Codfish. Decapoda: *Pandalus borealis* Krøyer, *Spirontocaris groenlandica* (J. C. Fabricius), *S. polaris* (Sabine), *S. spina* (Sowerby), *S. gaimardii* (Milne Edwards), *S. gaimardii belcheri* (Bell), *Sclerocrangon boreas* (Phipps), *Argis dentata* (Rathbun), *Hyas coarctatus alutaceus* Brandt. Amphipoda: *Themisto libellula* (Mandt), *Anonyx nugax* (Phipps), *Pseudolibrotes nanseni* Sars, *Gammarus locusta* (L.), *Gammaracanthus loricatus* (Sabine).

Unidentified fish. Decapoda: *Pinnixa occidentalis* Rathbun.

ZOOLOGY.—*The histology of nemic esophagi. VI. The esophagus of members of the Chromadorida.*[1] B. G. CHITWOOD, Bureau of Animal Industry, and M. B. CHITWOOD.

This paper is the sixth of a series (Chitwood and Chitwood, 1934–1936) dealing with the structure of esophagi in representatives of various groups of nematodes. Previous papers in the series have covered representatives of the Rhabdiasidae, Strongylidae, Metastrongylidae, Heterakidae, Rhabditidae and Anguillulinidae. The present paper covers representatives of the order Chromadorida, namely: Plectidae, Camacolaimidae, Axonolaimidae, Comesomatidae, Cyatholaimidae, Tripyloididae, Desmodoridae, Chromadoridae, Monhysteridae, Linhomoeidae, and Siphonolaimidae. In representatives of the Chromadorida as in the other aphasmidian order, Enoplida, absolute identifications of nerve cell, radial and marginal nuclei are often not possible, as there is too little distinction between the characters of these 3 types of nuclei, and the cell bodies of "nerve cells" are seldom observable. However, the distribution of nuclei is sufficiently similar in the various genera for homologies to be ascertained. In the following text, the authors have identified nuclear types to the best of their abilities. In some instances it has been possible to determine cytologically the identity of a given nucleus, while in other cases the position indicated that the nucleus in question was homologous to one definitely identified in another form although they might differ cytologically in some respects. Future papers will include representatives of the orders Enoplida (Enoplata, Dorylaimata, and Dioctophymata) and Spirurida (Camallanata and Spirurata).

The data given in this paper are, for the most part, presented in tabular form (Figs. 3, 5, 10) and in illustrations, since the essay form of presentation would result in extended descriptions requiring much more space than the present form. The text calls attention to the major features given in the tables and illustrations, and presents some data not immediately obvious in the latter. Previous papers in

[1] Received June 22, 1936.

this series supply extended descriptions of other forms, sufficient to orient the reader of the present paper.

PLECTUS GRANULOSUS (Plectidae) Figs. 1, 2, 3

The esophagus of *Plectus* resembles in a general way that of *Rhabditis*, as does the mouth cavity; it consists of an anterior cylindrical part, the corpus, connected with a posterior swelling or bulb by an indistinctly set off isthmus. The lumen of the esophagus is similar to that of *Rhabditis* in that in the precorpus it terminates marginally in well developed "tubes" (Fig. 1, B), while in the remainder of the esophagus the lumen is simple, i.e., without particular modification, except in the bulb where it is hexalobate at the valve.

The precorpus contains 29 nuclei (Fig. 1, A-E) as follows: One group of 3 bilobed or 6 marginal nuclei, (m_{1a-b}–m_{3a-b}); 3 groups of 6 radial nuclei each (r_{1-6}, r_{7-12}, and r_{13-18}); and 2 groups of nerve cell nuclei (n_{1-3} and n_{5-6}). The marginal nuclear pairs, m_{1a-b} etc., may or may not be connected in such a way as to represent lobes of a single nucleus rather than individual nuclei; however, it is not possible to determine this on the basis of present material. A similar appearance is given by the marginal nuclei in *Rhabditis*, in which case the lobes were found to be joined anteriorly (Chitwood and Chitwood, 1936).

The postcorpus contains 26 nuclei (Fig. 1, F-L); 6 marginal nuclei (m_{4a-b}–m_{6a-b}), similar to those of the margins of the precorpus, 6 radial nuclei (r_{19-24}), and 14 nerve cell nuclei ($n_{4,7-19}$). The isthmus is too indistinct to be recognized as a unit. The most posterior nerve cell nuclei of the postcorpus might be considered as belonging to the isthmus.

