PROC. BIOL. SOC. WASH.
105(1), 1992, pp. 136–142

# CLAUSOGNATHIIDAE, A NEW FAMILY OF GNATHOSTOMULIDA FROM BELIZE

Wolfgang Sterrer

*Abstract.*—*Clausognathia suicauda,* a new genus and species of Gnathostomulida, is described from subtidal sand in the vicinity of Carrie Bow Cay, Belize, and a new family, Clausognathiidae, is created within the lower Bursovaginoidea-Scleroperalia. The novel features of *Clausognathia* consist of the combination of a filospermoid rostrum and sensorium with a scleroperalian pharynx and male system; the relatively anterior position of the male organ; and the differentiation of the hindgut as a solid, lumen-less tissue composed of large, succulent cells. The latter feature might function as a chordoid organ, or be the site of prokaryotic endosymbionts.

---

Collections of sand-living meiofauna made in the vicinity of Carrie Bow Cay, Belize (Rützler & Macintyre 1982) in 1974, 1984 and 1991 yielded about 20 different species of Gnathostomulida, some of them new. While a complete account of this fauna is now being prepared, the most curious of the new species, which merits erecting a new genus and family, is described herein.

Sediment samples were collected by Scuba, with a bucket, and treated as described previously (Sterrer 1971a). The methods of analyzing and describing specimens and species, including measurements and indices used, are as detailed in Sterrer (1991).

## Order Bursovaginoidea Sterrer, 1972

*Composition.*—Two suborders, Scleroperalia Sterrer, 1972, and Conophoralia Sterrer, 1972.

## Suborder Scleroperalia Sterrer, 1972

*Composition.*—Seven families, Agnathiellidae Sterrer, 1972; Mesognathariidae Sterrer, 1972; Gnathostomariidae Sterrer, 1972; Rastrognathiidae Kristensen & Nørrevang, 1977; Problognathiidae Sterrer & Farris, 1975; Onychognathiidae Sterrer, 1972; and Gnathostomulidae Sterrer, 1972.

## Clausognathiidae, new family

*Diagnosis.*—Scleroperalia with an elongated, pointed rostrum (index greater than 3) that lacks (!) paired sensory organs. Epidermal cells not in stripes. Male stylet of the rod type. Sperm small, round or polygonal. Basal plate may be absent. Jaws lamellar but not closed, without a cauda; teeth uniform, arranged in a ventro-rostral arc. Without a jugum. With the ability to swim backwards.

## *Clausognathia suicauda,* new genus, new species
Figs. 1–3, Table 1

Diagnosis of *Clausognathia* new genus: Clausognathiidae without a basal plate. Posterior portion of gut without a lumen, consisting of highly vacuolized cells. Male organ with a vesicula seminalis and a vesicula granulorum.

Type species: *Clausognathia suicauda,* new species.

*Etymology.*—Genus from the Latin *clausus* (closed) and the Greek root *gnath-* (jaw), in reference to the usually tightly clenched jaws; species from *sus* (pig) and *cauda* (tail), in reference to the often curled-up tail.

*Holotype.*—USNM 142377, one specimen in squeeze preparation.

Table 1.—*Clausognathia suicauda,* measurements and statistics.

| | $\bar{X}$ | *SD* | Max | Min | *n* |
|---|---|---|---|---|---|
| Body length of adults | 1150.00 | 70.71 | 1200 | 1100 | 2 |
| Body width of adults | 85.00 | 7.07 | 90 | 80 | 2 |
| Body index of adults | 13.54 | 0.29 | 13.75 | 13.33 | 2 |
| Rostrum index of adults | 4.67 | | | | 1 |
| Jaw length | 13.56 | 1.13 | 15 | 12 | 9 |
| Penis stylet length | 28.33 | 4.51 | 33 | 24 | 3 |
| Sperm length | 5.00 | 0.00 | 5 | 5 | 6 |
| Sperm width | 4.67 | 0.52 | 5 | 4 | 6 |
| Sperm index | 1.08 | 0.13 | 1.25 | 1.00 | 6 |

*Type locality.*—Belize (Western Atlantic Ocean), barrier reef south of Carrie Bow Cay. Detritus-rich sand bordered by *Thalassia,* at the shoulder of one of the Southern Sand Bores (reef islets) at 9 m depth; sample collected 18 Apr 1991; 8 specimens.

