TWO NEW DICYEMID MESOZOANS FROM THE GULF OF MEXICO[1]

ROBERT B. SHORT,

Department of Biological Sciences, Florida State University, Tallahassee, Florida

The dicyemid mesozoan fauna of the Atlantic and Gulf coasts of the United States has received little attention. Only three species have been reported heretofore, all from the coast of Florida: *Dicyema typus* van Beneden, from near St. Augustine (McConnaughey and Kritzler, 1952); *D. aegira* McConnaughey and Kritzler, from near St. Augustine (McConnaughey and Kritzler, 1952) and the northern Gulf (Short, 1957); and *D. briarei* Short from off Long Key (Short, 1961). Herein are described two additional species from the northern Gulf of Mexico.

The descriptions are based on coverslip smear preparations of octopus kidneys fixed in Bouin's and Sanfelice's fixatives, stained with Ehrlich's acid haematoxylin and iron haematoxylin, and mounted in Damar. All drawings were made with the aid of a camera lucida. Cilia, which are always present on peripheral cells of vermiform stages, have been omitted from most drawings.

I wish to thank Dr. Meredith L. Jones for collecting octopuses, Dr. Gilbert L. Voss for help in identification of them, and Mr. Raymond T. Damian for aid in preparation of mesozoan material for study and for reading the manuscript.

Dicyema **hypercephalum** sp. nov.

(Figures 1 to 27, 45 to 48)

Description.—Dicyema: Mature vermiform stages relatively small; lengths of two longest nematogens, 0.259 and 0.264 mm; rhombogens seldom longer than 0.550 mm; lengths of ten longest rhombogens, 0.483 to 0.657 mm. Somatic cell number almost invariably 14: 4 propolars, 4 metapolars, 2 parapolars, 2 diapolars, 2 uropolars.

Calotte markedly elongate, about 1/3 or more of body length in fully developed vermiform larvae (Figures 3-5), in young free vermiform individuals (Figures 6-15, 47), often 1/3 to 1/2 and in largest adults (Figure 21), 1/7 to 1/5 total length; orthotropal, especially in young vermiform stages, slightly plagiotropal in some older individuals. Calotte usually narrower than widest body region, more or less pointed in vermiform larvae, less pointed in older stages, often bluntly rounded anteriorly and constricted where propolars and metapolars meet (Figures 20-22). Propolars and metapolars about equal in size.

Body usually with no conspicuous cephalic swelling, commonly widest at diapolars, sometimes at the parapolars (Figures 46-48). Parapolar cells usually shorter than calotte, sometimes equal to calotte in length in largest rhombogens (Figure 21). Parapolars usually rounded or bluntly pointed posteriorly. Trunk cells in opposed pairs. Cytoplasm of parapolar and trunk cells usually with irregular particles which are characteristically darkest and most plentiful in parapolars (Figures 19, 45-48). No verruciform cells.

Nuclei of calotte cells about equal in size. Nuclei of all somatic cells with relatively small nucleoli. Accessory nuclei in parapolar and trunk cells of rhombogens few, usually one or two per cell.

Cilia on calotte shorter, more closely set, more conspicuous and apparently stiffer than those on trunk.

Axial cell usually extending anteriorly to propolars, occasionally ending bluntly near bases of metapolars (Figures 8, 11, 13, 18).

Vermiform larvae at eclosion about 40 to 50 microns long, containing two axoblasts with one axial cell nucleus between them (6 larvae) or anterior to both (7 larvae).

Rhombogens containing a single infusorigen which is usually postequatorial.

