rats with 100 metacercariae of the Brazilian strain failed.

*Echinostoma lindoense* also develops in the snail *Biomphalaria straminea* (Dunker), but the experimental infection rate is low. It varies from 0.5–3% upon exposure of each snail to 20 miracidia, compared to 30–50% in *B. glabrata*. The first intermediate host of the parasite in Central Celebes is *Gyraulus sarasinorum* Boll, and in West Malaysia *Gyraulus convexiulus*. In 1964 I reported that *E. lindoense* produces two redial generations in the snail, but I now find at least three. Production of at least three redial generations has also been observed in other species of echinostomes, i.e., *Echinostoma nudicaudatum* Nasir, 1960; *E. audyi* Lie and Umathevy, 1965; *E. hystricosum* Lie and Umathevy, 1965; *E. barbosai* Lie and Basch, 1966; *Echinoparyphium dunnii* Lie and Umathevy, 1965; *Hypodermaeum conoideum* (Bloch, 1782); *H. dingeri* Lie, 1964; *Isthmiophora spiculator* (Dujardin, 1845); and *Paryphostomum segregatum* Dietz, 1909.

**Summary**

*Echinostoma lindoense* Sandground and Bonne, 1940, a Southeast Asian parasite of man and animals, is also found in Brazil. Its first intermediate host is the snail *Biomphalaria glabrata* (Say). The worm also develops in *B. straminea* (Dunker) under experimental conditions. There are at least three redial generations. Certain aspects of its life cycle not previously covered are described, and the life cycle of the Brazilian strain is compared with that of the Malaysian *E. lindoense*. Both strains developed well experimentally in *B. glabrata* and in California chicks.

**Literature Cited**


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**Revision of the Genus Anaplectus (Nematoda: Plectidae)**

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**Introduction**

The genus *Anaplectus* was proposed by de Coninck and Schuurmans Stekhoven (1933) "for all those species, formerly reckoned to *Plectus* Bastian, which possess a crown of four cephalic setae and a set of preanal tubuli in the male sex." *Plectus granulosus* Bastian, 1865 was made the genotype. Prior to this time males were known for five other species, *P. cirratus* Bastian, 1865; *P. longicaudatus* Bütschli, 1873; *P. blancli* Hofmanner and Menzel, 1914; *P. Schneideri* de Man, 1880; and *P. tubifer* Cobb, 1914. Males of the first two species do not possess preanal tubuli and remained in *Plectus*. The last three species have preanal tubuli and were placed in *Anaplectus*.

The validity of the genus *Anaplectus* has been questioned by several authors. Schneider...
(1939), Goodey (1951) and Goodey (1963) placed the genus as a synonym of *Plectus* Bastian, 1865. Chitwood and Chitwood (1937), Maggenti (1961), Brzeski (1963), and Killick (1964) accepted *Anaplectus*. These differences of opinion resulted from the fact that the morphological characters upon which the genus was based were not sound. Cuticularized preanal tubuli and four cephalic setae are present in both *Plectus* and *Anaplectus* species. The most recent generic diagnosis by Brzeski (1963) indicates that *Anaplectus* differs from *Plectus* by the “widening prostom hexagonal in cross-section.” In this study of six species, additional morphological characters of the genus have been observed. These include the shape of the amphid aperture, lip configuration, presence of a collecting duct in the excretory system, and the outstretched anterior testis. These characters are discussed in detail in the section on morphology and the redescription of the genotype.

**Morphology**

Species of *Anaplectus* are typically cylindrical and vary in length from 0.6 to 2.0 mm. Males and females are similar in appearance, but males tend to taper less at the posterior end. The cuticle is transversely striated from the lip region to near the terminus. Laterally there are two alae which begin near the nerve ring and extend nearly to the terminus. A cervical papilla is located between the alae about one body width posterior to the nerve ring. Somatic setae occur only on the tails of females, the number varying from none to three pairs. These setae are small and often obscure.

The lips are obscure in profile view; they may be set off by a constriction or continuous with the body contour. Most authors have indicated there are six lips; however, in face views, the lip region is seen to consist of 12 sectors (Fig. 3b). There are six large sectors which conform to the lateral, subdorsal and subventral lips, each bearing a single papilla. The smaller sectors do not bear papillae. Similar modification of the lip region has not been reported previously for *Plectidae* or in the *Araeolaimida*. The genus *Plectus* with which *Anaplectus* has been synonymized does not have this type of lip region.

The four cephalic setae are situated two to five body annules posterior to the lips. These setae are relatively short and are sublateral in position.

