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Mudry, Dwight R. and Dailey, Murray D., "*Phlyctainophora squali* sp. nov. (Nematoda, Philometridae) from the Spiny Dogfish, *Squalis acanthias*" (1969). *H. W. Manter Laboratory Library Materials*. 109.
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***Phlyctainophora squali* sp. nov. (Nematoda, Philometridae)
from the Spiny Dogfish, *Squalis acanthias*¹**

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In 1921, G. Steiner described *Phlyctainophora lamnae* from a single female worm found in the subcutaneous tissue above the hyomandibular arch in the mackerel shark *Lamna nasus* (= *cornubica*) (Bonnaterre). Larva thought to be *P. lamnae* have been described by Johnston and Mawson (1943) and de Ruyck and Chabaud (1960), but no additional adult specimens have been reported since 1921.

During parasitological studies off Los Angeles, California, a spiny dogfish (*Squalis acanthias* L.) was caught at a depth of 200 meters. Grouped around its dorsal fins, caudal peduncle, and mandibular arches were raised areas about 5 mm high, which when excised were found to contain worms similar to that described by Steiner; a total of 23, all female, were taken. Subsequent external examination of 440 *S. acanthias* failed to reveal any additional specimens.

Adults of these unusual nematodes are easily distinguished by huge vesicular enlargements

on the ventral surface of the body. In older worms the vesicles totally obscure the worm's basic shape and are unlike any structure found in other nematodes.

Steiner did not give a location of capture for his host, *Lamna nasus*, but this species is normally confined to the North Atlantic Ocean (Bigelow and Schroeder, 1948). As a result of having only a single specimen, Steiner was able to give a limited description of these interesting forms. This report not only records a new species but also offers additional information on the genus *Phlyctainophora* with suggestions for its taxonomic position.