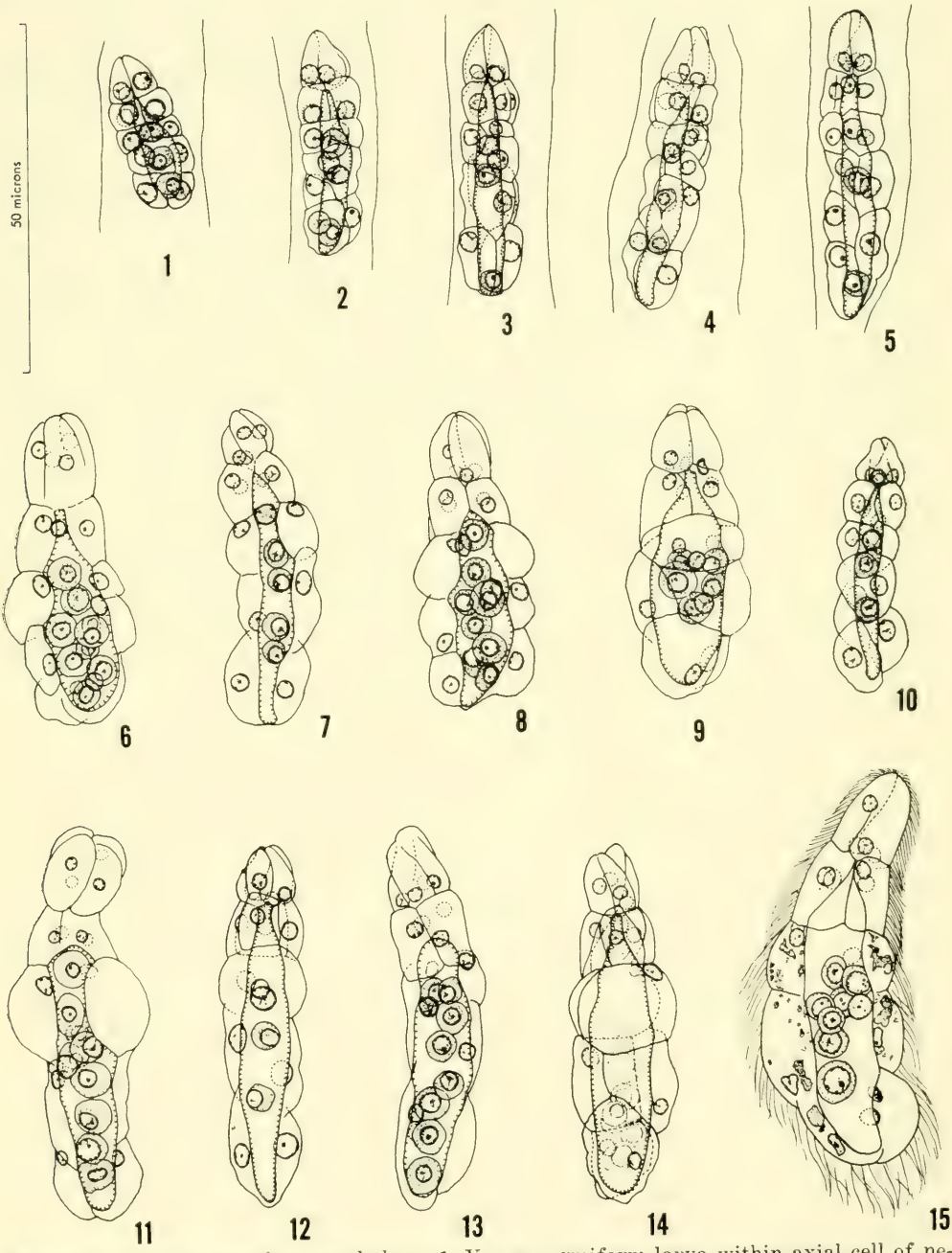
Infusorigens small with few female cells; for 50 infusorigens: range of three to seven female cells per individual; mode, four.

Infusoriforms rounded posteriorly. Average length of five apparently mature individuals in axial cells: 28.6 microns, range 24.8 to 32.5. Two relatively large refringent

