

***Mesidionema praecomasculatis* gen. et sp. n.;**
Mesidionematidae fam. n. (Drilonematoidea: Rhabditida),
a Nematode Parasite of Earthworms

GEORGE O. POINAR, JR.

Department of Entomology and Parasitology, University of California,
 Berkeley, California 94720

ABSTRACT: *Mesidionema praecomasculatis* gen. et sp. n.; Mesidionematidae fam. n. (Drilonematoidea: Rhabditida) is described from earthworms in West Africa. The new family is characterized by the presence of well-developed lips, an oval nonvalvated muscular pharynx, paired ovaries and a single spicule. Morphological and biological characters of the new species places it in an intermediate position between the Drilonematoidea and Thelastomatoidea. On the basis of data collected during this study, it is proposed that the Drilonematoidea are a specialized group which evolved from primitive members of the Thelastomatoidea.

Members of the superfamily Drilonematoidea occur in earthworms and are considered one of the most ancient groups of nematode parasites (Timm, 1964). They possess a number of specialized characters and very little is known of their bionomics or phylogeny.

The present paper describes a member of the Drilonematoidea which occurs in earthworms in West Africa. This nematode has morphological and biological characteristics showing distinct relationships with the Thelastomatoidea and suggests that the Drilonematoidea may have evolved from a primitive member of the Thelastomatoidea.

Materials and Methods

Two hundred specimens of the earthworm, *Eudrilus eugeniae* Kinberg (Eudrilidae: Oligochaeta), were collected in a ditch adjacent to the laboratory in Bouaké, Ivory Coast, West Africa. The above earthworms were maintained in a container of soil and periodically dissected in a 1.0% NaCl solution. Both the coelom and intestine of the earthworms were carefully examined for nematodes. All nematodes collected were first observed alive, then killed in hot 1.0% NaCl solution and processed to glycerin.

Results

Nematodes of the superfamily Drilonematoidea removed from the coelom and intestine of *E. eugeniae* were considered new to sci-

ence and a description follows below. In the quantitative portion of the description, all measurements are in microns, unless otherwise specified.

Mesidionematidae fam. n. (Drilonematoidea: Rhabditida)