The prevalvar region of the bulb contains 14 nuclei (Fig. 1, O–P), of which 6 are marginal nuclei (m_{7a-b}–m_{9a-b}), 6 radial nuclei (r_{25-30}), and 2 nerve cell nuclei (n_{20-21}).

The postvalvar region of the bulb contains 24 nuclei as follows (Fig. 1, Q–S); 6 marginal nuclei or nuclear lobes (m_{10a-b}–m_{12a-b}), 6 radial nuclei in 2 groups (r_{13-33}, r_{34-36}), 9 nerve cell nuclei (n_{22-30}), and 3 gland cell nuclei (g_{1-3}). The marginal nuclear pairs of the postvalvar region of the bulb appear in all probability to represent lobes rather than individual nuclei. In the series illustrated (Fig. 3) m_{11} is not double; n_{23-24} were not observed.

The orifices of the esophageal glands were not determined with absolute certainty. The dorsal gland appears to open into the lumen at the base of the stoma, while the subventrals appear to open at or near the level of n_{17-19}.

The esophago-intestinal valve of *Plectus* is extremely well developed (Fig. 2, A–C) and consists of 23 nuclei. (Some of these nuclei are probably intestinal—compare Figs. 2, B–C and 2, I). The valve is laterally elongated and rather flat.

Two other representatives of the same subfamily, very closely related to *Plectus*, were studied, these being *Chronogaster gracilis* and *Wilsonema bacil-*

livorus, in both of which the nuclei of the esophagus appear to be similar in number and distribution to those of *Plectus*.

ANONCHUS MIRABILIS (Plectidae) Figs. 2, D–F; 3

The esophagus of *Anonchus mirabilis* is cylindrical in the adult stage, but corpus, isthmus and pseudobulb are faintly recognizable in larval stages.