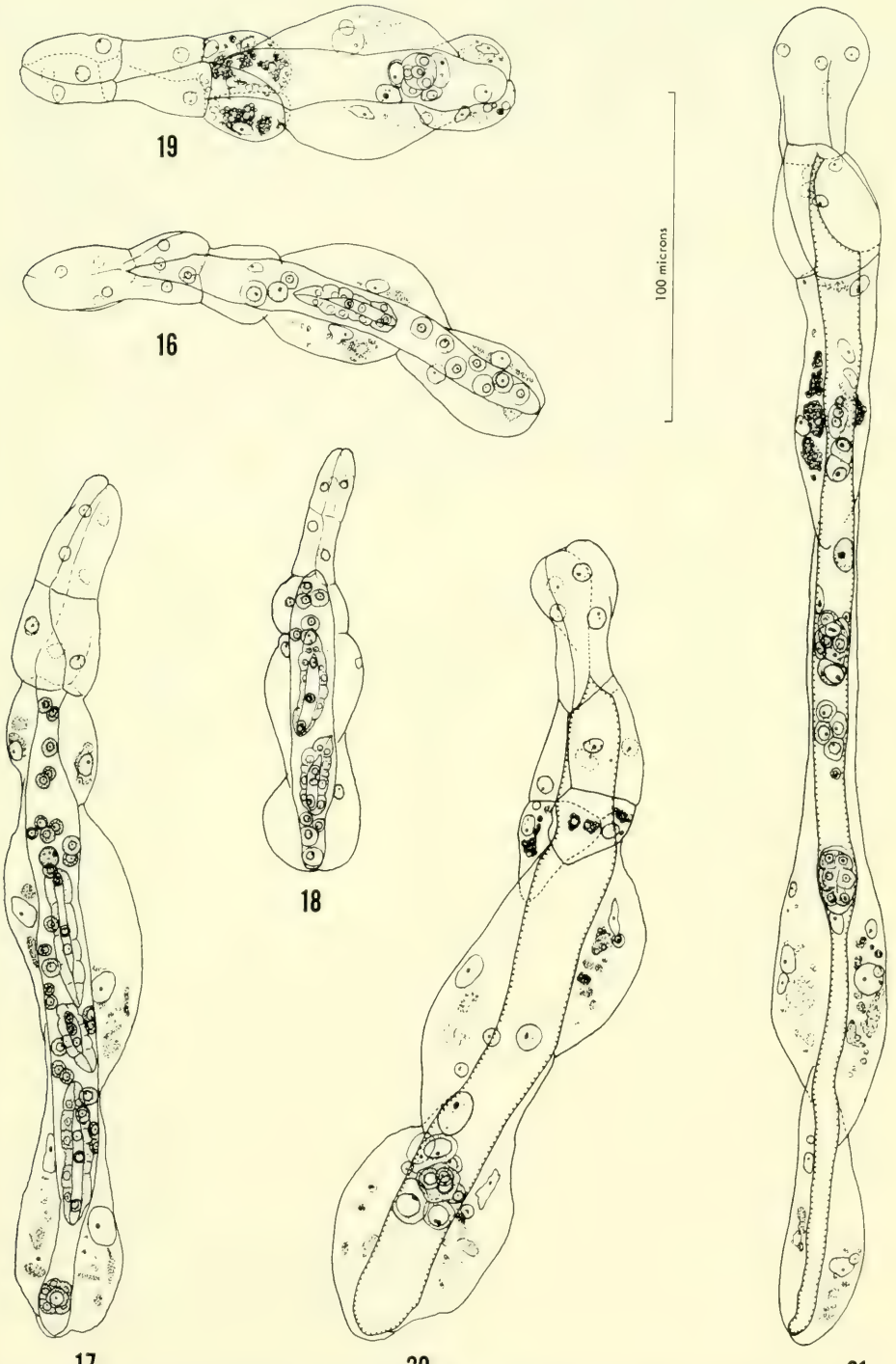
[1] This study was supported by Research Grants G-4449 and G-7466 from the National Science Foundation.

bodies extending about to midbody, appearing in lateral view larger than urn contents. Capsule cells without conspicuous granules, apparently unusual in their ventral position, with nuclei ventrolateral to urn contents. Each urn cell containing a single germinal cell and two somatic nuclei.