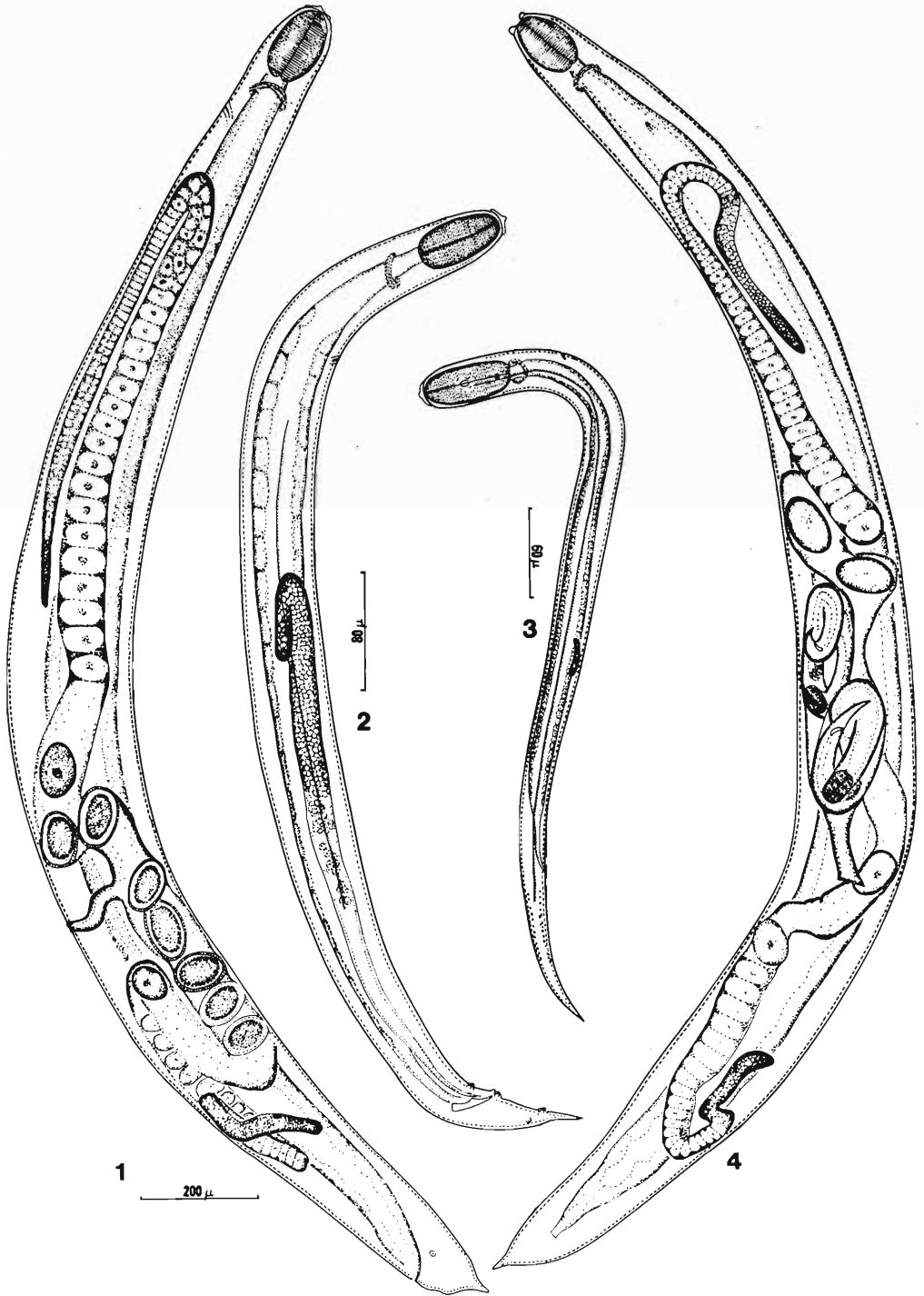
Stoma absent or greatly reduced; mouth hooks absent; lips well developed; pharynx oval, muscular, without corpus, isthmus or valvated bulb; ovaries paired; spicule single; phasmids not enlarged; found in the coelom and intestine of earthworms.

Mesidionema n. gen.

Head bearing two lateral lip regions; each lip region subdivided into three lips, a lateral and two submedial. Amphids slightly raised on tip of lateral lips; stoma absent; pharynx oval, muscular; nerve ring posterior to pharynx; ovaries outstretched or reflexed; phasmids porelike.

Mesidionema praecomasculatis sp. n.

Cuticle smooth, lateral alae present in males and young females; mouth terminal; head bearing two pronounced lateral lip regions, each composed of one lateral and two submedial (one subdorsal and one subventral) partially fused lips. Each submedial lip contains a pair of papillae, one located on the outer edge (representing an outer labial papilla) and one



extended into a filament which is directed inwards toward the mouth of the nematode (representing an inner labial papilla). Each lateral lip contains an inner small papilla (representing part of the inner labial papillary group) and a conspicuous peglike amphid. This results in six inner labial papillae, four outer labial papillae and two amphids. The stoma is absent. The pharynx is oval and muscular, without a valve; it is extremely complex and the anterior portion is capable of opening widely to grasp host tissue. When opened, each of the three sections of the pharynx bear six retrorse, anteriorly placed teeth. Young juvenile females possess ridges lining the walls of the basal portion of the pharynx (pseudovalve) and thickenings in the median portion of the pharynx. These characters, which are best seen in living specimens, are not visible in older specimens. Nerve ring encircles the anterior portion of intestine; excretory pore located posterior to the nerve ring; intestine composed of a single row of cells; vulva slitlike, vagina muscular, ovaries paired, flexed or extended at tip; two types of eggs produced; a thick-walled egg (wall composed of three major layers) which does not develop in the uterus and a larger thin-walled egg that develops "in utero" into males; anus distinct, functional; tail conical, with a short acute tip; phasmids porelike and located opposite anus in female, inconspicuous in male; testis single, flexed at tip; spicule single; gubernaculum and bursa absent; four pairs of genital papillae present.