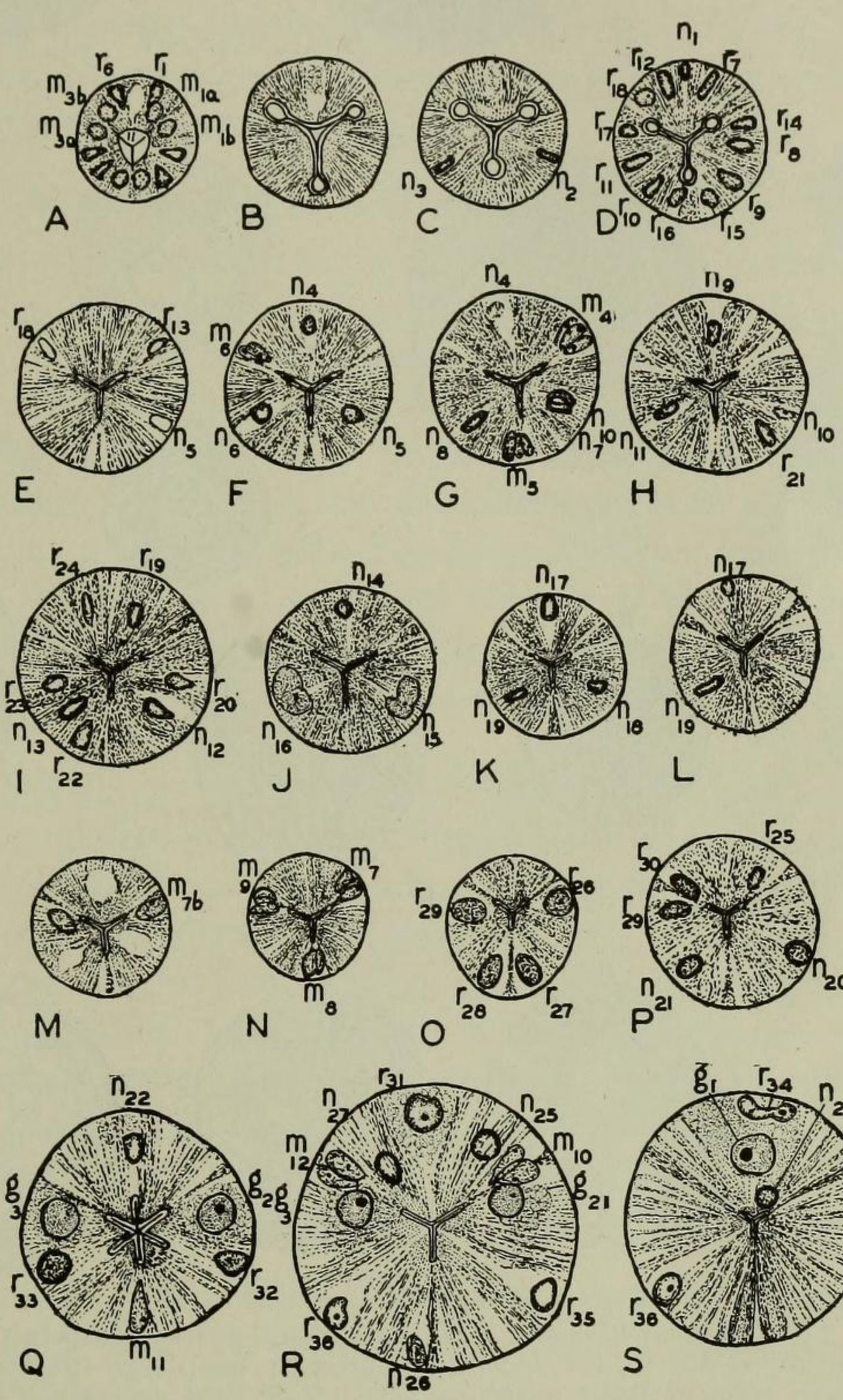

Fig. 1.—*Plectus granulosus*. A–F, precorpus; F–L, postcorpus; M–P, prevalvar region; Q–S, postvalvar region (See Fig. 2, B, for n_{29-30}).

The lumen is simple and triradiate, without marginal "tubes" (Fig. 2, E). The most striking pecularity of the esophagus is the presence of large chromidial bodies in the marginal regions (Fig. 2, D).

The nuclear number and distribution is nearly identical with that of *Plectus granulosus*, the following differences being noted: n_{20-21} and n_{23-24}