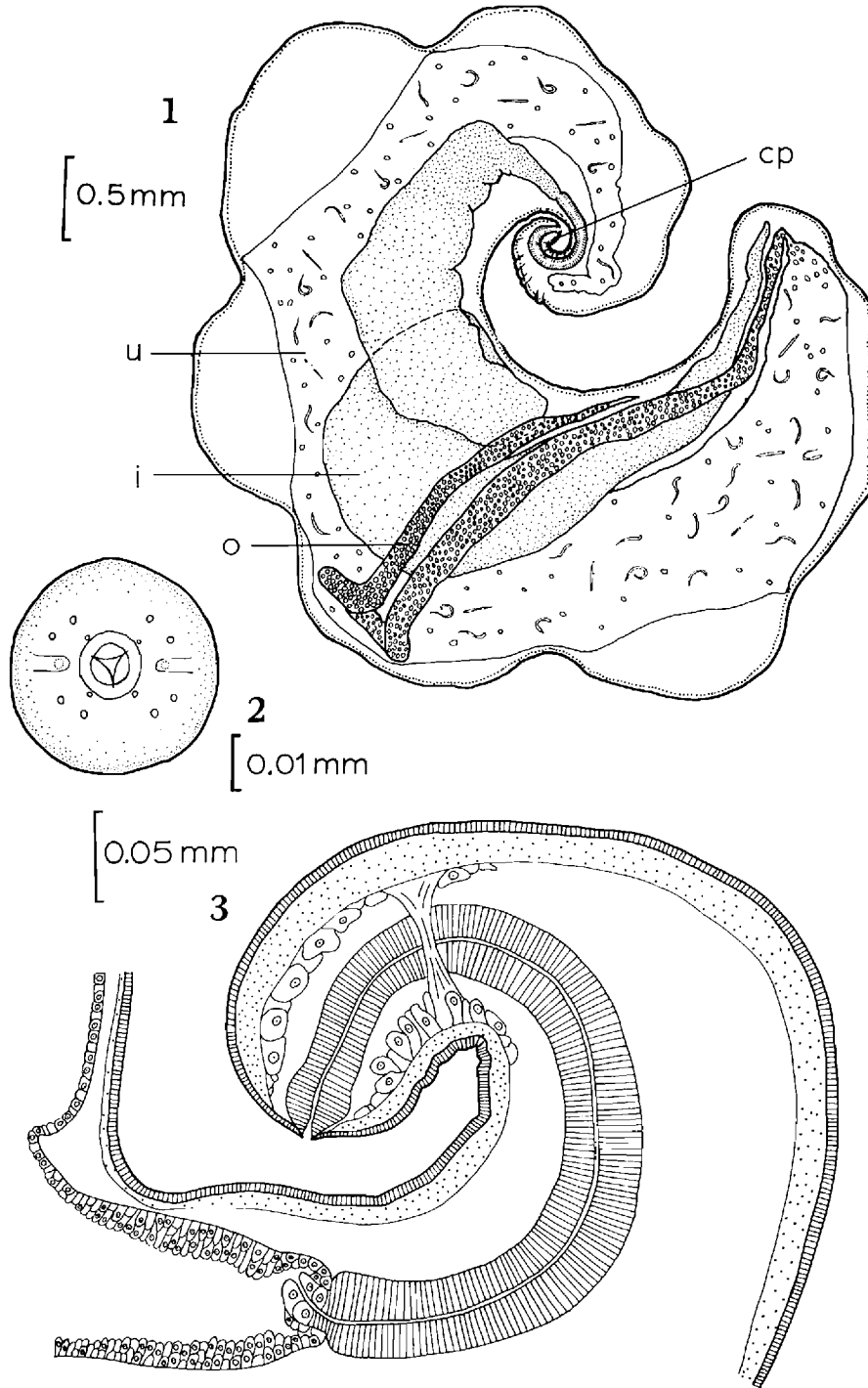
Materials and Methods

All worms were fixed in AFA and later placed in 70% ethyl alcohol. Several were embedded, sectioned, and later stained with Mayer's hematoxylin and eosin Y. The remainder were cleared in glycerin and mounted in glycerin jelly. All drawings were made with the aid of a drawing tube. Measurements are given in microns unless otherwise stated.

¹This study was supported in part by the Long Beach California State College Foundation under grant NSF IG 212.73.

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Figures 1-3. *Phlyctainophora squali*. 1. Mature female. 2. En face view. 3. Sagittal section of anterior region. Abbreviations: cp, cephalic protrusion; i, intestine; o, ovary; u, uterus.



Description

Phlyctainophora squali sp. nov. (Figs. 1-7)

DIAGNOSIS (based on 23 specimens: 2 immature and 21 mature females). Body of mature females tightly coiled dorsally into crescent shapes. Body length 2.3-14.0 mm by 1-3 mm in diameter. Ventral surface with large outpocketings, variable in size and number, without pattern or symmetry. Body rigid, musculature reduced, very stout, narrowing at mouth; posterior end rounded. Cuticle with small parallel annules. Mouth simple, without well defined lips. Eight cephalic papillae in outer circle, four in inner circle. Amphids present. Nerve ring at or near anterior fourth of esophagus. Esophagus 500-600 long by 50 wide, narrowing slightly before joining intestine, surrounded by cells containing large nuclei. Oesophageo-intestinal valve projecting into intestine. Intestine expands immediately behind esophagus filling midbody and tapering toward posterior extremity where it terminates. Anus atrophied. Ovary single, originating posterior to midbody, anteriorly directed, looping posteriorly, emptying into uterus at posterior extremity (Fig. 1). Uterus large, filling all available body space and terminating blindly in esophageal region; capable of undulating motion.

Eggs and larva present in all stages of development. Larva 200-250 long by 14 wide. Anterior with toothlike projection; two large preanal phasmids present; anus 165 from anterior end, tail sharply pointed.

HOST: *Squalis acanthias* L.

LOCATION: Subcutaneous tissue.

LOCALITY: Eastern Pacific Ocean off Los Angeles, California. Depth 200 meters.

SPECIMENS: Holotype and two paratypes in USNM Helm. Coll. No. 63044.

Remarks

Phlyctainophora squali differs from *P. lamnae* in the following characteristics: Adults and

intrauterine larvae of *P. squali* are smaller than those of *P. lamnae* measuring 2-14 mm versus 17 mm and 200-250 versus 330-350 respectively. They also differ in host and geographical distribution.