The external openings of the amphids of *Anaplectus* are transverse and slitlike as indicated by Cobb (1914) in his description of *Plectus tubifer* = *A. tubifer* and by Killick (1964) for *A. arenicola*. When Bastian described *P. granulosus* in 1865, no mention was made of the lateral organs (amphids). However, Bütschli in 1873 emphasized the fact that he was able to see lateral organs in all *Plectus* species excepting *P. granulosus*. In 1876 and 1884 de Man illustrated and described *P. granulosus* as having circular amphids. This erroneous concept of the amphids of *P. granulosus* has been perpetuated in the literature to the present time excepting for the observations of Cobb and Killick. All of the standard reference works including de Coninck and Schuurmans Stekoven (1933), Chitwood and Chitwood (1937), Schneider (1939) and Goodey (1951, 1963) describe and illustrate *A. granulosus* as having circular amphids. In Goodey (1951, 1963) the nematode is described and figured as a typical representative of the genus *Plectus* and is figured as having circular amphids. Hirschmann in 1952 described and figured *P. submersus* = *A. submersus* as having circular amphids and more recently Brzeski (1963) in his emended diagnosis of the genus *Anaplectus* stated, “the amphids are circular or oval.” He also describes in the same paper *A. magnus* as having broadly oval amphids. These authors did not see the amphids but described and illustrated *Anaplectus* to conform with the concepts prevalent in the literature.

All *Anaplectus* species have a large number of conspicuous sublateral hypodermal glands which open to the surface of the cuticle in two rows of pores, one on either side of the lateral alae. The first of these glands is unpaired and the pore is located posterior to the amphid aperture. This pore might possibly have been mistaken for the amphidial aperture by some authors. In both sexes, there is always a papilla associated with the first or second lateral hypodermal pore. In most species it is dorsal to and near the first pore, but in one species this papilla is nearest the second lateral pore and it may be dorsal, ventral, or anterior to the pore. The laterodorsal series of glands extends to the
terminus, while the lateroventral series terminates near the anal opening.

One species of *Anaplectus* is characterized by having a dorsal and a ventral series of hypodermal glands with ducts opening to the surface of the cuticle. These begin near the stoma and continue posteriorly to about the level of the excretory pore. The dorsal and ventral series of pores appear to be similar to the sublateral series and the glands appear to be located in the dorsal and ventral chords.

The stoma of *Anaplectus* has been described by several authors. The cheilostom is globular in shape and its walls, the cheilorhabdions, are strongly cuticularized and hexaradiate in cross section. This is followed by the pro-mesometastom which is cylindrical, with less heavily cuticularized walls which are roughly triangular in cross section.

The esophagus is nearly cylindrical, with its diameter only slightly reduced posterior to the nerve ring. It is terminated by a large bulb with a strongly cuticularized denticulate valve. The valve is similar to that illustrated by Maggenti (1961) for *Plectus*. The esophageal lumen has tuboid radii for a distance of about one and one-half body diameters and then has convergent radii. The esophagus is terminated by an elongate nearly cylindrical esophageal valve which is about one-half a body diameter in length. The lumen of the esophageal valve is dorsoventrally compressed.

**Excretory system**

The most obvious feature of the *Anaplectus* excretory system is the long cuticularized excretory duct (Fig. 1). Maggenti (1961) has described the excretory system of *Plectus* in detail as consisting of a cuticularly lined terminal duct which extends to a single large uninucleate excretory cell. The odd looping of the terminal duct is largely within the tissue of the excretory gland. Similarly *Anaplectus* has a terminal duct which loops ventrally around the esophagus in a ventrally located excretory cell. This cell which partly surrounds the esophagus is highly modified in *Anaplectus*. On the right side there is a short posterior extension which connects to the thicker central portion containing the nucleus. On the left side, the gland has an elongated extension which extends posteriorly past the terminal esophageal bulb, and then enters or is closely appressed to the lateral chord. It extends to a point about 60 per cent of the body length from the lip region. In one female, *A. granulosus*, 1.4 mm in length, the gland extension terminated 0.85 mm from the head or 0.65 mm from the end of the esophagus. There are two subventral glands which appear to be connected to the excretory system. These glands are located just posterior to and on either side of the ventral gland. Thus the excretory system in *Anaplectus* consists of the long cuticularized terminal excretory duct, a ventral cell (sinus cell) which is modified on one side to form a lateral collecting canal presumably located in or near to the lateral chord, and two subventral glands. This system has many similarities to that in some Secernentea and supports previous suggestions (Chitwood and Chitwood, 1938) that the lateral collecting tubules in these systems could have arisen as outgrowths of the ventral sinus cell (Fig. 2a–f).

The collecting tubule is not readily seen in unstained specimens. If living specimens are placed in very dilute aqueous solutions of neutral red, the entire excretory system becomes lightly stained and the posterior extension of the ventral gland is easily seen when the living specimens are viewed under oil immersion. The collecting tubule was on the left side in all specimens examined.

**Reproductive system**

The female reproductive system is similar to that found in *Plectus* and consists of opposed gonads reflexed at the juncture of the ovary and oviduct. The male reproductive system consists of two opposed (diorchic) testes; an anterior outstretched testis and a posterior one that is reflexed near its center as indicated by Cobb (1914). The anterior testis is connected to the seminal vesicle by a duct (vas efferens) which lies along the side of the reflexed posterior testis. In all males that we have examined there is a pair of uninucleate glands associated with the vas deferens (Fig. 4f). These glands appear to be connected to the vas deferens just anterior to the cloaca, and may function as ejaculatory glands as in some *Rhabditis* species, Chitwood (1930).