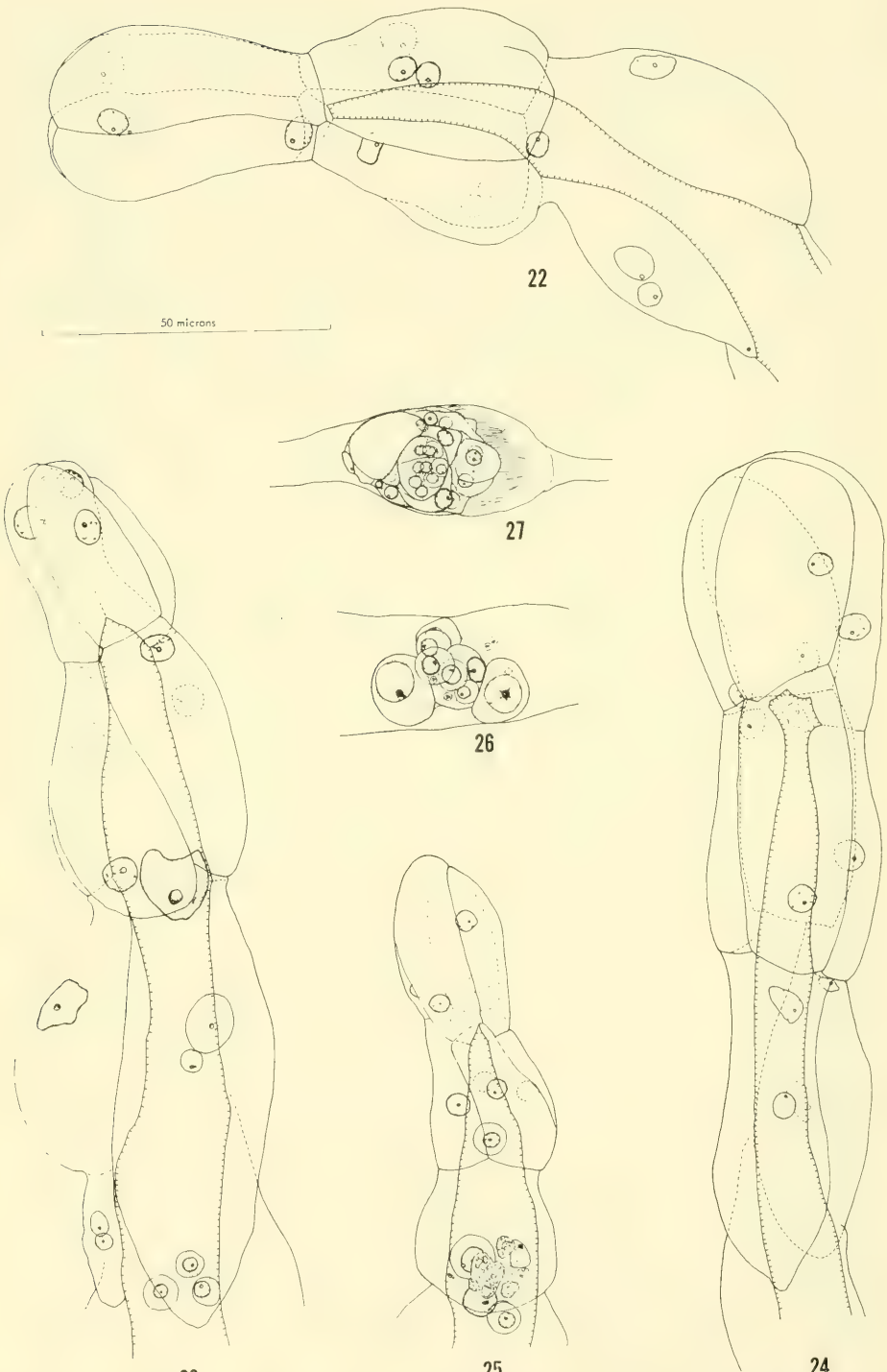
Host.—Octopus joubini. One small speci-



Figures 1-15. *Dicyema hypercephalum*. **1.** Young vermiform larva within axial cell of nematogen. **2-5.** Older vermiform larvae, apparently fully developed, within axial cells of nematogens. **6-15.** Young, free vermiform stages, probably all rhombogens.



Figures 16-21. *Dicyema hypercephalum*. **16-18**. Nematogens. **19-21**. Rhombogens.



Figures 22-27. *Dicyema hypercephalum*. **22-24.** Anterior ends of rhombogens. **25.** Anterior end of nematogen. **26.** Infusorigen. **27.** Infusoriform larva, parasagittal optical section, within axial cell of parent rhombogen.

men with a mantle length of 15 mm. This dicyemid was the only species in this host individual.

Locality.—Apalachee Bay, Gulf of Mexico, about six miles south of Light House Point, Franklin Co., Florida.

Type specimens.—Syntypes on slide 542-8 (U. S. N. M. Helm. Coll. 59615) and other slides from host 542 (author's collection).

Discussion.—For the above description, young vermiform stages (presumably immature rhombogens) and older rhombogens were plentiful, but very few of the latter contained mature infusoriforms or even large embryos. The account of the infusoriform is based on six apparently mature specimens in axial cells. Nematogens and vermiform larvae were also scarce, only 13 nematogens and 16 vermiform larvae within axial cells being seen. Thus, descriptions of nematogens and infusoriforms are not as complete as desirable. Also an accurate account of cilia was hampered by their poor visibility in the fixed material. On the calotte of free vermiform stages cilia were conspicuous and brush like, but on other body regions they were seen only with difficulty on a few specimens, and then with phase contrast microscopy.

Although the somatic cell number is almost always 14, other numbers were encountered. Cell counts were made on 114 individuals (45 rhombogens, 5 nematogens, 16 vermiform larvae, 46 young free vermiforms, and 2 transitional individuals). Except for six specimens, the somatic cell number was 14. Of these six, three each possessed 15 somatic cells and one each possessed 12, 13 and 16.

One hundred rhombogens were examined for number and position of infusorigens; single infusorigen occurred in every one. However, during subsequent study two immature infusorigens were seen in one rhombogen.

D. hypercephalum differs from all other described species of *Dicyema* in the shape and proportions of its calotte. It is also unusual in possessing typically 14 somatic cells; only two other known species have this low a number. *D. oligomerum* Bogolepova, 1960, usually has 14 to 16 peripheral cells (Bogolepova, 1960), and *D. apalachiensis* (described below) has typically 14. Besides having a relatively much longer calotte, *D. hypercephalum* differs from *D. oligomerum* in being considerably smaller. Differences between *D. hypercephalum* and *D. apalachiensis* will be indicated after description of the latter.

In somatic cell number *D. hypercephalum* is close to *D. monodi* Nouvel, 1934, *D. megalocephalum* Nouvel, 1934, and *D. caudatum* Bogolepova, 1960, all with 16. In *D. megalocephalum* fewer than 16 cells may occur; exact counts were rendered difficult by flattening and possible fusion of peripheral cells (Nouvel, 1934). *D. monodi* and *D. megalocephalum* are also similar to D. *hypercephalum* in having unusually long calottes. In *D. monodi,* however, the metapolar cells become much longer than the propolars and the axial cell does not penetrate to the propolars. The metapolar cells of *D. megalocephalum* are likewise longer than propolars and the entire calotte is considerably wider than the trunk.