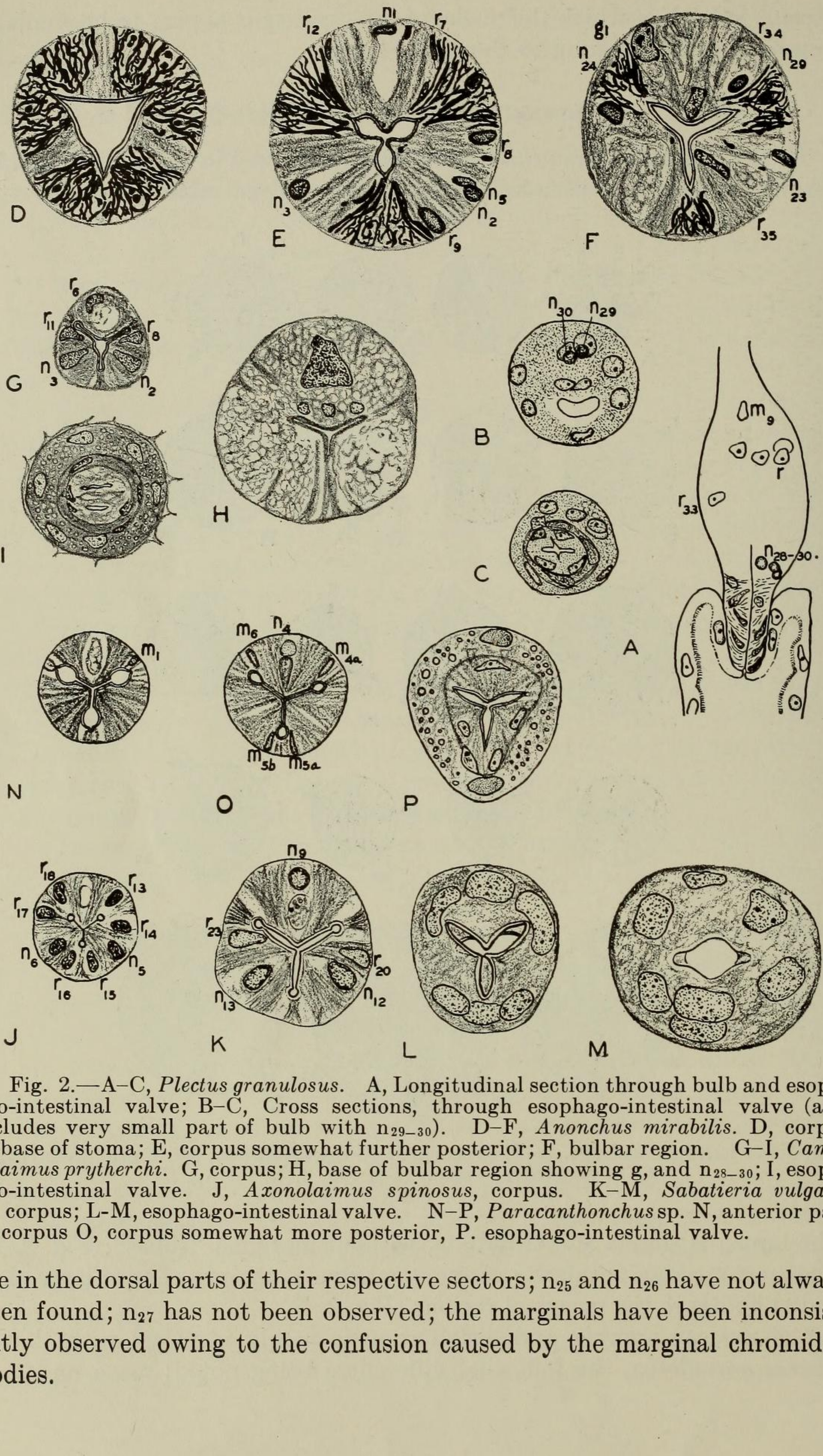

Fig. 2.—A–C, *Plectus granulosus*. A, Longitudinal section through bulb and esophago-intestinal valve; B–C, Cross sections, through esophago-intestinal valve (also includes very small part of bulb with n_{29-30}). D–F, *Anonchus mirabilis*. D, corpus at base of stoma; E, corpus somewhat further posterior; F, bulbar region. G–I, *Camacolaimus prytherchi*. G, corpus; H, base of bulbar region showing g, and n_{28-30}; I, esophago-intestinal valve. J, *Axonolaimus spinosus*, corpus. K–M, *Sabatieria vulgaris* K, corpus; L-M, esophago-intestinal valve. N–P, *Paracanthonchus* sp. N, anterior part of corpus O, corpus somewhat more posterior, P. esophago-intestinal valve.

are in the dorsal parts of their respective sectors; n_{25} and n_{26} have not always been found; n_{27} has not been observed; the marginals have been inconsistently observed owing to the confusion caused by the marginal chromidial bodies.

The marginal nuclei are very faint and nothing definite can be said about them. The gland cell nuclei differ from the other nuclei in that several small nucleoli are present instead of a single large one (see Fig. 2, F). The esophageal glands are very large and there is a vesicle near the orifice of each gland. The dorsal gland opens into the lumen of the esophagus anterior to the level of the first radial group, while the subventrals open anterior to the level of n_{17-19}.

The esophago-intestinal valve is similar to that of *Plectus* but the dorso-ventral form is more pronounced. Eleven large nuclei and possibly 4 smaller ones were observed in this structure.

CAMACOLAIMUS PRYTHERCHI (Camacolaimidae) Figs. 2, 3

The esophagus of this species is cylindroid, slightly constricted at the nerve ring, and gradually enlarged posteriorly. The lumen is normally closed, simple or triradiate, and minute marginal "tubes" are present only in the anterior part of the esophagus (Fig. 2, G). There is a total of 81 nuclei, the same number as in *Plectus* if the marginals are considered as lobed nuclei rather than double nuclei. The following differences in nuclear distribution in this species, as compared with *Plectus granulosus*, have been noted: N_{23} and n_{24} are in the ventral or marginal regions of their respective sectors; n_{26} is anterior to m_{11}; the fifth group of radials is subdivisible into 2 groups, $r_{25, 27, \text{ and } 28}$ being posterior to $r_{30, 26, \text{ and } 29}$ respectively; $r_{14 \text{ and } 22}$ were not always observed.

The esophageal glands are much more highly developed in *Camacolaimus* than in *Plectus* and occupy the greater part of the bulbar region (Fig. 2, H). The dorsal esophageal gland appears to open into the lumen slightly anterior to m_{1-3}, while the subventrals open near the level of n_{15-16}.

The esophago-intestinal valve (Fig. 2, I) is elongated, dorso-ventrally flattened, and contains 11 nuclei (only 8 shown in figure).

The rudimentary stoma is surrounded by esophageal tissue and contains a dorsal tooth which is apparently not connected with the dorsal esophageal gland.

APHANOLAIMUS sp. (Camacolaimidae) Fig. 3

The esophagus of *Aphanolaimus* is narrow, gradually enlarged posteriorly and without visible modified regions; the stoma is completely rudimentary and esophageal tissue extends to the anterior extremity. The esophageal lumen is simple, as is also the esophageal lining.