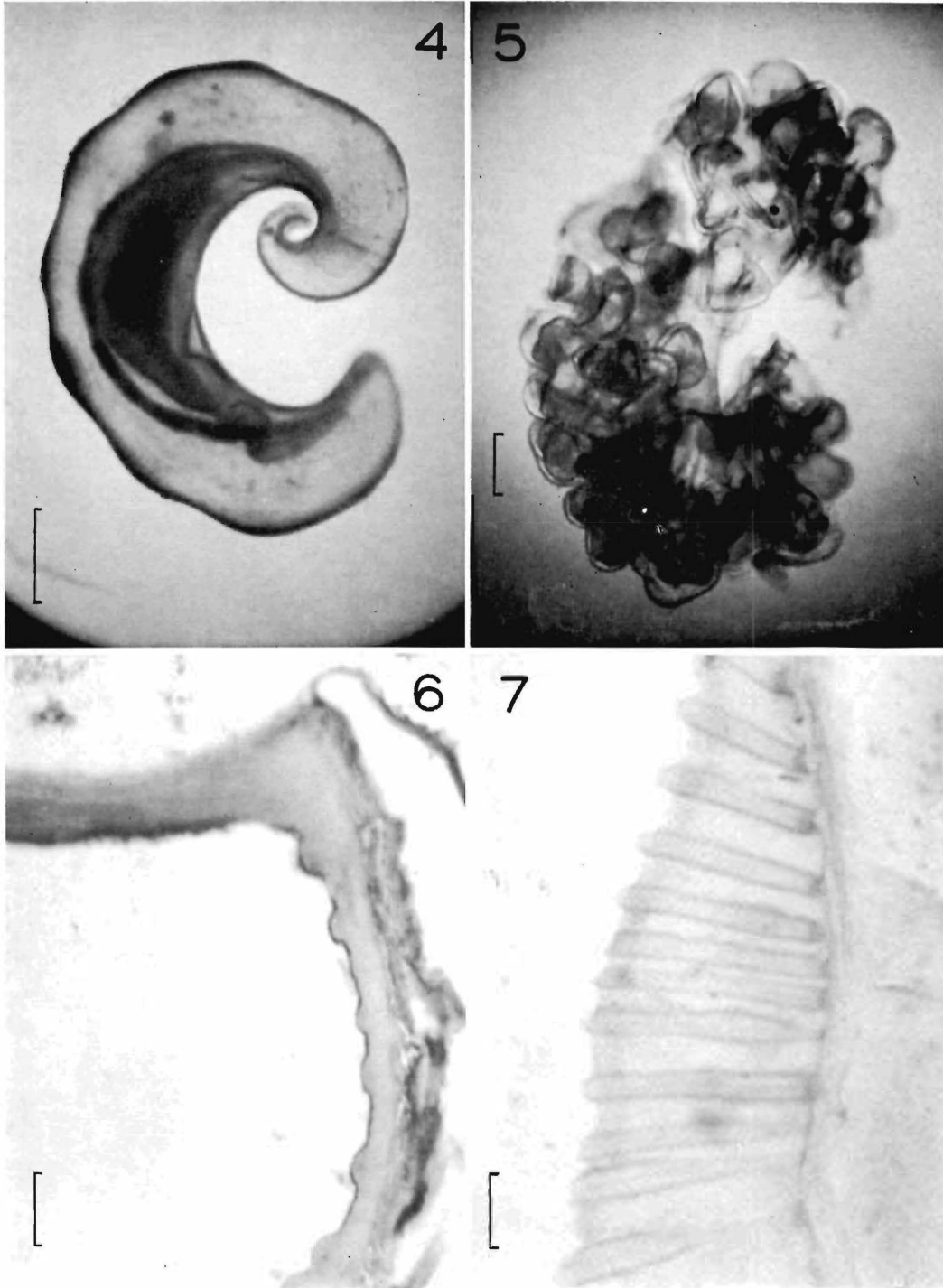
Discussion

The systematic position of *Phlyctainophora* is somewhat unsettled. Yorke and Maplestone (1926) and Yamaguti (1961) considered it a genus *incertae sedis*, while Johnston and Mawson (1943) suggested its placement in Philometridae. De Ruyck and Chabaud (1960) disagreed with the latter placement and considered the genus more closely related to *Muspicea* Sambon, 1925, and *Robertdollfus* Chabaud and Campano, 1960, on the basis of larval characteristics. Our adult specimens demonstrate that *Phlyctainophora* is more closely related to Philometridae in that it possesses a digestive system (not found in Robertdollfusidae) and lacks the bilobed tail structure found in *Muspicea*. The atrophication of vulva and anus, presence of a simple mouth, viviparity, and location of worms in connective tissue of fishes, combine to indicate that *Phlyctainophora* belongs in the Philometridae. The absence of an anterior ovary is here recognized as a modification of the more primitive didelphic condition. In this respect *Phlyctainophora* appears to be closely related to *Ichthyofilaria* Yamaguti, 1935, which has its anterior ovary reduced. The diagnosis of Philometridae Baylis and Daubney, 1926, is amended accordingly to read "Ovaries relatively short, situated at opposite ends of body or anterior ovary rudimentary or absent."

Rasheed (1963) has discussed characteristics of systematic importance in the family Philometridae and lists them as follows: 1. Size and shape of body. 2. The cuticle and its modifications. 3. Cephalic papillae. 4. The esophagus. 5. The tail. Regarding body shape and size she concluded that the "general shape of the body does not vary enough to give it any taxonomic importance." While this is true for

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Figures 4-7. *Phlyctainophora squali*. 4. Young female showing cuticular vesicles beginning to form (scale: 0.5 mm). 5. Older female with many pronounced cuticular vesicles (scale: 0.5 mm). 6. Cross section of cuticular annules (scale: 0.02 mm). 7. Optical section of dorsal surface of young female showing cuticular annules (scale: 0.02 mm).



the majority of Philometridae, adult *Phlyctainophora* are easily recognizable by their coiled shape and vesicular enlargements (Figs. 1, 4 and 5). The vesicles involve not only the cuticle, but also the hypodermis and muscular layers of the body wall. A wide range in size of adult *Phlyctainophora* indicates they follow the general philometrid growth pattern cited by Rasheed as continuing long after fertilization.