Dicyema **apalachiensis** sp. nov.

(Figures 28 to 44, 49 to 66)

Description.—Dicyema: Mature nematogens seldom longer than 0.350 mm; range of ten longest specimens 0.299 to 0.645 mm. Somatic cell number usually 14, sometimes 15, occasionally 16 or 17. Results of cell counts on 123 individuals summarized in Table 1.

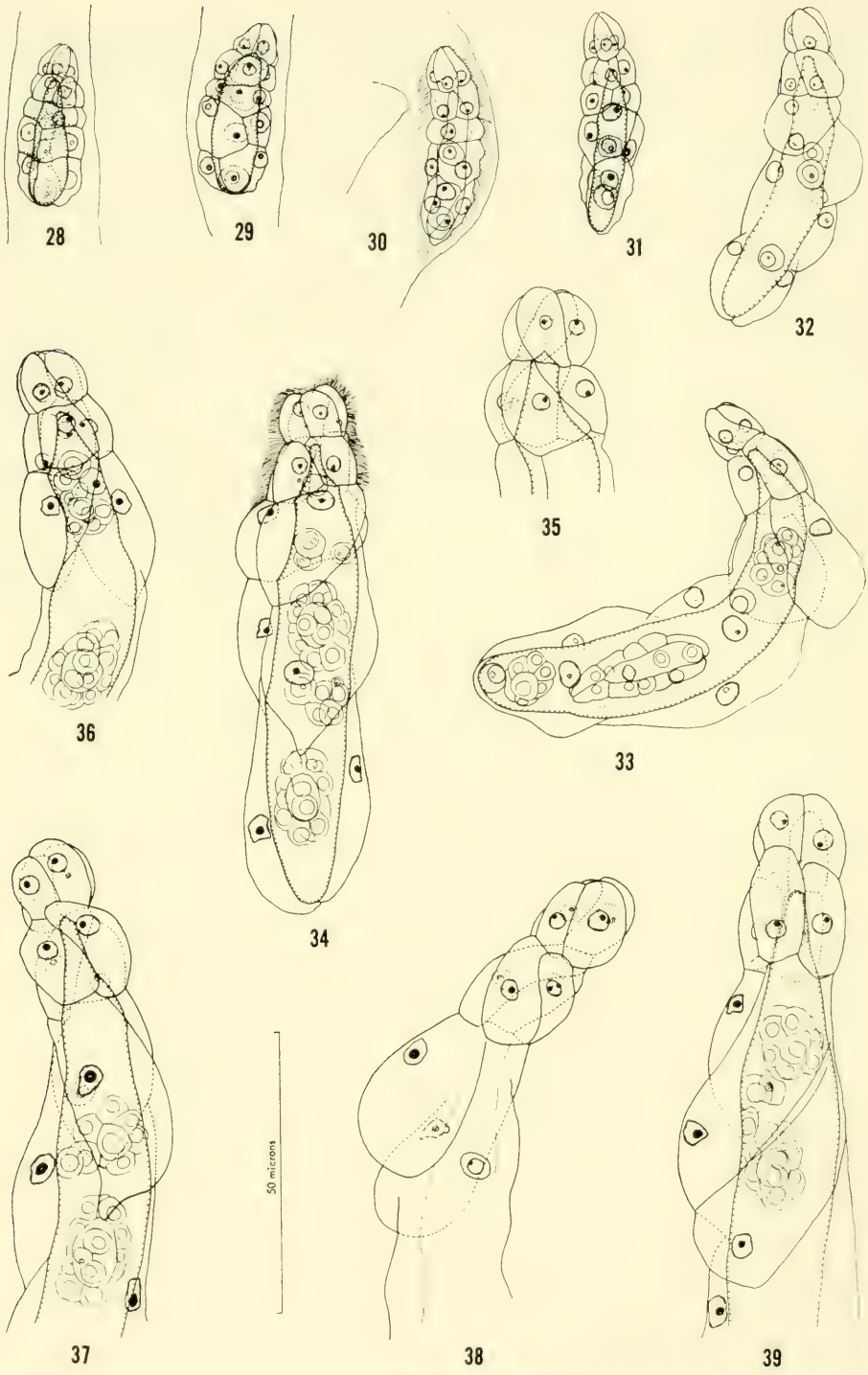
Calotte orthotropal, sometimes apparently plagiotropal; typically narrower than parapolar and widest trunk regions; longer than wide; in vermiform larvae more or less pointed, in adults bluntly pointed to rounded. Propolar and metapolar cells of younger