The male tail, spicules, gubernaculum, and cuticularized tuboid supplements provide the best morphological characters for distinguishing the species of *Anaplectus*. The tuboid sup-
Supplements are large and conspicuous, and vary in number from two to five. There is intraspecific variation in the number of tuboid supplements. Hirschmann (1952) concluded that intraspecific variation in the number of tuboid supplements was not likely to occur and separated A. submersus from A. granulosus partly on this basis. However, Brzeski (1963) has pointed out that there may be variation in the number of supplements amongst males in populations of A. granulosus. This was also indicated by Cobb (1914) for P. tubifer. We have observed similar variations in other species. The tuboid supplements are connected to large unincuneate glands that are located in the right side of the body.

There is a subventral and subdorsal series of papillae on the male tail. The number and position of these papillae are variable in both series and minor differences are not useful specific characters. In order to minimize variation, illustrations were prepared to show the right side of the tail.

The spicules are arcuate and vary in size amongst the species. Except for differences in the size of the manubrium, the spicules are similar in all of the known species.

The gubernaculum is well developed and appears to consist of one piece. The corpus is a thin plate with lateral extensions that partly surround the spicules (Fig. 2i). Arising from the corpus there is a caudal projection of variable size which may or may not be associated with paired caudal apophyses (Fig. 2i). There is sometimes a small posteriorly directed process at the distal end of the gubernaculum. The well developed cuneus projects between the spicules and is bifurcate at the distal end (Fig. 2h). There are three caudal glands which open at the terminus, and except for one species, the spinneret is strongly cuticularized.

**Systematics**


**Diagnosis (Emended):** Cuticle with transverse striae and lateral alae. Lateral hypodermal glands in two sublateral rows, sometimes a partial dorsal and ventral series present. Lip region set off or continuous with body contour. Lips complex consisting of 12 sectors.

A single papilla present on the subdorsal, lateral, and subventral sectors. Four cephalic setae present. Stoma composed of two parts, the globular cheilostom with hexaradiate walls, and the pro-meso-metastom with triradiate parallel walls. Amphid openings transverse slits. Cervical papillae present. Esophagus consisting of corpus, isthmus and a terminal bulb with a denticulate valve. Esophageal radii tuboid in anterior corpus. Esophago-intestinal valve elongate; lumen dorsoventrally flattened. Excretory duct cuticularized. Ventral excretory cell elongated posteriorly and forming a collecting tubule. Vulva about equatorial. Female gonads amphididelphic and reflexed. Tail conoid-cylindrical with three caudal glands. Spinneret present, orifice usually cuticularized. Male testes paired, opposed with the posterior one reflexed. Males with two to five large, cuticularized preanal tubuli. Spicules arcuate, gubernaculum well developed with a caudal process and a bifurcate cuneus. Subdorsal and subventral papillae present on male tail.

**Type species:** Anaplectus granulosus (Bastian, 1865) de Coninck and Schuurmans Stekhoven, 1933.

The genus Anaplectus differs from Plectus Bastian, 1865, in the shape of the stoma, the modified lip region with 12 sectors, the slitlike transverse amphid openings and the presence of a collecting duct in the excretory system, numerous lateral hypodermal glands and the outstretched anterior testis.

**Anaplectus granulosus** (Bastian, 1865) de Coninck and Schuurmans Stekhoven, 1933 (Fig. 1 and Fig. 2, a-i)


**Dimensions**

**Females** (84): \( L = 0.7-1.5 \text{ mm}; a = 20-39; b = 4-6; c = 12-23; V = 10^{4-5} 46-57^{a-22}; \)
Figure 1. *Anaplectus granulosus* male.
Figure 2. *A. granulosus*: a, male head; b, female tail; c, variation in tuboid supplements; d, e, f, left lateral, ventral, right lateral views of excretory system; g, spicule, gubernaculum and first tubule; h, gubernaculum cross section through cuneus; i, gubernaculum cross section through caudal projection and caudal apophysis. *A. varicaudatus*: j, male head; k, female tail; i, male tail; m, spicule, gubernaculum and first tubuli.
Stoma* = 15–30 μ; Amphid* = 5–11 μ; Ex. Porc* = 69–146 μ; T/ABD** = 1.6–2.7.

Males (75): L = 0.7–1.2 mm; a = 21–39; b = 4.0–6.4; c = 11–19; T = 47–84; Stoma = 15–28 μ; Amphid = 5–11 μ; Ex. Porc = 73–132 μ; T/ABD = 1.4–2; 1st Tuboid Suppl. = 14–27 μ; Spicules = 35–50 μ; Gubernaculum = 8–15 μ.

Male (Neotype): L = 1.0 mm; a = 35; b = 5.4; c = 15.3; T = 73; Stoma = 22.0 μ; Amphid = 7.5 μ; Ex. Porc = 103 μ; T/ABD = 1.8; 1st Tuboid Suppl. = 17.5 μ; Spicule = 40.0 μ; Gub. = 10.5 μ.