The first, second and fourth groups of marginal nuclei are simple, while the third group is lobed as in *Plectus*. There are a total of 80 nuclei, corresponding to those of *Plectus* with the following exceptions, m_{7bx} and m_{9ax} were inconsistently observed as lobes of m_{7b} and m_{9a}, respectively; n_{27} is posterior to g_1; $r_{25 \text{ and } 28}$ are nearly marginal in position; n_{23-24} were not observed but 1 nucleus, x_1, marginal in position, and in the right subventral sector, may correspond to n_{24}.

The esophago-intestinal valve is similar to that of *Camacolaimus*.

The esophageal glands are similar to those of *Camacolaimus* except that the dorsal gland nucleus is near the left side of the dorsal sector.

AXONOLAIMUS SPINOSUS (Axonolaimidae) Figs. 2, J; 3

The esophagus of *Axonolaimus* is clavate, relatively short, and muscular throughout. This form is very close to *Plectus* in the character of the stoma and also in the presence of well developed marginal "tubes" in the corpus (Fig. 2, J). The nuclear distribution of the corpus is closer to that of *Plectus* than to any of the forms previously mentioned. The first marginal group appears to consist of 6 separate and distinct nuclei (m_{1a-1b}–m_{3a-3b}); this is followed by the first 3 radial groups ($r_{1-6,7-12,13-18}$) in series. The second marginal group appears to be somewhat variable. In the series illustrated it consists of 7 separate nuclei, 4 ($m_{4a1,4a2}$ and $m_{6a1,6a2}$) being present in the dorsal sector, 2 (m_{4b} and m_{5a}) in the left subventral sector, and 1 (m_{5b}) in the right subventral sector. The fourth group of radial nuclei appears to consist of 6 or 8 nuclei (r_{19-24}) with the ventral nucleus in each subventral sector sometimes doubled ($r_{21a,21b}$ and $r_{22a,22b}$). The nerve cells of the corpus agree in number and position with those of *Plectus*.

The nuclei of the bulbar region are difficult to identify, and the labelling given in Fig. 3 is to some extent arbitrary. The nuclei labelled c_{1-3} are large and bilobed; $n_{23 \text{ and } 24}$ also appear to be bilobed in some instances.

The dorsal esophageal gland orifice is situated just anterior to the first group of marginal nuclei, while the orifices of the subventral glands appear to be near the level of n_{18-19}.

The esophago-intestinal valve is well developed but not so elongated as in *Plectus*; it is distinctly triradiate anteriorly and rather circular posteriorly, containing 10 to 11 nuclei. It is very similar to the valve of *Subatieria vulgaris*.

For purposes of comparison with *Plectus*, the total number of nuclei or nuclear lobes in the corpus is 58 (55 in *Plectus*) and in the bulbar region 35, 38 or 40 (38 in *Plectus*).

DORYLAIMOPSIS METATYPICUS (Comesomatidae) Fig. 5

The stoma and esophagus of *Dorylaimopsis* are closest, among the forms thus far studied, to those of *Axonolaimus*. The marginal "tubes" are well developed, and there is a very slight thickening of the cuticular lining extending throughout the corpus. The first and second marginal groups appear to consist of 3 bilobed nuclei. Data regarding the radial nuclei are not entirely satisfactory, but there appear to be 22 or 24 radial nuclei (in 4 groups) in the corpus, r_7 and r_{12} of *Axonolaimus* being the ones sometimes absent. The nerve cell nuclei (n_{1-19}) of the corpus agree with those of *Axonolaimus*. The marginal nuclei of the bulbar region (m_{7-9} and m_{10-12}) are simple. As in *Axonolaimus*, r_{27} and r_{28} are posterior to r_{26} and r_{29}, but r_{25} and r_{30} are at the

level of r_{27} and r_{28}. The last group of radials presents the unusual arrangement of r_{32} and r_{35}, being anterior to the level of r_{33} and r_{34} which are in turn anterior to r_{31} and r_{36}; the closest counterpart of this grouping is seen in *Theristus*. The nerve cells of the bulbar region correspond in number to those of *Plectus*, n_{20-21} being just posterior to r_{27-28} and slightly ventral to the mid-