TABLE 1.
Somatic cell numbers of Dicyema apalachiensis

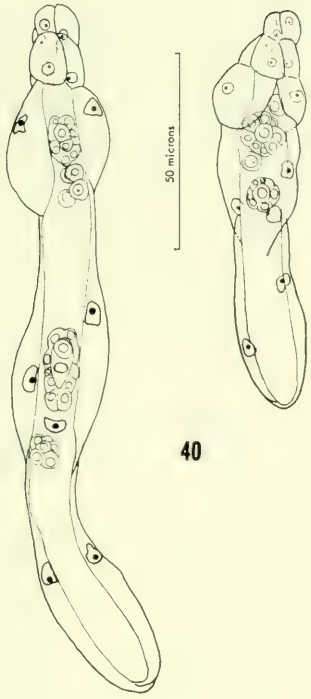
Cell No.	Phase		Totals
	Veriform larva	Nematogen	
12	2*	0	2
13	0	0	0
14	88	10	98
15	13	3	16
16	1	6**	7
Totals	104	19	123

* Anomalies?

** Four of these were among the longest nematogens.



Figures 28-39. *Dicyema apalachiensis*. **28-29**. Young vermiform larvae within axial cells of nematogens. **30**. Older vermiform larva, within axial cell, apparently fully developed. **31-32**. Young, free vermiform individuals. **33-34**. Small nematogens. **35-39**. Anterior ends of nematogens.



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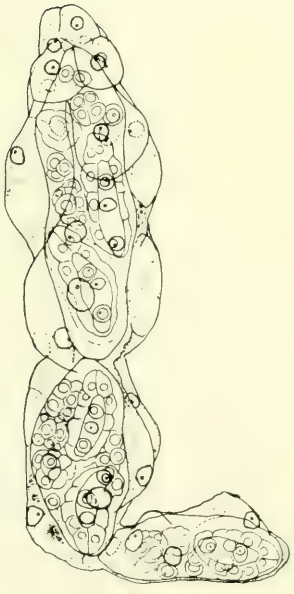

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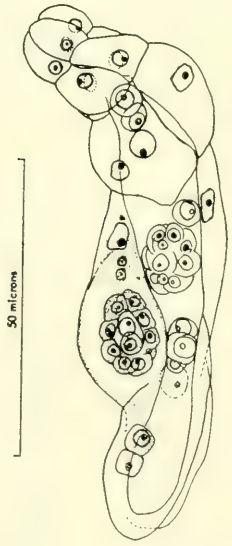

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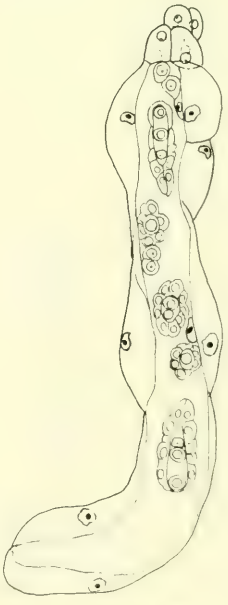

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Figures 40-44. *Dicyema apalachiensis*. Scale with 40 also for 41 and 43. **40-42**. Nematogens. **43**. Stem nematogen, posterior end slightly shriveled. **44**. Nematogen with apparently normal vermiform larva developing in diapolar cell.

individuals about equal in size, metapolars of old nematogens usually longer than propolars. Calotte often twisted clockwise (Figure 38).

Body of young nematogens often widest at parapolars (Figure 40), in longest specimens usually slight if any cephalic swelling (Figure 42). Parapolar cells of vermiform larvae shorter than calotte, becoming longer than calotte in larger nematogens; parapolars in young vermiform stages bluntly rounded (Figure 32); in older individuals often more pointed posteriorly (Figure 37). Parapolars sometimes asymmetrically disposed (Figures 38, 39) with one diapolar cell extending between them to base of metapolars. Trunk cells usually in opposed pairs. Usual granular material in somatic cells (Figures 62-65); no verruciform cells.

Nuclei of calotte about equal in size. Nucleoli, especially of parapolar and trunk cells, typically prominent, sometimes very large.

Axial cell usually ending anteriorly in a blunt point at bases of propolars (Figures 33-37); in vermiform larvae rarely ending near middle of metapolars (Figure 31). Axial cell of largest nematogens often with many vermiform larvae and embryos.

Vermiform larvae at eclosion about 25-40 microns long, containing two axoblasts with one axial cell nucleus between them or anterior to both.

Rhombogens, infusorigens and infusoriforms unknown.

Host.—This species was found in 11 very small specimens of *Octopus joubini,* all from the same locality. Seven hosts also harbored another unidentified larger species of dicyemid with more than 14 peripheral cells.

Locality.—Apalachee Bay, Gulf of Mexico, about six miles south of Light House Point, Franklin Co., Fla.

Type specimens.—Syntypes on slide 516-13 (U. S. N. M. Helm. Coll. 59616) and other slides from hosts 516, 520, 523, and 525 (author's collection).