Lip region set off by constriction, not striated. Cephalic setae arising at level of third annule. Amphids located eight annules from lip region, and anterior to middle of stoma. First lateral pore 2.7 μ posterior to amphid opening. A papilla adjacent and dorsal to the first lateral pore. Annules in cervical region 0.07–1.6 μ wide. Cervical papillae in lateral field one body width posterior to nerve ring. Lateral field consisting of two alae beginning posterior to stoma and extending almost to terminus. The lateral field appears as three lines. A sublateral series of about 160 hypodermal glands.

The stoma consists of a globular cheilostom and the subcylindrical pro-meso-metastom. The pro-meso- and metarhabdions enclosed in esophageal tissue. Corpus and isthmus not well differentiated, nerve ring appears to encircle the posterior end of corpus. Esophageal valve elongate, one-half body length in length. Excretory pore opening one-half body width posterior to nerve ring.

Three heavily cuticularized preanal tubuli; the first opening 13 μ, the second 37 μ, and the third 85 μ, anterior to the cloacal opening. First tubuli less than one-half the length of the spicules. Spicules arcuate, manubrium expanded, wider than calamus and blade. Gubernaculum with a dorsal projection from corpus. Paired caudal apophyses present (Fig. 2i). Cuneus projecting between spicules and bifurcate at distal end (Fig. 2h). Margins of corpus partially enclosing spicules, serving as crura (Fig. 2i). Subventral papillae; four on the tail and three preanal. Six subdorsal papillae extending to midway of the spicules. A large median papilla located about midway between first preanal tubuli and cloacal opening. A coelomocyte located anterior to caudal glands. Spinear cuticularized.

Female: Similar to male. Lateral papillae near and dorsal to first lateral pore. Lips of vulva protruding in fixed specimens. Two lateral alae, marked by three lines. Ovaries reflexed. Usually not more than one egg in uterus. Rectal glands present. Approximately 162 sublateral hypodermal pores on each side of body. Tail conoid and curved. Three caudal glands and associated coelomocyte present. Three pairs of small setae near terminus. Spinear cuticularized.

Neotype: Male collected 11 December 1959, by Mr. F. C. Peacock. Catalogue number 838, University of California Nematode Survey Collection, Davis.

Topotypes: Two females and one male same data as neotype.

Type habitat: Soil around stubble.

Type locality: Broadmoor, England.

Bastian’s original description of A. granulosus was based upon females. A male from the type locality is designated as a neotype because the morphological features of males provide a better basis for species recognition than do those of females.

Diagnosis

A. granulosus differs from A. submersus, A. similis n. sp., A. varicaudatus n. sp., and A. porosus n. sp. in having the lip region set off by constriction. From A. magnus it differs in size, the shape of the spicules and the absence of a distal projection on the gubernaculum.

Paratype females of A. arenicola Killick, 1964 could not be distinguished from females of A. granulosus. The presence of the slitlike amphidial opening of A. arenicola was given as a differentiating character but as is indicated in the generic diagnosis this is characteristic of all Anaplectus species. Marinoplectus tetrapapillatus Kreis, 1963 was described as a marine species from collections made in Iceland. The figures and description indicate that the single male and female are Anaplectus granulosus despite the author’s statement that a valvular apparatus was not present in the esophageal bulb. Collections made by Dr. J. Klingler from the type locality of Plectus blanct Hofmanner and Menzel, 1914 contained
Figure 3. *A. submersus*: a, male head; b, face view; c, male tail; d, variation in tuboid supplements; e, female tail; f, spicule, gubernaculum and first tuboid supplement. *A. magnus*: g, female tail; h, female head; i, spicule, gubernaculum and first tuboid supplement; j, male tail.
many specimens of *A. granulosus* and we believe that this species is a synonym of *A. granulosus* as indicated by other authors.

Commonly the males of *A. granulosus* have three preanal tuboid supplements, but occasional specimens are encountered with two or four supplements or rarely with none.

Specimens of this species have been collected in the United States from California, Florida, Hawaii, Kansas, Maryland, Minnesota, New Mexico, New York, South Carolina, South Dakota, Utah, Washington, and Wisconsin. Also from Austria, England, Galapagos Islands, Germany, Ireland, Italy, Lichtenstein, Netherlands, Republic of South Africa, Sweden, Switzerland, and Yugoslavia.

*Anaplectus submersus* (Hirschmann, 1952)

**Maggenti, 1961 (Fig. 3, a–f)**


**Dimensions**

**Females (32):** L = 1.0–1.7 mm; a = 23–41; b = 4.5–6; c = 12–23; V = 11–24; 44–568–20; Spicule = 20–34 μ; Amphid = 8–13 μ; Ex. Pore = 114–186 μ; T/ABD = 2–3.

**Males (30):** L = 0.8–1.9 mm; a = 26–44; b = 4–6; c = 13–20; T = 51–69; Stoma = 19–33 μ; Amphid = 7–13 μ; Ex. Pore = 100–178 μ; T/ABD = 1.7–2.6; 1st Tuboid Suppl. = 21–33 μ; Spicules = 34–51 μ; Gub. = 10–17 μ.