The cuticle and its modifications have been categorized by Rasheed into the following: smooth, bosses, rods and cones. In *P. squali* the corticle layer of the cuticle possesses annules running perpendicular to the longitudinal axis (Fig. 6, 7).

The small cephalic papillae (Fig. 2) of *P. squali* appear most similar to those found on *Philometra* (*Philometra*) *lateolabracis* Yamaguti, 1935.

The esophagus (Fig. 3) is typically philometrid with a slightly enlarged anterior and cylindrical posterior portion of uniform diameter.

Several observations made by Steiner (1921) on *P. lamnae* may now be reviewed in the light of the large number of specimens recovered in this study. Steiner indicated the mouth of *P. lamnae* to be located in a slight depression and the presence of a terminal anus. In *P. squali* the mouth is located on a small cephalic protrusion (Fig. 1) and the anus is completely atrophied. Steiner noted that cuticular vesicles appeared paired with a single vesicle located at the anterior end. *Phlyctainophora squali* shows no pairing or pattern of vesicles. Generally, more vesicles occur in older, larger worms, although one large specimen was almost devoid of them.

De Ruyck and Chabaud (1960) suggest the mode of transmission for *Phlyctainophora* to be cannibalism, the larva being passively transmitted from one shark to another. While this may be possible, the present writers observed openings to the outside in vesicles containing worms. This indicates that larvae may escape and *Phlyctainophora* would more likely require a copepod or similar small crustacean as a first intermediate host, as shown by previous work on the life cycles of Philometridae (Platzer and Adams, 1967).

Summary

Phlyctainophora squali sp. nov. is described from 23 female specimens recovered from the subcutaneous tissue of one of 440 *Squalis acanthias* caught off Los Angeles, California. This finding represents a new host and distribution for this genus. *Phlyctainophora* is placed in the family Philometridae on the basis of atrophication of vulva and anus, simple mouth, viviparity and location in tissue of fishes. The family diagnosis for Philometridae is amended to include *Phlyctainophora* which lacks an anterior ovary.

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