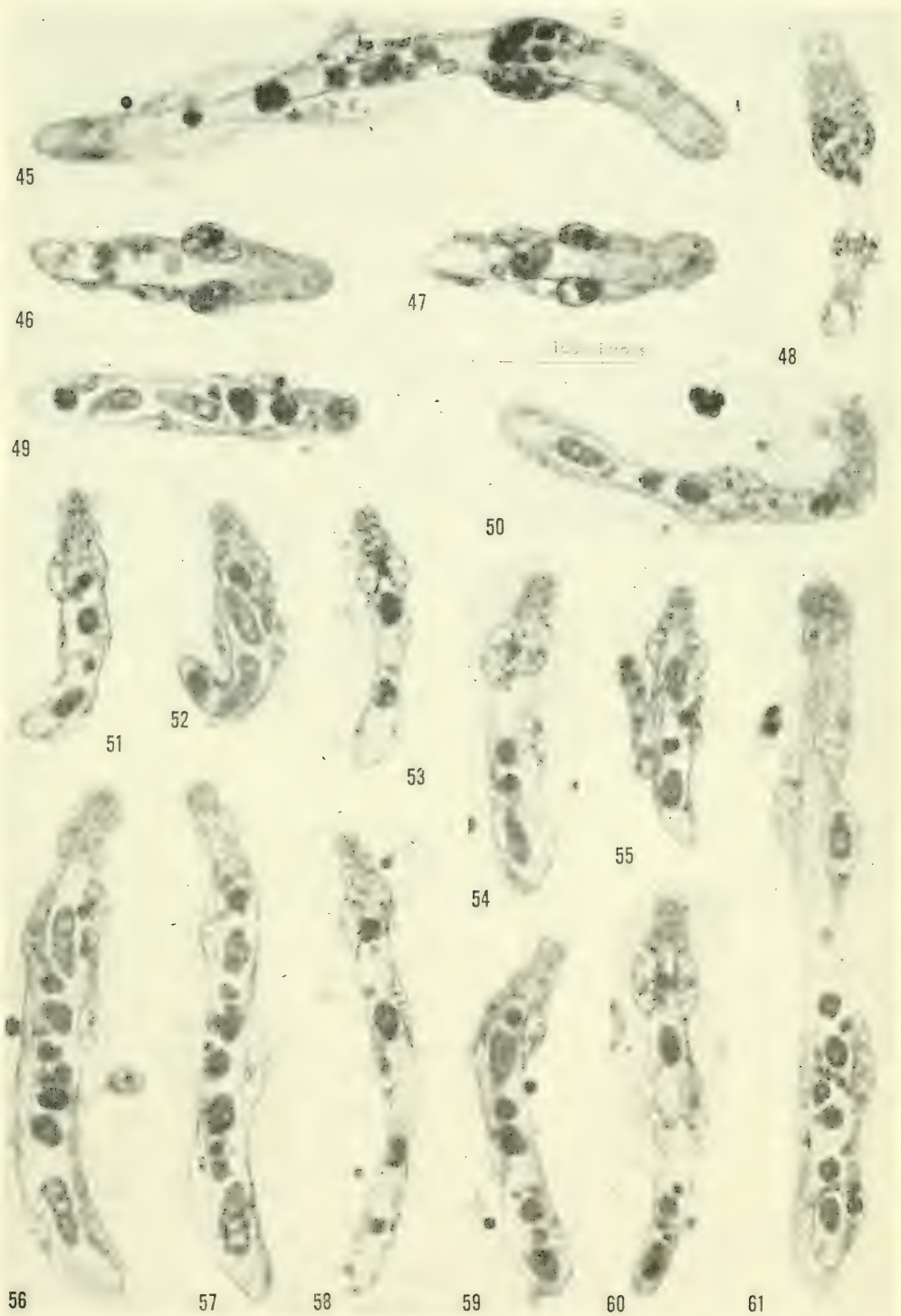
Discussion.—The above description is based mainly on material from host 516. All cell counts of Table 1 were made on specimens from this octopus as well as all figures except 32 (host 520), 33 (host 523), 43 (host 525), 63 and 65 (host 520).

Some variation from the usual appearance was noted in populations from hosts 520 and 521. Parasites from these octopuses contained more conspicuous granular material in the somatic cells, especially in the parapolars (Figures 63, 65), and the calottes of some appeared more elongate than usual (Figure 33). Nucleoli were usually not as prominent in these specimens, but this may have resulted from poor staining.

Part of a large stem nematogen, apparently of this species, and an entire, smaller specimen were found in two different hosts. The fragment is 505 microns long and consists of the two anterior axial cells, the calotte and four or five diapolar cells. Each axial cell contains vermiform larvae, embryos and axoblasts; the anterior cell is longer and possesses more reproductive elements than the other. Somatic cell counts on four vermiform larvae gave: 14, 14 and 15 or 16.