*Other localities.*—Belize, barrier reef off Carrie Bow Cay. Fine sand with detritus from the sand trough at 33 m depth; sample collected 19 Apr 1991; 1 specimen.

Diagnosis of *C. suicauda,* new species: Fairly slender *Clausognathia* (body index 13.54) with slender rostrum (index 4.67) and a well defined, fragile tail. Jaws 13.56 μm long, with 10.86 teeth. Sperm round, 5 μm in diameter. Penis stylet 28.33 μm long.

*Description.*—Organization and behavior: Colorless-translucent to faintly yellowish. The only complete adult (Fig. 2A) was 1100 μm long and 80 μm wide at U 59.1; another adult, which had lost its tail section, was estimated to have had a total length of 1200 μm, and was 90 μm wide at U 53.3. The mean body index of adults is 13.54. The rostrum (Fig. 2B, C) is slender and pointed, 125–140 μm long and 30–35 μm wide (index 4.67). The posterior part of the body usually looks swollen and succulent (Fig. 1), and rather abruptly narrows to an extremely fragile, wrinkled, contractible and usually curled-up tail region of 50–150 μm length. In the petri dish the animal usually appears as a short spiral which turns slowly, reversing direction when the rostrum hits an obstacle. The tip of the rostrum is very flexible and constantly probes its surroundings. Extremely fragile and slow-moving, the animal can easily be mistaken for catenulid turbellarians of the family Retronectidae (Sterrer & Rieger 1974), which are found in the same sample.

The skin is made up of polygonal cells of 5 μm diameter that do not seem to be arranged in any pattern, each carrying a single cilium of 20 μm length. Cilia around the mouth may reach a length of 42 μm (Fig. 2C). There are round epidermal inclusions throughout the body. The sensorium consists of a row of occipitalia (Fig. 2C), single stiff cilia arranged along the dorsal median of the rostrum; some of these are kinked and may reach 35 μm in length. No other sensory cilia, bristles or pits were found, although there is a possibility that single paired cilia (as which the apicalia typically appear) might have been overlooked.

Digestive tract: The oval mouth opening, situated between U 14.1 and U 15.1, is 5–10 μm long and leads into a buccal cavity (Fig. 2B, C) whose epithelium is thickened rostrally (to 20 μm) but seems otherwise devoid of specialized glands. There is no basal plate. The jaws (Figs. 2D–G, 3A–F) are 12–15 μm (mean 13.56 μm) long, delicate, and rather complex under a deceptively simple dorsal outline (Fig. 2D). Being higher than wide, the jaws usually come to lie on the side during squeeze preparation, which makes it difficult to obtain an accurate dorsal view. The jaws are forceps-