FEMALE (N = 10) (Figs. 1, 3, 4, 5, 6, 8, 9): Length, 2,030 (1,150–2,640); width at vulva, 174 (100–220); distance from tip of head to base of pharynx, 111 (85–123); distance from tip of head to nerve ring, 125 (92–146); distance from tip of head to excretory pore, 202 (123–239); percent vulva, 62 (58–65); length of tail, 113 (91–124); dimensions of thick-walled eggs, 55–65 × 85–97; dimensions of thin-walled eggs, 108 × 220. Narrow lateral alae in juvenile and young adult females (2–

6) extends from the pharynx to just beyond the anus (Figs. 2, 3).

MALE (N = 10) (Figs. 2, 7, 10): Length, 696 (620–800); greatest width, 45 (39–64); distance from tip of head to base of pharynx, 50 (40–59); distance from tip of head to nerve ring, 73 (62–84); distance from tip of head to excretory pore, 109 (99–153); length of tail, 64 (59–74); length of spicule, 27 (22–33); reflexion of testis, 48 (25–93); diameter of spherical sperm cells, 4; lateral alae narrow (about 6 μ wide), extending from the excretory pore about to the middle of the vas deferens; tail with four pairs of anal papillae, one pair preanal, and three pairs postanal.

TYPE SPECIMENS: Holotype and allotype deposited in the collection of the Nematology Department, University of California, Davis, California.

TYPE HOST: *Eudrilus eugeniae* Kinberg (Eudrilidae: Oligochaeta).

TYPE HABITAT: Coelom and intestine.

TYPE LOCALITY: Bouaké, Ivory Coast, West Africa.

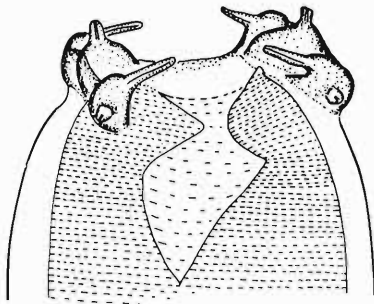
DIAGNOSIS: The present nematode shares characters found in both the Drilonematoidea and Thelastomatoidea and is unique among both superfamilies in having a simple, oval nonvalvated pharynx and six lips separated into paired lateral lip regions.

The present species is very similar to *Pharyngonema pheretimae* Timm (1959); however, the original description of *Pharyngonema* Pierantoni (1923) is very different from *P. pheretimae* Timm and the present species. Pierantoni (1923) described the genus *Pharyngonema* as possessing a swollen region in the anterior portion of the body, bristlelike papillae and a single ovary. The description is very brief, but the above characters clearly show that the *Pharyngonema* of Pierantoni is different from *M. praecomasculatus* and *P. pheretimae* Timm.

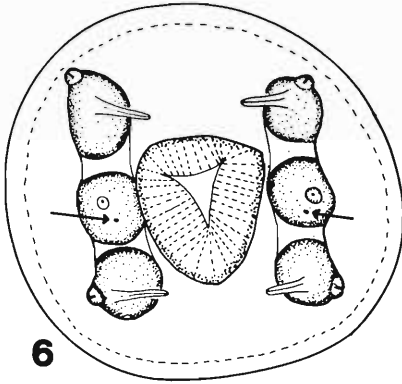
The nominal species *P. pheretimae* Timm agrees with all characters of the new genus *Mesidionema* and is hereby transferred to this

