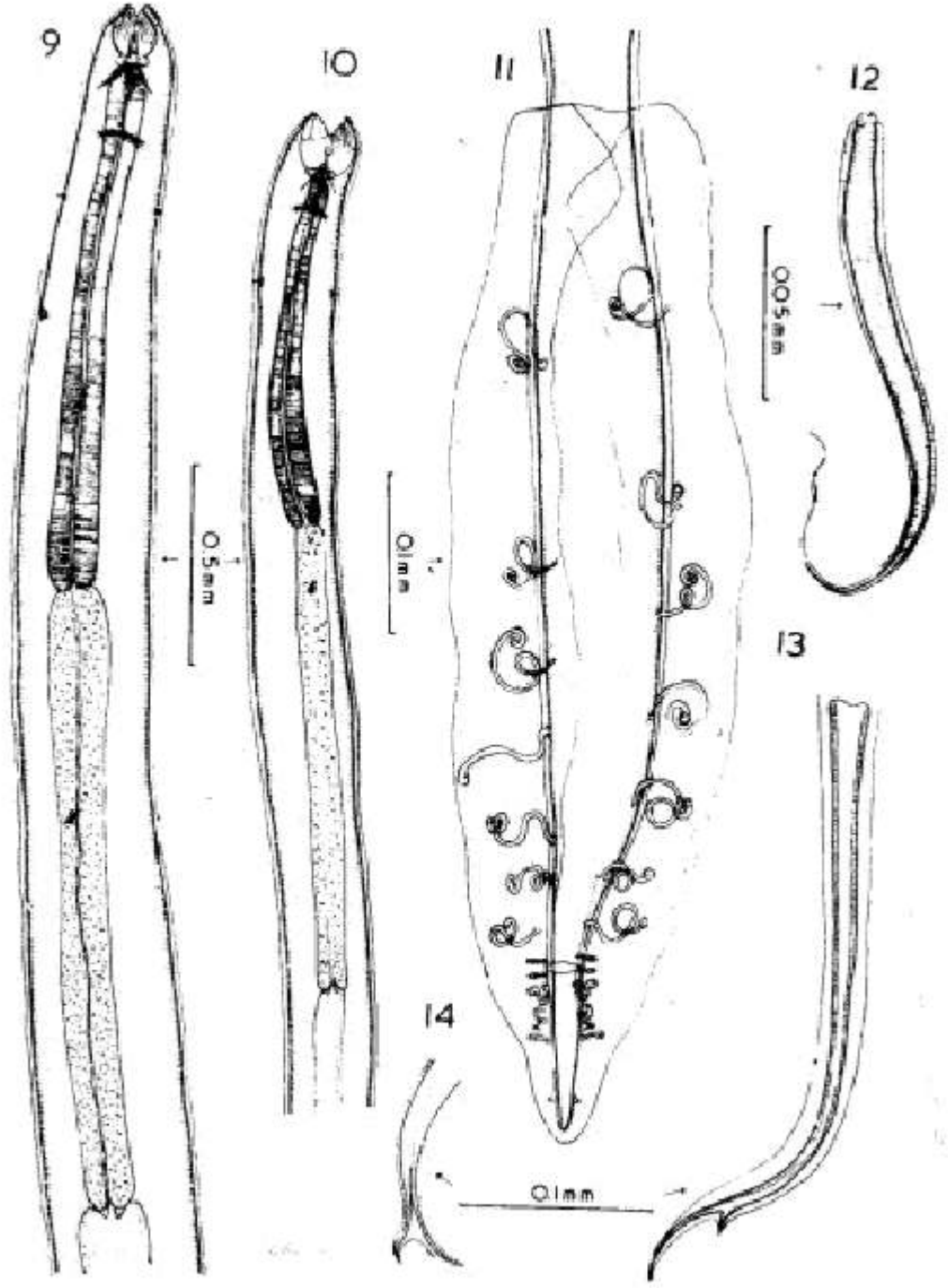


Plate 2. Comparative figures of *Camallanus chorinemi* n. sp. and *C. surmai* n. sp.

Fig. 9, Anterior end, ventral view, showing head and esophagus of *C. surmai*; Fig. 10, Same in *C. chorinemi*; Fig. 11, Male tail end, ventral view; Fig. 12, Larva, *C. chorinemi*; Fig. 13, Spicule, *C. chorinemi*; Fig. 14, Spicule tip of *C. surmai*.