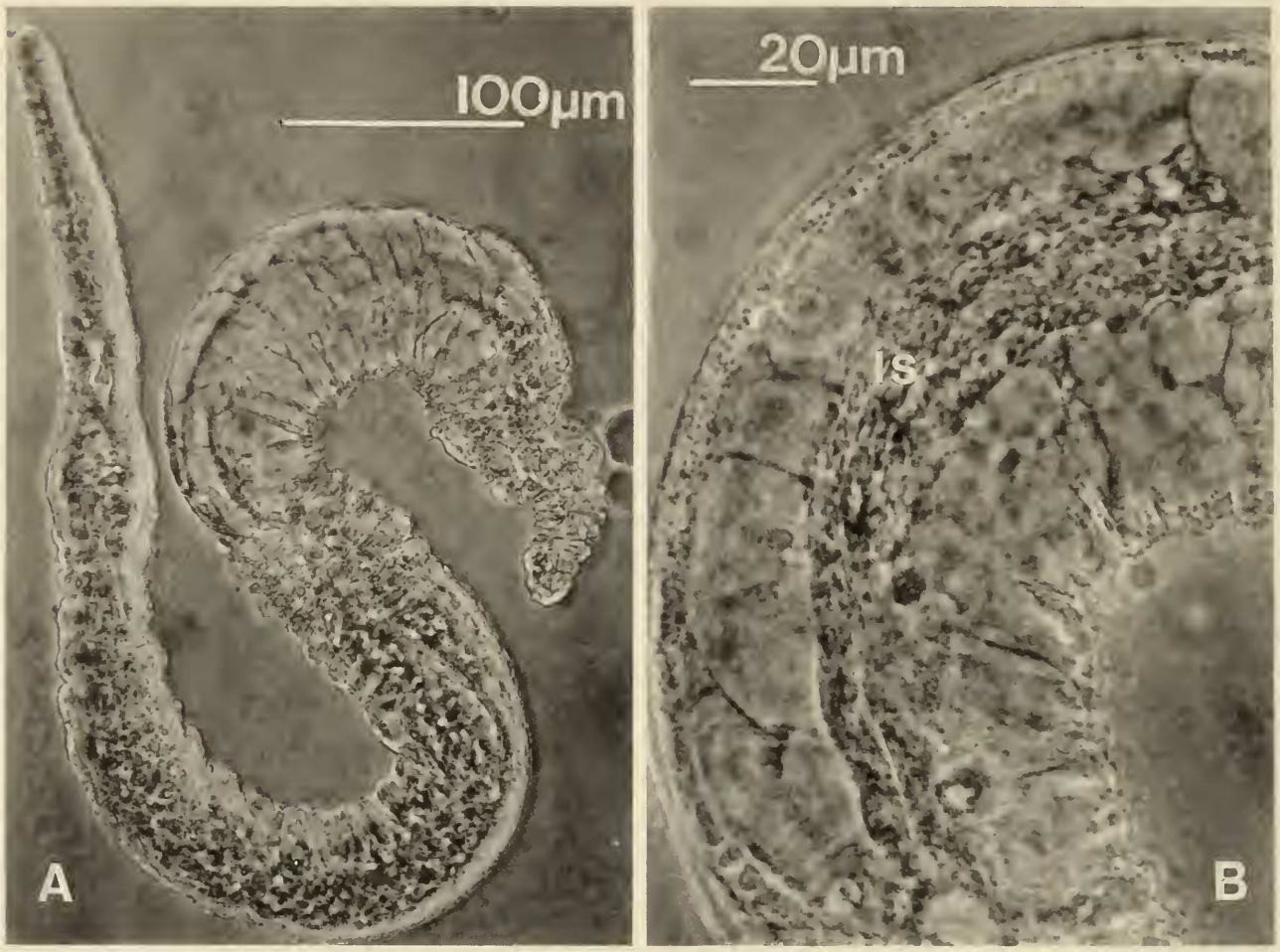


Fig. 1. *Clausognathia suicauda.* A, Habitus of a juvenile; B, Posterior body section of the same individual showing vacuolized cells and "lateral system" (ls). Phase contrast photographs of live specimens.

shaped, with 9–12 (mean 10.86) short but pointed teeth arranged in a dorso-rostro-ventral arc. A crista (cr) flares out dorso-laterally, and a sharp rostral apophysis (ra) points caudo-ventrally. There are "stiffening rods" running from the anterior, tooth-bearing part to the posterior part of the jaws. The symphysis, however, is not reinforced or broadened, and there is no cauda. The posterior third of the jaws is embedded in a muscular pharynx which extends 10–16 µm (mean 12.83 µm) behind the symphysis. The pharynx is neither tripartite, nor does it contain discrete glands. The gut cells, 5 µm high, enclose a well defined lumen (gl) that extends to about U 59. Between U 59 and U 88, i.e., somewhat rostrally of the tail, the body is filled with large, succulent cells that do not seem to enclose a lumen (Figs. 1, 2A, K, L). These cells are flanked laterally by a pair of stringy tissue strands ("lateral system," ls) that originate in the anterior body half, but become prominent only in the region of the succulent cells. Upon squeezing, one specimen produced elongated cells with an equally elongated, dark inclusion (nucleus?) from the neck region (Fig. 2H); although their function is unknown they are reproduced here because of their similarity, in shape and location, with the sperm of some Turbellaria-Retronectidae (Sterrer & Rieger 1974, figs. 10, 13, 14).

Male system: Three specimens had mature male organs (Figs. 2A, I–L, 3G, H), of which the most conspicuous structure is the penis stylet. Situated ventrally, approximately between U 60 and U 63, the stylet is straight, slightly conical, 24–33 µm (mean 28.33 µm) long and 4–5 µm (mean 4.33 µm)