The smaller, entire stem nematogen (Figure 43) is 192 microns long and appears to be in good condition except for a slightly shriveled posterior end. There are three axial cells, each with apparently a single nucleus. The anterior cell is the longest and the most productive; it contains two mature vermiform larvae, five embryonic vermiform larvae and five axoblasts. The middle cell contains two slightly smaller vermiform larvae, four embryonic vermiforms and three axoblasts; the posterior cell holds one vermiform larva (smaller than the other four), three embryonic vermiforms and two (?) axoblasts. The calotte consists of eight cells, four propolars and four metapolars. In this specimen and the fragment the propolars appear to alternate with the metapolars, a condition described in other stem nematogens (Nouvel, 1947). The number and disposition of parapolars could not be determined. There appears to be a single uropolar cell. Besides the calotte, there seem to be 14 somatic cells, giving a total of 22. The five largest vermiform larvae each have 14 somatic cells, the number typical for the species. More detailed information on the stem nematogen of this species must await examination of more favorable material.

Several anomalies were observed besides the two vermiform larvae each with 12 somatic cells (Table 1). In one young nema-



Figures 45-61. Photomicrographs. **45-48.** *Dicyema hypercephalum*, rhombogens. **49-61.** *D. apalachiensis*, nematogens.

Figures 62-66. Photomicrographs. *Dicyema apalachiensis*, nematogens. **62.** Small specimen and posterior end of larger one, showing granular material in peripheral cells. **63.** Small specimens; note heavier concentration of granules in parapolar cells of one. **64.** Anterior end of large nematogen. **65-66.** Small nematogens; note granules in parapolar cells of 65.

togen, 92 microns long, there are two axial cells side by side, the one about twice the length of the other. Each axial cell has a nucleus, axoblasts and embryonic vermiform larvae. One larva in the longer cell appears almost mature. The somatic cell number is doubled (28) with 16 calotte cells, four parapolars and eight trunk. This anomalous individual resembles that of *Dicyema typus* reported by Nouvel (1948, Figure 90) except for a normal somatic cell number in Nouvel's specimen.

A more unusual finding is the presence of 19 apparently normal vermiform larvae of various sizes in *somatic cells* of 14 otherwise normal nematogens, ten from one octopus, three from another (Figures 44, 61). These nematogens range in length from 60 to 360 microns. Eleven each contain one vermiform in a somatic cell, two each contain two, and one has four. Twelve of the larvae are in diapolar cells, five in uropolars, and two in parapolars. All such larvae occur singly within vacuoles; all appear normal. Two axoblasts are in axial cells of at least ten and the two largest individuals are 24.8 and 27.9 microns long respectively, the latter being well within the range of full sized vermiform larvae. Two apparently normal single axoblasts were also noted in somatic cells of these nematogens, one in a diapolar, the other in a uropolar cell.

Single axoblasts have been reported in somatic cells of dicyemids, especially in transitional individuals (Nouvel, 1948; McConnaughey, 1951). Such axoblasts have been stated to be digested completely (McConnaughey, 1951) or to lose their cytoplasm and contribute their nuclei as accessory nuclei in the peripheral cells (Nouvel, 1948). Two rarer findings similar to the present ones have been reported by Nouvel (1948). One was a rather large nematogen of *Dicyema typus* with germinal cells and vermiform embryos in a uropolar cell; the other was a rhombogen of *Dicyemennea lameeri* which contained in a peripheral cell near the middle of the body an infusorigen and embryonic infusoriforms.

The presence of apparently normal axoblasts, vermiform larvae of various sizes and infusorigens in somatic cells indicates that

such cells are capable of assuming at least part of the reproductive function of the axial cell. There seems to be a definite tendency for this phenomonen in *D. apalachiensis.*

As indicated above, *D. apalachiensis* shares the low somatic cell number of 14 with only two other species of *Dicyema: D. hypercephalum* and *D. oligomerum.* Fifteen and 16 peripheral cells occurred more often in *D. apalachiensis* than in *D. hypercephalum* and exceptionally 17 were observed in the former; however, this difference may not be significant because most individuals of *D. hypercephalum* were rhombogens, whereas only nematogens of *D. apalachiensis* were available. *D. apalachiensis* differs markedly from *D. hypercephalum* in having a relatively much shorter calotte and usually larger nucleoli.

D. apalachiensis is unlike *D. oligomerum* in having a smaller body size, a relatively longer and narrower calotte and, especially in young individuals, relatively smaller diapolar and uropolar cells.

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Abstract

Dicyema **hypercephalum** and *D.* **apalachiensis** are described from *Octopus joubini* from Apalachee Bay, off the Florida coast. Both new spp. have typically 14 peripheral cells. The calotte of *D.* **hypercephalum** is unusually long.

Nineteen vermiform larvae of *D.* **apalachiensis** were found developing in peripheral cells of 14 nematogens.