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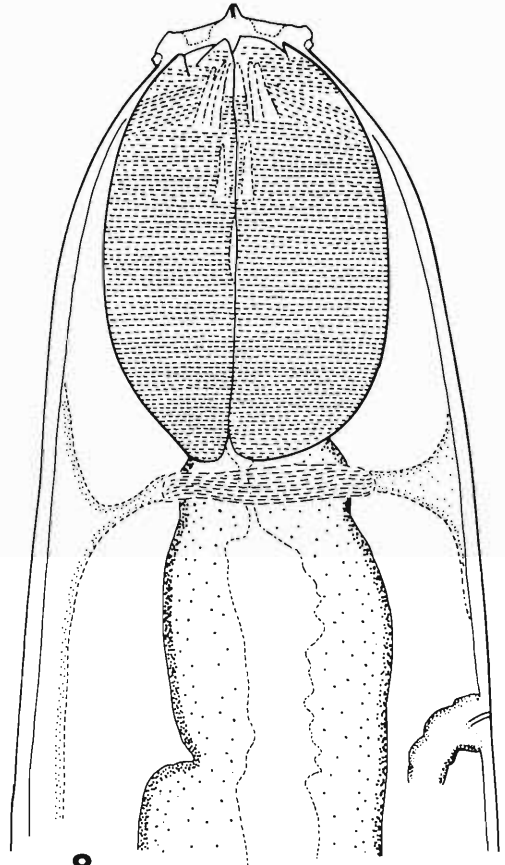
Figures 1–4. *Mesidionema praecomasculatis* gen. et sp. n. 1. Lateral view of a mature female with thick-walled eggs. 2. Lateral view of a male. 3. Lateral view of a newly hatched female. 4. Ventral view of a mature female with thin-walled eggs (same mag. as Fig. 1).



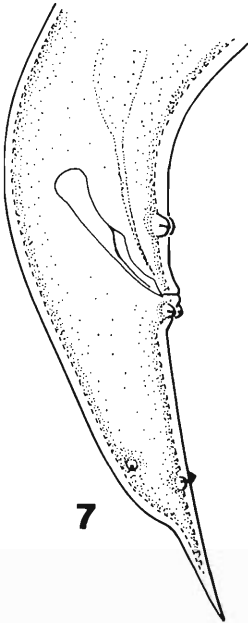
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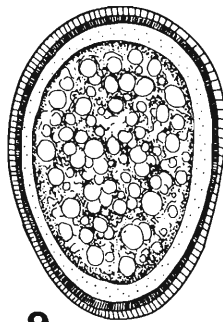
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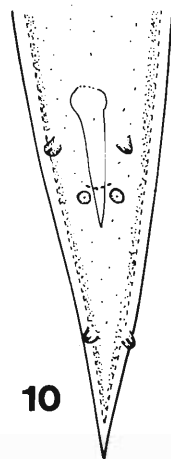
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genus. It can be easily separated from *M. praecomasculatis* by the shape of the pharynx (panduriform rather than oval) and tail (significantly longer). The lips of *M. pheretimae* as figured by Timm are withdrawn into the oral cavity, which also occurred during fixation in about half of the specimens of *M. praecomasculatis*. Living specimens of *M. pheretimae* probably would have shown a lip arrangement similar to that of *M. praecomasculatis*. Timm (1959) did not possess mature males or young juveniles of *M. pheretimae*.

BIOLOGICAL NOTES: Approximately 50% of all earthworms examined contained one or more specimens of *M. praecomasculatis*. Adult nematodes of both sexes as well as juvenile females were collected from the coelom of the host, whereas only adult and very young juvenile females were found in the earthworm's intestine. In the coelom, the nematodes were either moving freely or were anchored by their pharynx to various tissues of the host. The nematodes probably ingest material released from the damaged cells. Most of the females found in the body cavity contained thin-walled eggs in various stages of development. Some contained both thick-walled and thin-walled eggs. In contrast, nearly all the females found in the earthworm's intestine contained thick-walled eggs.