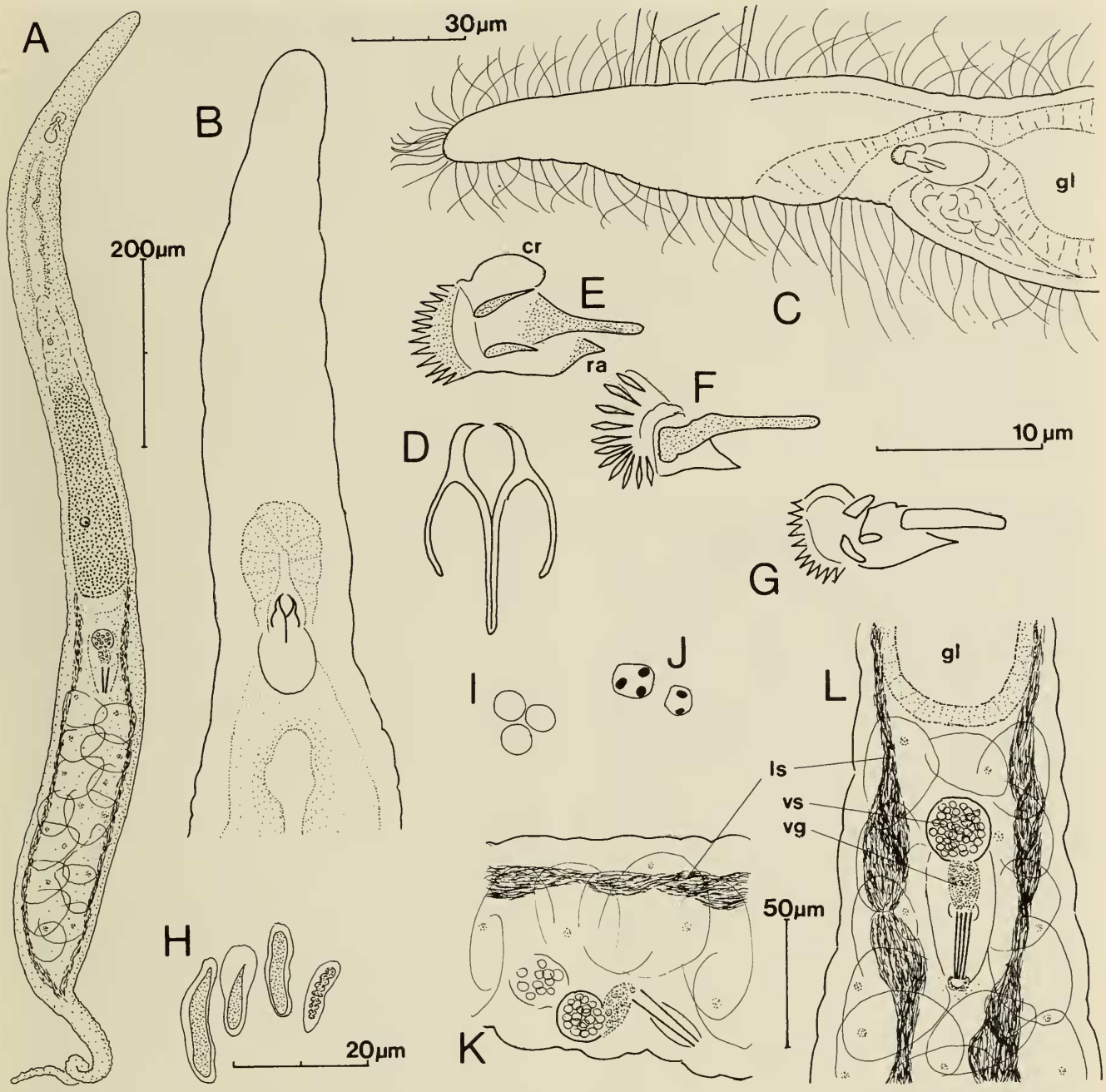


Fig. 2. *Clausognathia suicauda.* A, Habitus of an adult; B, Rostrum and pharyngeal region, dorsal view; C, Rostrum and pharyngeal region, left lateral view; D, Jaws, dorsal view; E–G, Jaws of 3 specimens, left lateral view, showing crista (cr) and rostral apophysis (ra); H, Elongated cells squeezed from neck region; I, Sperm from the vesicula seminalis, in situ; J, The same, squeezed out of the vesicula; K, Male copulatory organ, left lateral view; L, The same in dorsal view, showing gut lumen (gl), "lateral system" (ls), vesicula granulorum (vg), vesicula seminalis (vs) and stylet. Cilia have been omitted except in 2C. Scales apply to A, B–C, D–G, H–J and K–L, respectively.