Specimens of *A. submersus* were not available from the type locality and the following description is made of a male collected in Wageningen, The Netherlands.

**MALE (Wageningen):** L = 1.9 mm; a = 36; b = 6; c = 20; T = 62; Stoma = 30 μ; Amphid = 8 μ; Ex. Pore = 168 μ; T/ABD = 2; 1st Tuboid Suppl. = 30 μ; Spicule = 47 μ; Gub. = 16 μ.

Lip region continuous, no striations. Base of cephalic setae at fourth annule. Amphidial opening located anterior to middle of stoma, at about the eighth annule. First lateral pore 3 μ posterior to amphidial opening. A lateral papilla is located 1 μ posterior and dorsal to first lateral pore. Width of cervical annules range from 1.1 to 1.5 μ. Cervical papilla two-thirds body width posterior to the nerve ring. Lateral field consists of two alae and three lines, beginning anterior to the nerve ring and extending almost to terminus. Length of esophago-intestinal valve about one-third body width. Excretory pore opening adjacent to nerve ring. Four heavily cuticularized tuboid supplements, first 9 μ, second 35 μ, third 91 μ, fourth 158 μ anterior to cloacal opening. First tubuli about two-thirds the length of the spicules. Spicules with manubrium not exceeding width of the adjacent part of spicule. Gubernaculum with a dorsal projection from the corpus and a small projection at the distal end. No paired caudal apophysis. The dorsal projection of the cuneus is bifurcate and sharply pointed. Six subventral papillae on the tail, and three preanal papillae which extend anterior to the second tubuli. Seven subdorsal papillae on the tail. A median papilla is located halfway between the cloacal opening and the first tubuli. Spinneret cuticularized.

**FEMALE:** Similar to males. Lateral papillae near and dorsal to first lateral pore. Cephalic setae fourth to sixth annules lip region. Lips of vulva protruding only slightly in fixed specimens. Two lateral alae marked by three lines. Ovaries reflexed. Rectal glands present. Number of lateral hypodermal pores variable (110–186). Tail conoid, curved. Three caudal glands and associated coelomocyte present in tail. Two pair of small setae near tail terminus. Spinneret cuticularized.

**Diagnosis**

*A. submersus* can be distinguished from other species of *Anaplectus* by the continuous lip region, the size of the manubrium, absence of paired caudal apophysis and the large tuboid supplement. This species resembles *A. similis* but differs in lacking paired caudal apophysis and in having a longer first tuboid supplement.

Thirty-eight males of *A. submersus* were examined; 24 had four tuboid supplements, 13 had three, and one had five. As in other species in the genus, identification cannot be based solely upon the number of tubuli in the male. Distinguishing morphological differences are spicules, gubernaculum and supplement size. Females of *A. submersus* and *A. similis* differ in size, length of tail, and shape of the lip region.

Specimens of this species have been examined from Canada, Japan, The Netherlands, California, Colorado, and Utah.
Figure 4. *A. similis*: a, female head; b, female tail; c, male tail; d, variation in tuboid supplements; c, spicule, gubernaculum and first tuboid supplement; f, gland associated with vas deferens.

Anaplectus similis n. sp.
(Fig. 4, a-f)

Dimensions

**Females** (44): L = 1.2–1.6 mm; a = 26–48; b = 5–7; c = 13–18; V = 71746–55712; Stoma = 26–35 μ; Amphid = 7–13 μ; Ex. Pore = 124–172 μ; T/ABD = 1.6–2.7.

**Males** (19): L = 1.1–1.7 mm; a = 25–37; b = 5–7; c = 12–17; T = 56–68; Stoma = 26–37 μ; Amphid = 8–11 μ; Ex. Pore = 132–168 μ; T/ABD = 1.9–2.3; 1st Tuboid Suppl. = 19–26 μ; Spicules = 44–53 μ; Gub. = 10–14 μ.

**Male** (Holotype): L = 1.4 mm; a = 35; b = 5.4; c = 16.6; T = 64; Stoma = 34 μ; Amphid = 8 μ; Ex. Pore = 154 μ; T/ABD = 2; 1st Tuboid Suppl. = 20 μ; Spicule = 48 μ; Gub. = 12 μ.

Lip region not set off by a constriction, no striations. Base of cephalic setae at about the fourth annule. Amphidial opening anterior to middle of stoma, at the seventh annule. First lateral pore 2.5 μ posterior to amphidial opening. A lateral papilla located dorsal and adjacent to first lateral pore. Width of annules in the cervical region from 1.0–1.5 μ. Cervical papilla about two-thirds body width posterior to nerve ring. Lateral field composed of two alae and three lines, beginning at level of nerve ring and extending almost to terminus. Posterior bulb about one-half the width of the body. Esophago-intestinal valve one-half body width in length. Excretory pore at level of nerve ring. Four heavily cuticularized preanal tuboid supplements, first located 15 μ anterior
to cloacal opening, second 46 μ, third 114 μ, and the fourth 174 μ. First tubuli about one-half the length of the spicules. Spicules and gubernaculum similar to *A. granulosus* but with smaller manubrium. Five subventral papillae on the tail and three preanal. Eight subdorsal papillae extending to the level of the second tubuli. A large preanal median papilla located midway between the cloacal opening and first tuboid supplement.