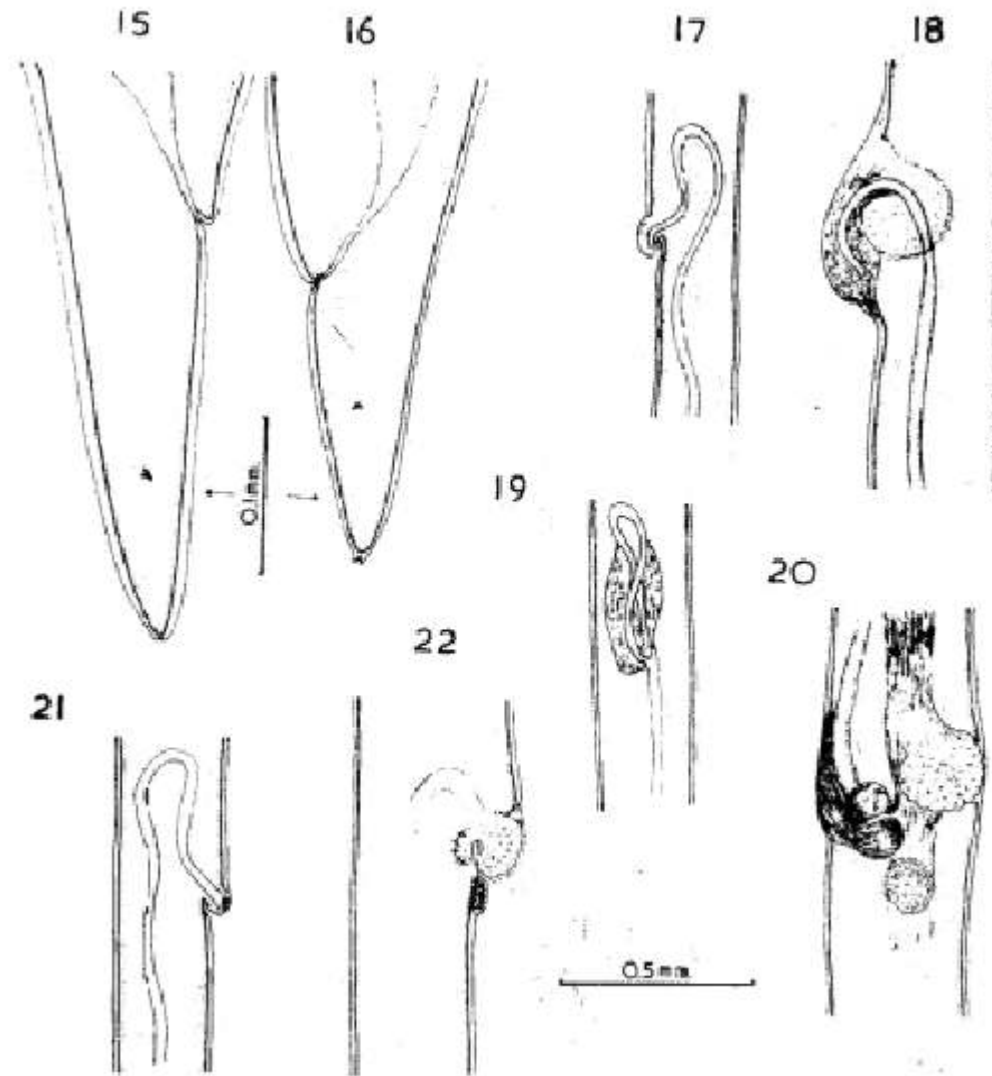


Plate 3. Females, *Camallanus chorinemi* n. sp. and *C. surmai* n. sp.

Fig. 15, Tail, *C. surmai*, lateral view; Fig. 16, Tail, *C. chorinemi*, lateral view; Fig. 17, Vulva, left lateral view, *C. chorinemi*; Fig. 18, Same, in *C. surmai*; Fig. 19, Vulva lips, ventral view in *C. chorinemi*; Fig. 20, Same in *C. surmai*; Fig. 21, Vulva, right lateral view, *C. chorinemi*; Fig. 22, Same in *C. surmai*; Figs. 17-22, Note the structure of the vulval lips in the two species.

(Scale: 0.5 mm applies to all the figures of vulval apparatus).