wide proximally. It consists of 6–8 rods, and the distal two-thirds of its length are surrounded by a fine-grained glandular sheath. Anterior to the stylet there is an ellipsoidal vesicula granulorum (vg), about 20 µm long and 10 µm in diameter, filled with delicate granular secretion in round clusters of 5 µm diameter. Further anterior is the spherical vesicula seminalis (vs; diameter 25 µm), which is filled with sperm. Testes could not be identified with certainty; in one of the specimens the vesicula seminalis appeared to open frontally into an unpaired testis. A male pore is located ventrally of the tip of

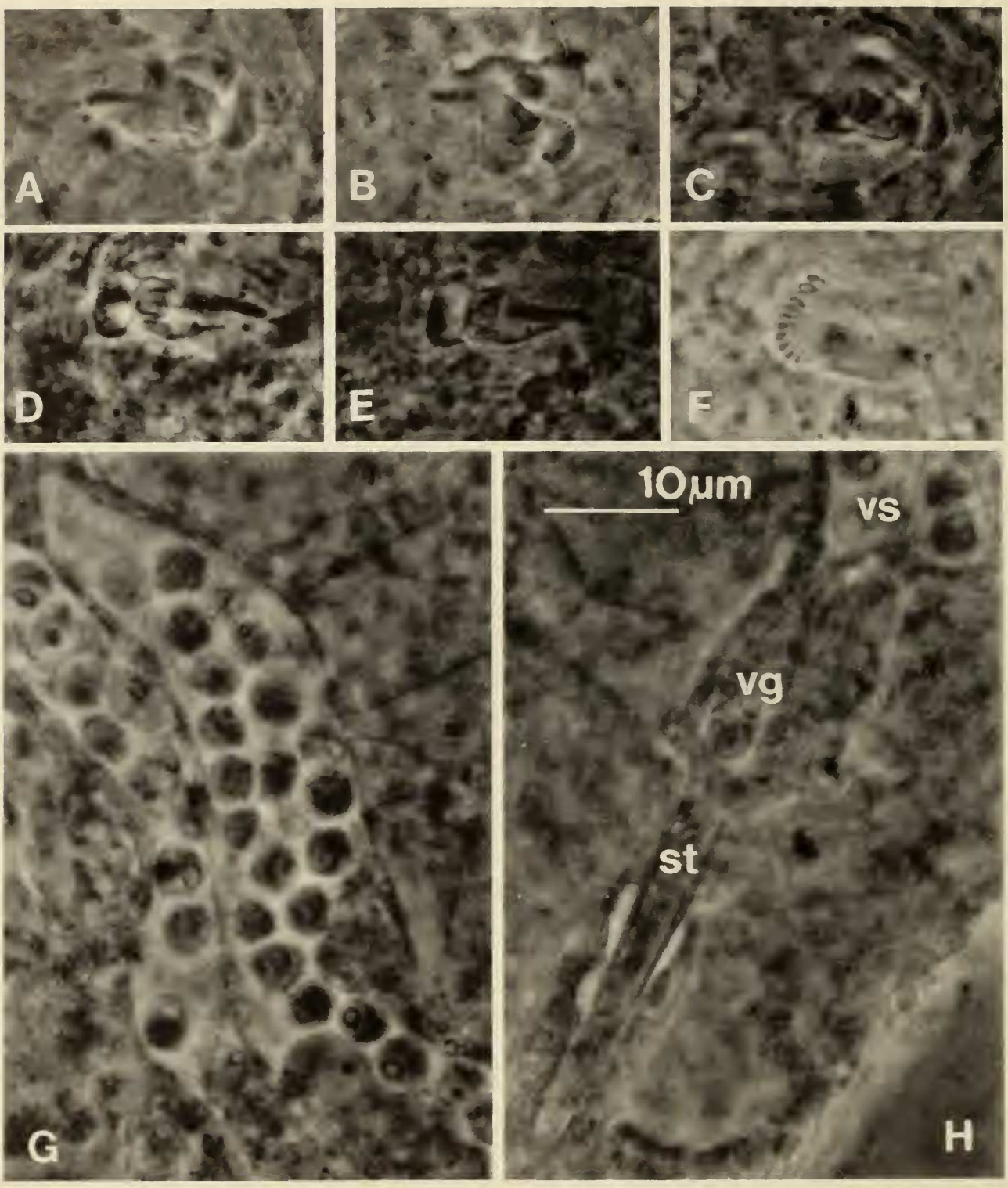


Fig. 3. *Clausognathia suicauda.* A, Jaws, unsqueezed, in right lateral view; B, The same jaws, squeezed; C, Jaws of another specimen, squeezed, in right lateral view; D–F, Jaws of 3 other specimens, unsqueezed, in left lateral view; G, Vesicula seminalis with sperm, squeezed; H, Penis stylet (st), vesicula granulorum (vg) and part of vesicula seminalis (vs), squeezed. Phase contrast photographs of live specimens, all in the same scale.