**Female:** Similar to male. Vulva protrudes slightly in fixed specimens. Approximately 142 lateral pores on each side of body. Lip region not set off by constriction, no striations. Base of cervical setae at fourth annule. Amphidal opening anterior to middle of stoma at seventh annule. First lateral pore opens 2.5 μ posterior to amphidal opening. Lateral papilla located dorsal and adjacent to first lateral pore. Annule width in cervical region from 1.0–1.5 μ. Cervical papilla about one-half body width posterior to nerve ring. Lateral field consists of two alae and three lines, beginning anterior to nerve ring and extending almost to terminus. Oval posterior bulb about one-half the body width. Esophago-intestinal valve about one-half body width in length. Excretory pore adjacent to nerve ring. Tail conoid and elongate. Two small setae on the right and one on the left side near terminus. Spine
eret cuticularized.

**Holotype:** Male collected 19 July 1957, by Mr. Gerald Thorne. Catalogue number 839, University of California Nematode Survey Collection, Davis.

**Paratype:** Forty-three females and 20 males, same data as holotype distributed as follows: 42 females and 19 males, University of California, Davis; one female and one male deposited USDA Nematode Collection, Nematology Investigations, Beltsville, Maryland; one female and one male Wageningen, The Netherlands.

**Type habitat:** Soil around the roots of Maple.

**Type locality:** Wasau, Wisconsin.

**Diagnosis**

*A. similis* can be distinguished from *A. granulosus* by the shape of the lip region and the number of tuboid supplements. It differs from *A. submersus* in having paired caudal apophysis, manubrium exceeding the width of the adjacent part of the spicule, and a shorter first tuboid supplement which is about one-half the length of the spicules.

Males of *A. similis* usually have four tuboid supplements. In the populations examined, 19 of the males had four tubuli and three had five.

Specimens of this species were also found at Wisconsin Rapids, Wisconsin, in soil around the roots of Jack Pine.

**Anaplectus porosus** n. sp.

(Fig. 3, a–f)

**Dimensions**

**Females (2):** L = 1.6 mm; a = 34–35; b = 5.7; c = 22–24; V = 1253–5411-12; Stoma = 23–25 μ; Amphid = 8–9 μ; Ex. Pore = 160–164 μ; T/ABD = 2.3–2.5.

**Males (5):** L = 1.5–1.7 mm; a = 30–39; b = 5–6; c = 20–24; T = 54–68; Stoma = 26–30 μ; Amphid = 7–8 μ; Ex. Pore = 140–160 μ; T/ABD = 1.8–2.1; 1st Tuboid Suppl. = 37–42 μ; Spicules = 46–52 μ; Gub. = 11–13 μ.

**Male (Holotype):** L = 1.5 mm; a = 30; b = 5.6; c = 20; T = 54; Stoma = 26 μ; Amphid = 7 μ; Ex. Pore = 140 μ; T/ABD = 1.9; 1st Tuboid Suppl. = 38 μ; Spicule = 47 μ; Gub. = 12 μ.

Lip region continuous with body contour. Base of cephalic setae at fourth annule. Amphidal opening at the seventh annule, anterior to middle of stoma. First lateral pore 3.5 μ posterior to amphidal opening. A lateral papilla 9.5 μ posterior to first lateral pore. Cervical annule width from 1.0–1.5 μ. Cervical papillae about one-half body width posterior to nerve ring. Lateral field consists of two alae and three lines, beginning anterior to nerve ring and extending almost to terminus. Posterior bulb about two-thirds body width. Esophago-intestinal valve less than one-half body width in length. Excretory pore adjacent to nerve ring. A dorsal series of 12 hypodermal pores beginning one-fourth body width posterior to nerve ring, extending to lip region. Ventrally a series of eight hypodermal pores beginning anterior to excretory pore and extending to lip region. About 200 lateral hypodermal pores on either side of body. Three heavily cuticularized preanal tuboid supplements, first 10 μ anterior to cloacal opening, second 33 μ, third 88 μ. First tuboid supplement three-fourths as long as spicules (38/47).

Gubernaculum with a long, narrow dorsal and

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Figure 5. *A. porosus*: a, male head; b, anterior end showing dorsal, lateral and ventral series of hypodermal glands; c, male tail; d, male with three tuboid supplements; e, spicule, gubernaculum and first tuboid supplement; f, end of female tail.

A small distal projection from corpus. Paired caudal apophyses present. Cuneus projecting between the spicules, the distal ends bifurcate, long and sharply pointed. Five subventral caudal papillae; three preanal papillae extending about to level of the second tuboid supplement; one adanal papilla. Six subdorsal papillae extending anteriorly to level of cloacal opening. One lateral papilla located just anterior to tail terminus. No median papilla between cloacal opening and first tuboid supplement. Spinneret cuticularized.