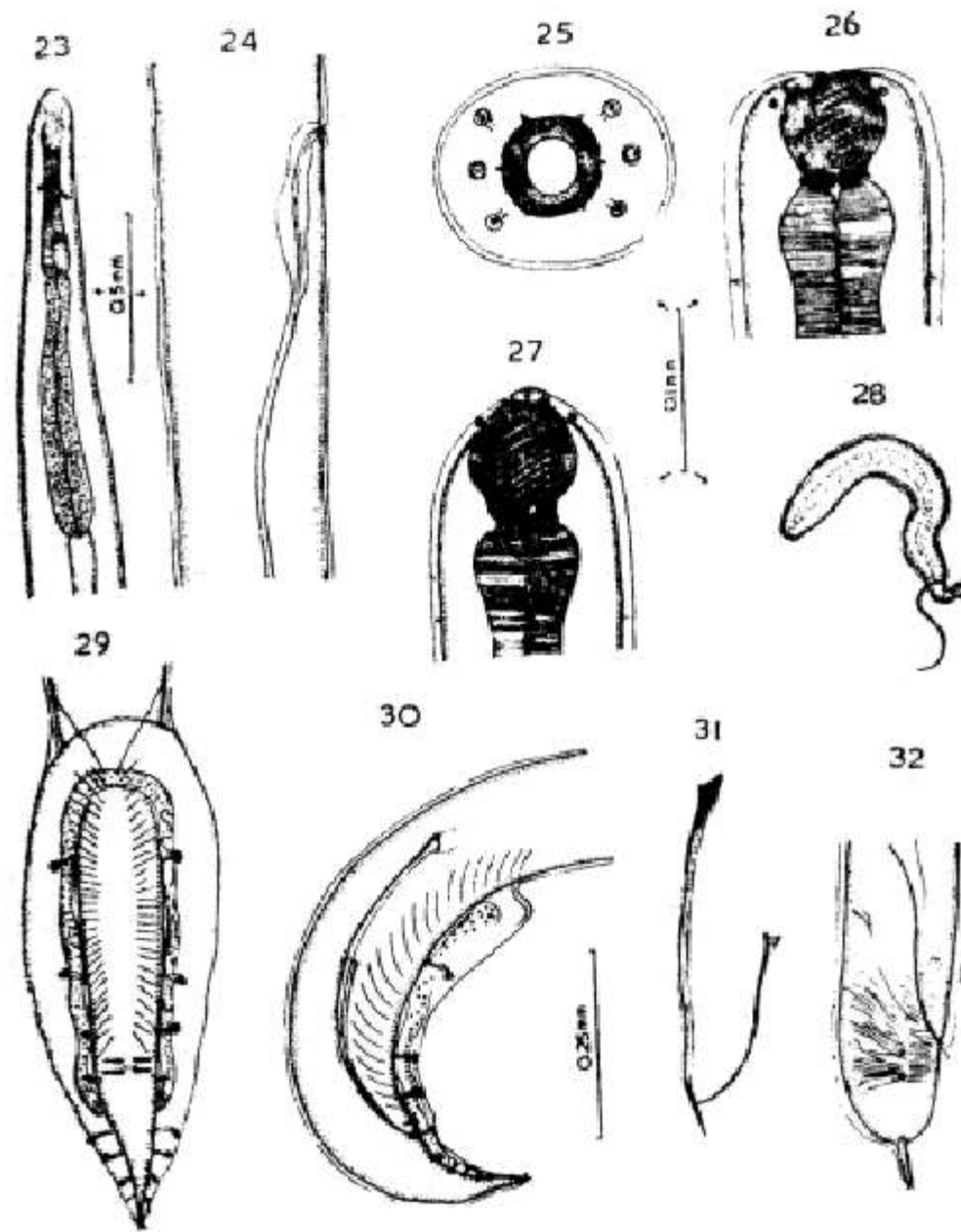


Plate 4. *Spirocamallanus pereirai* (Annereaux, 1946)

Fig. 23, Anterior end, dorsoventral view, showing bucal capsule, muscular and glandular portions of the esophagus; Fig. 24, Female, lateral view, vulva and vagina; Fig. 25, *En face* view, head (the lateral thickenings on the rim of the mouth); Fig. 26, Head, dosolateral view; Fig. 27, Same, lateral view; Fig. 28, Larva; Fig. 29, Male tail, ventral view; Fig. 30, Same, lateral view; Fig. 31, Spicules; Fig. 32, Female tail, lateral view.