the stylet (Fig. 2L). One specimen seemed to have a sphincter muscle between the vesicula granulorum and the stylet. The sperm (Figs. 2I, 3G) are globular, 5 μm in diameter, and devoid of any flagellar structure recognizable in the light microscope. Each sperm usually carries 2 or 3 round inclusions that are highly refractile in phase contrast (Fig. 2J).

Female system: The ovary (Fig. 2A), as

seen in two specimens, is dorsal and unpaired, extending between U 27 and U 53; eggs mature caudally, and the largest egg may reach a length of 250 μm. None of the specimens examined had a vagina or bursa, and there was no evidence of sperm outside the male organ.

*Discussion.*—*Clausognathia* is of particular interest since it combines characters that had hitherto been neatly separated between the two orders of Gnathostomulida (Sterrer 1972). The long, slender rostrum, and the simple sensorium (consisting of nothing but a row of occipitalia) are indistinguishable from those of Filospermoidea; on the other hand, the possession of a penis stylet of the rod type and round sperm of the dwarf type clearly place *Clausognathia* in the Bursovaginoidea, suborder Scleroperalia. Several further characters deserve more detailed attention.

The absence of a basal plate is shared with the genera *Agnathiella* Sterrer, 1971b, *Tenuignathia* Sterrer, 1976, *Rastrognathia* Kristensen & Nørrevang, 1977, and at least two undescribed genera. The jaws are most similar to those of Mesognathariidae, in particular the genus *Mesognatharia* Sterrer, 1966, with regard to the small size, uniformity (absence of a prominent terminal tooth) and arc-like arrangement of the teeth. In dorsal view, the unsqueezed jaws are remarkably similar in outline to those of *Gnathostomaria lutheri* Ax, 1956. General features of the pharynx, such as the absence of discrete glands and the non-tripartite appearance of the pharyngeal bulb, are also shared with lower Scleroperalia.

The differentiation of the hindgut as a solid tissue made up of large, highly vacuolized cells is clearly new among Gnathostomulida. It is most likely derived from a condition found in *Tenuignathia rikerae* (cf. Sterrer 1976, figs. 26, 39) and confirmed in *T. vitiensis* (Sterrer 1991, fig. 10D), where such cells only occupy the dorsal portion of the gut, albeit throughout its entire length. With *Tenuignathia, Clausognathia* shares also a pair of conspicuous tissue strands of unknown function ("lateral system"). Vacuolized tissues and chordoid organs occur in a number of vermiform interstitial taxa (Ax 1966, Schoepfer-Sterrer 1969), and have been functionally interpreted as a turgor skeleton facilitating the locomotion between sand grains. In the case of *Clausognathia,* however, the extreme fragility of the body and weak musculature in general do not support such an interpretation. Another possibility is that the hindgut contains prokaryotic endosymbionts such as described from a number of meiofauna taxa lacking mouth and gut lumen (Ott et al. 1982). This explanation is particularly attractive since Gnathostomulida, which are typically found in anoxic or microxic environments, and often in the company of mouthless Turbellaria-Retronectidae (Sterrer & Rieger 1974), have yet to be shown to contain such endosymbionts.

The male system of *Clausognathia* conforms, in principle, with that of lower Scleroperalia. A vesicula seminalis is present in *Gnathostomaria, Rastrognathia, Mesognatharia* and *Labidognathia.* However, *Clausognathia* stands alone in having a distinct vesicula granulorum. The sperm agrees best in shape and size with that of *Rastrognathia* (Kristensen & Nørrevang 1977, fig. 15) although microvilli were not seen. The absence of a bursa in otherwise mature specimens, finally, has been observed in *Agnathiella beckeri* Sterrer (1971b:222), where one of three adults lacked a bursa, and shown by Riedl (1971) to be a temporary condition in the cycle of bursa replacement. Riedl (1970:229) reports for *Labidognathia* that "a few individuals, characterized by a swollen gut, . . . were of a medium or larger size range and showed no stylet, no bursa, or both were lacking." The observation, in *Clausognathia,* of an incomplete reproductive system (no bursa, no testes) in the presence of a swollen hind gut suggests a cycle in which a feeding phase (such as increased symbiont activity?) al-

ternates with a reproductive phase. However, should the lack of a bursa and/or the possession of only one unpaired testis turn out to be true characters of *Clausognathia,* a new suborder might be called for to accommodate this unique genus.