**FEMALE:** Similar to male. Vulva not protruding in fixed specimens. About 194 lateral hypodermal pores on each side of the body. Thirteen dorsal hypodermal pores beginning about one-half body width posterior to nerve ring and extending to lip region. A series of nine or ten ventral pores beginning anterior to the excretory pore and extending to the lip region. Lip region not set off by constriction. Base of cephalic setae at fourth annule. Amphidial opening at seventh annule and located anterior to middle of stoma. First lateral pore 3 μ posterior to amphidial opening. A lateral papilla located 8 μ posterior to first lateral pore. Width of cervical annules from 1.3 to 1.5 μ. Cervical papillae located about one-half body width posterior to nerve ring. Lateral field consists of two alae and three lines, beginning anterior to nerve ring and extending posterior almost to terminus. Esophageal bulb about two-thirds body width. Esophago-intestinal valve about one-third body width in length. Excretory pore adjacent to nerve ring. Two small setae near terminus. Spinneret cuticularized.

**HOLOTYPE:** Male collected 14 October 1962,
by Dr. D. J. Raski. Catalogue number 840, University of California Nematode Survey Collection, Davis.

Paratypes: Two females and four males, same data as holotype, distributed as follows: two females and three males, University of California, Davis; one male USDA Nematode Collection, Nematology Investigations, Beltsville, Maryland.

Type Habitat: Soil around the roots of
Pinus sp.

Type Locality: Tangmarg, Kashmir, India.

On trail halfway between Tangmarg and Gulmarg, elevation about 6,500 feet.

Diagnosis

A. porosus can be distinguished from other species by the presence of an anterior series of dorsal and ventral hypodermal pores. The number of glands in the dorsal and ventral series is variable amongst the five males in the collection from India. The dorsal series varied from 10 to 14 in number and the ventral series from eight to 11. Specimens from two other localities, Scotland and Australia, show some deviation in the number and position of these pores. The ventral series has one to three pores posterior to the excretory pore. In addition the position of the papilla associated with the first lateral pore differed in these populations. In the Scottish and Australian specimens the papilla was near to the first lateral pore rather than the second as in the India specimens. These variations are considered to be within the probable morphological variation of the species.

The five males from India also vary in the number of preanal tubuli. Three of the males have three tubuli and two have four. Two males from Scotland each have four tubuli. The collection from Australia consisted of two females.

Anaplectus varicaudatus n. sp. (Fig. 2, j-m)

Dimensions

Females (8): L = 0.8–0.9 mm; a = 25–33; b = 5–7; c = 16–20; V = 12.5; 48–53; 14–29; Stoma = 22–26 μ; Amphid = 4–7 μ; Ex. Pore = 81–102 μ; T/ABD = 1.8–2.5.

Males (8): L = 0.7–1.2 mm; a = 25–32; b = 4–6; c = 17–22; T = 42–78; Stoma = 21–31 μ; Amphid = 4–7 μ; Ex. Pore = 86–125 μ; T/ABD = 1.3–1.8; 1st Tuboid Suppl. = 15–17 μ; Spicules = 35–48 μ; Gub. = 7–12 μ.

Male (Holotype): L = 0.76 mm; a = 29; b = 5; c = 18; T = 78; Stoma = 26 μ; Amphid = 5 μ; Ex. Pore = 94 μ; T/ABD = 1.4; 1st Tuboid Suppl. = 15 μ; Spicule = 40 μ; Gub. = 7 μ.

Lip region not set off by constriction, not striated. Cephalic setae short and robust, base at second annule. Amphidial opening located at posterior end of cheilostom, about at third annule. First lateral pore 2 μ posterior to amphidial opening. A lateral papilla located dorsal and adjacent to first lateral pore. Width of cervical annules from 1.0–1.5 μ. Cervical papillae located about one-third body width posterior to nerve ring. Lateral field with two alae and three lines. Esophageal bulb about two-thirds body width. Length of esophagointestinal valve about one-half body width. Excretory pore opening adjacent to nerve ring. Three cuticularized tuboid supplements, first 11 μ, second 28 μ, third 56 μ anterior to cloacal opening. First tubuli about one-third the length of the spicules. Manubrium set off from the rest of the spicules. Gubernaculum with a dorsal projection from corpus. Four subventral papillae on the tail, two preanal papillae located at anterior ends of first and second tubuli. Five subdorsal papillae on the tail. A median papilla located halfway between cloacal opening and first tubuli. Spinneret not cuticularized. Coelomocyte located anterior to glands.

Female: Similar to male. Vulva protrudes in fixed specimens. About 98 lateral hypodermal pores on each side of the body. Lip region not set off by a constriction. Cephalic setae short and robust, arising at second annule. Amphidial opening at second annule, about level with posterior part of cheilostom. First lateral pore 2.5 μ posterior to amphidial opening. Lateral papilla adjacent and dorsal to first lateral pore. Width of cervical annules from 1.0 to 1.8 μ. Cervical papilla about one-third body width posterior to nerve ring. Lateral field width of two alae and three lines. Esophageal bulb about one-half as wide as body. Esophago-intestinal valve length slightly less than one-half body width. Excretory pore opening adjacent to nerve ring. Spinneret not cuticularized. Two pair of small setae near terminus.
**Diagnosis**

A. varicauudatus differs from other species of *Anaplectus* in lacking a cuticularized spinneret. The amphidial openings are more anterior than in other species and the first tuboid supplement is less than half the length of the spicules.