Males of *M. praecomasculatis* develop to maturity inside the thin-walled eggs in the uterus of the coelomic females. No juvenile males were collected in the soil or intestine of the host during this investigation. However, various stages of juvenile females were collected from the coelom of the earthworm. Young juvenile females were very active and thrashed about similar to free-living rhabditids. Soil containing infected earthworms was analyzed for nematodes but no free-living motile stages were found. From the above observations, a probable life cycle can be surmised. Female nematodes containing thick-walled eggs enter the intestine of the host and oviposit. The eggs pass out of the earthworm, develop

in the soil, and serve as the infective stage. The eggs hatch after being ingested by another earthworm, and the emerging juvenile females immediately enter the host's coelom. In this location, they grow and produce thin-walled eggs (either by parthenogenesis or hermaphroditism) that develop into males "in uteri." The males enter the host's coelom and mate (this is supposition since mating was never observed, but sperm identical to that found in the male occurred in the female oviducts), and this union produces thick-walled eggs. After producing a number of thick-walled eggs, the female again passes through the intestinal wall into the intestinal lumen for oviposition.

Discussion

It is now clear that *M. praecomasculatis* possesses characters of both the Drilonematoidea and Thelastomatoidea. With the former superfamily it shares a valveless pharynx, greatly reduced stoma and association with earthworms (coelom). With the latter superfamily, it shares paired ovaries, a single spicule, four pairs of genital papillae, lateral alae, and its association in the intestine (at least during part of its life) of the host.

Finding a "pseudovalve" in the basal portion of the pharynx of newly hatched juvenile females of *M. praecomasculatis* indicates that the nonvalvated pharynx characteristic of the adults is a secondary character. It is known that other rhabditids which have become parasitic and changed to a semiliquid diet (e.g., *Heterorhabditis*, *Neoaplectana*) have lost a distinct valve in the basal bulb which is so characteristic of microphagous forms. Since the Drilonematoidea probably obtain most, if not all, of their nourishment (semiliquid) from the coelom of earthworms, the basal valve so typical of the Thelastomatoidea has become vestigial.

The discovery that adult females of *M. praecomasculatis* enter the intestine of the

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Figures 5-10. *Mesidionema praecomasculatis* gen. et sp. n. 5. Ventral view of female head 6. En-face view of female (arrows indicate lateral inner labial papillae) (same mag. as Fig. 5). 7. Lateral view of male tail (same mag. as Fig. 5). 8. Lateral view of female head region. 9. Thick-walled egg. 10. Ventral view of male tail (same mag. as Fig. 5).

earthworm (presumably to deposit their eggs) shows a close biological tie with the Thelastomatoidea. It is interesting that a member of the genus *Thelastoma* also occurred in the intestine of *Eudrilus eugeniae*, along with *M. praecomasculatis*, showing for the first time that earthworms also serve as hosts for thelastomatoid nematodes. Primitive thelastomatoids living in the gut of earthworms could have entered the coelom and evolved forms which adapted to this niche. Once in this relatively unexploited habitat, further development could proceed rapidly, although certain specialized characters found in drilonematoids (e.g., mouth hooks, enlarged amphids and phasmids) may indicate a polyphyletic origin for this superfamily, whose members only share a valveless pharynx and common host group. The oval, muscular pharynx of *Mesidionema* is undoubtedly a further specialized adaptation for attachment to host tissue. On the basis of this study, the author proposes that the Drilonematoidea are a specialized group which evolved (at least in part) from primitive Thelastomatoidea. Many of the specialized morphological

characters of the Drilonematoidea could have been formed after this group split off from the thelastomatoids. Both the Thelastomatoidea and Drilonematoidea undoubtedly arose relatively early in the evolutionary scale.

Acknowledgments

The author is grateful to Dr. Bernard Philippon for providing space in his laboratory in Bouaké, Ivory Coast, West Africa for undertaking the present study.

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