In view of its overall affinities, the new family Clausognathiidae seems best positioned among the lower Bursovaginoidea-Scleroperalia, in the vicinity of Mesognathariidae, Rastrognathiidae, Agnathiellidae and Gnathostomariidae.

## Acknowledgments

I am grateful to the Caribbean Coral Reef Ecosystems program (CCRE) of the National Museum of Natural History for travel support, and to Klaus Ruetzler and M. Carpenter for providing such congenial field facilities and creature comfort. This is contribution no. 335, Caribbean Coral Reef Ecosystems (CCRE) Program, Smithsonian Institution, partly supported by the EXXON Corporation.

## Literature Cited

Ax, P. 1956. Die Gnathostomulida, eine rätselhafte Wurmgruppe aus dem Meeressand.—Akademie der Wissenschaften und der Literatur in Mainz, Abhandlungen der mathematisch-naturwissenschaftlichen Klasse 8:1–32.

———. 1966. Das chordoide Stützewebe als histologisches Lebensformmerkmal der Sandlückenfauna des Meeres.—Naturwissenschaftliche Rundschau 19(7):282–289.

Kristensen, R. M. & A. Nørrevang. 1977. On the fine structure of *Rastrognathia macrostoma* gen. et sp. n. placed in Rastrognathiidae fam. n. (Gnathostomulida).—Zoologica Scripta 6:27–41.

Ott, J., G. Rieger, R. Rieger, & F. Enderes. 1982. New mouthless interstitial worms from the sulfide system: symbiosis with prokaryotes.—Pubblicazioni della Stazione Zoologica di Napoli I: Marine Ecology 3(4):313–333.

Riedl, R. J. M. 1970. On *Labidognathia longicollis,* nov. gen., nov. spec., from the West Atlantic Coast.—Internationale Revue der gesamten Hydrobiologie 55:227–244.

———. 1971. On the genus *Gnathostomula* (Gnathostomulida).—Internationale Revue der gesamten Hydrobiologie 56:385–496.

Rützler, K., & I. G. Macintyre (eds.). 1982. The Atlantic Barrier Reef Ecosystem at Carrie Bow Cay, Belize, I. Structure and communities.—Smithsonian Contributions to the Marine Sciences 12: 1–539.

Schoepfer-Sterrer, C. 1969. *Chordodasys riedli* gen. nov., spec. nov., a macrodasyoid gastrotrich with a chordoid organ.—Cahiers de Biologie Marine 10:391–404.

Sterrer, W. 1966. Neue Gnathostomulida.—Veröffentlichungen des Instituts für Meeresforschung in Bremerhaven, Sonderband 2:201–208.

———. 1971a. On the biology of Gnathostomulida.—Vie et Milieu, Suppl. 22:493–508.

———. 1971b. *Agnathiella beckeri* nov. gen. nov. spec. from southern Florida: the first gnathostomulid without jaws.—Internationale Revue der gesamten Hydrobiologie 56:215–225.

———. 1972. Systematics and evolution within the Gnathostomulida.—Systematic Zoology 21:151–173.

———. 1976. *Tenuignathia rikerae* nov. gen., nov. spec., a new gnathostomulid from the West Atlantic.—Internationale Revue der gesamten Hydrobiologie 61:249–259.

———. 1991. Gnathostomulida from Fiji, Tonga and New Zealand.—Zoologica Scripta 20:107–128.

———, & R. A. Farris. 1975. *Problognathia minima* n. g., n. sp., representative of a new family of Gnathostomulida, Problognathiida n. fam. from Bermuda.—Transactions of the American Microscopical Society 94(3):357–367.

———, & R. Rieger. 1974. Retronectidae—a new cosmopolitan marine family of Catenulida (Turbellaria). Pp. 63–92 *in* N. W. Riser & M. P. Morse, eds., Biology of the Turbellaria. McGraw-Hill, New York, 530 pp.

Bermuda Natural History Museum, P.O. Box FL 145, Flatts FLBX, Bermuda.