Specimens of this species were also collected in soil from Kansas and South Carolina.

*Anaplectus magnus* Brzeski, 1963

(Fig. 3, g–j)

**Dimensions**

**FEMALE (Allotype):** L = 2.0 mm; a = 39; b = 7; c = 19; V = 184716; Stoma = 30 μ; Amphid = 16 μ; Ex. Pore = 149 μ; T/ABD = 2.

**MALE (Holotype):** L = 1.9 mm; a = 58; b = 7; c = 26; T = 72; Stoma = 30 μ; Amphid = 13 μ; Ex. Pore = 143 μ; T/ABD = 1.5; 1st Tuboid Suppl. = 20 μ; Spicule = 49 μ; Gub. = 15 μ.

**MALE (Holotype):** Lip region set off by a deep constriction. Base of cephalic setae at third annule. Amphidial opening at eighth annule. First lateral pore 18 μ posterior to amphidial opening. A large lateral papilla is located 6.5 μ posterior to amphidial opening, almost one-half the distance between first lateral pore and amphid aperture. Width of cervical annules from 0.8–2.0 μ. Excretory pore opening adjacent to nerve ring. Cervical papilla located one-third body width posterior to nerve ring. Posterior bulb more than one-third body width. Esophago-intestinal valve about one-third body width. Lateral field with two alae and three lines. Two cuticularized tuboid supplements located anterior to cloacal opening, the first 26 μ and the second 46 μ. Gubernaculum with a dorsal and distal projection. Paired caudal apophysis present. Cuneus not seen. First tuboid supplement less than one-half the length of spicules. Manubrium of spicules not exceeding width of calmus. Series of nine subventral papillae, five on the tail and four preanal papillae extending almost to second tuboid supplement. Five subdorsal papillae on the tail. A large median papilla located one-half way between the cloacal opening and the first tuboid supplement. Spinneret cuticularized.

**FEMALE (Allotype):** Similar to male. Vulva not protruding in fixed specimen. Lip region set off by a deep constriction. Base of cephalic setae at third annule. Amphidial opening located at sixth annule. First lateral pore 17 μ posterior to amphidial opening. A lateral papilla is located 5.5 μ posterior to amphidial opening and anterior to first lateral pore. Width of cervical annules range from 1.0–1.5 μ. Excretory pore opening adjacent to nerve ring. Posterior bulb width about one-half body width. Three setae on tail. Spinneret cuticularized.

**Holotype:** Male collected 1961, by M. Stradowski. Catalogue number 442, University of California Nematode Survey Collection, Davis. Deposited at Davis by M. Brzeski.

**Allotype:** Female, same data as holotype. Catalogue number 443, University of California Nematode Survey Collection, Davis.

**Type locality:** Soil around psammon.

**Type locality:** Wolin Island, Poland.

**Diagnosis**

*A. magnus* differs from *A. granulosus* by the shape of the gubernaculum, the reduced diameter of the manubrium and the number of tuboid supplements. The set off lip region distinguishes *A. magnus* from other species in the genus.

*A. magnus* is known only from the type specimens. In the description of the species Brzeski (1963) indicated that the amphid apertures were oval. However, examination of the types indicates that the large circular papilla posterior to the slitlike amphid aperture was illustrated as the amphid opening. In the original description the vulva was indicated to be at 39%. Measurements of the same female specimen shows the vulva to be at 47%.

**Summary**

*Anaplectus granulosus* is redescribed from a neotype collected from the type locality.
**A. magnus** is redescribed from the type specimens and an emended description of **A. submersus** is presented. **A. similis** n. sp., **A. vari caudatus** n. sp., and **A. porosus** n. sp. are described. The generic diagnosis of **Anaplectus** is emended to include new information on the excretory system, lip region and amphids. **A. arenicola** and **Marinoplectus tetrapapillatus** are synonymized with **A. granulosus**.

**Key to Males**

1. Cuticularized spinneret present .......... 2
   Cuticularized spinneret absent

2. Dorsal and ventral hypodermal glands present .......... **A. porosus** n. sp.
   Dorsal and ventral hypodermal glands absent .......... 3

3. Lip region set off by constriction .......... 4
   Lip region not set off by constriction .... 5

4. Manubrium expanded, larger than blade, gubernaculum without distal projection, tuboid supplements usually three .......... **A. granulosus**
   Manubrium not expanded, gubernaculum with a prominent distal projection, tuboid supplements two .......... **A. magnus**

5. First tuboid supplement small, one-half or less length of spicule. Paired caudal apophysis present .... **A. similis** n. sp.
   First tuboid supplement large exceeding one-half length of spicule. Paired caudal apophysis absent .... **A. submersus**

**Literature Cited**