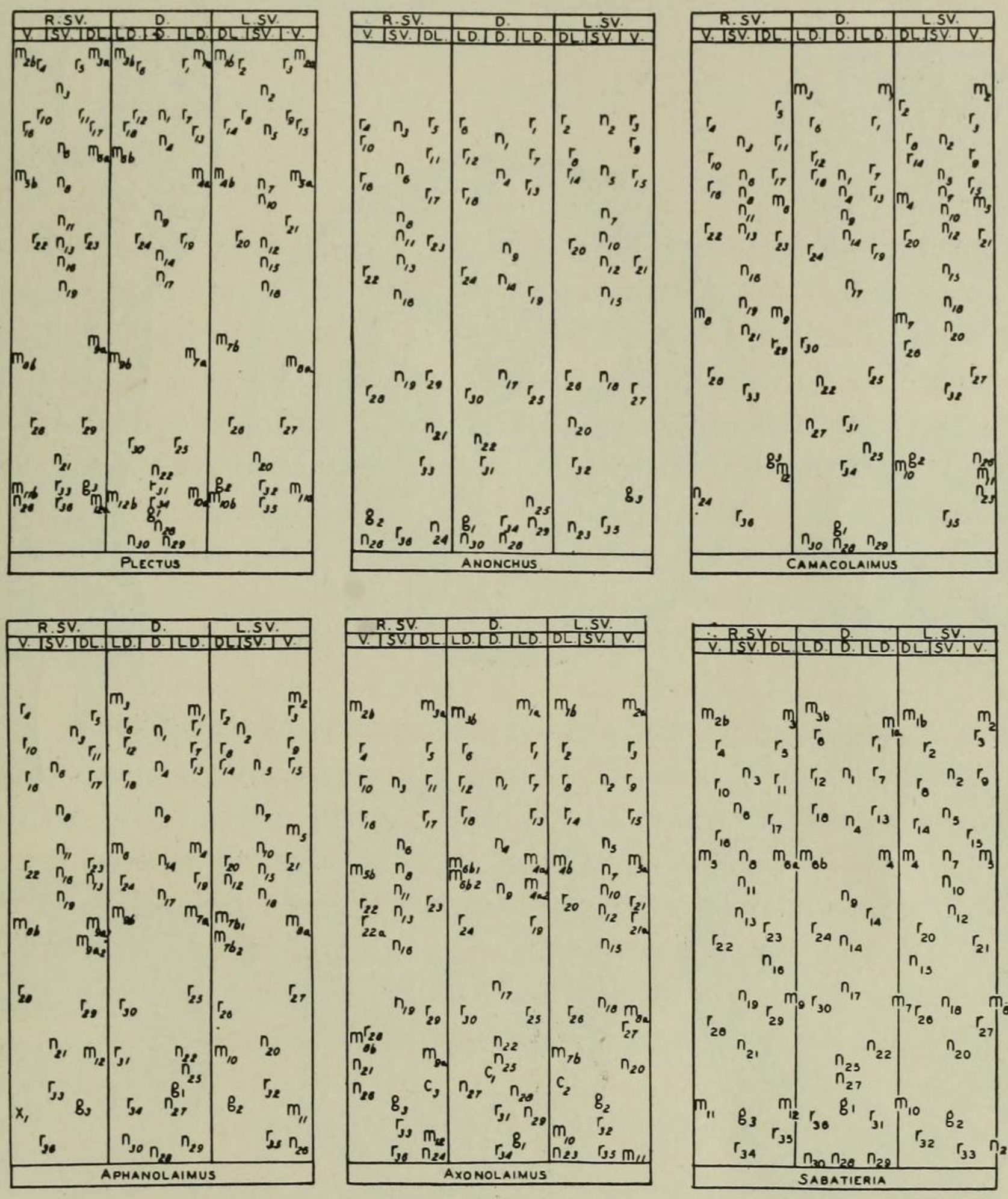

Fig. 3.—Table of nuclear distribution.

sector region; n_{23-24} are subventral, posterior to r_{33-34}; $n_{22,25,30}$ are distributed approximately as in *Plectus;* g_{1-3} are all in the center of their sectors between the levels of r_{33-34} and r_{31} and r_{36}. The esophageal glands of *Dorylaimopsis* are highly developed; the dorsal gland orifice is at the base of the stoma, and the subventral gland orifices are at the level of n_{18-19}. The glandular tissue is relatively much greater in this form than in *Axonolaimus* or *Plectus* but not as great as *Camacolaimus*. The esophago-intestinal valve is small and dorsoventrally flattened, and contains 12 nuclei.

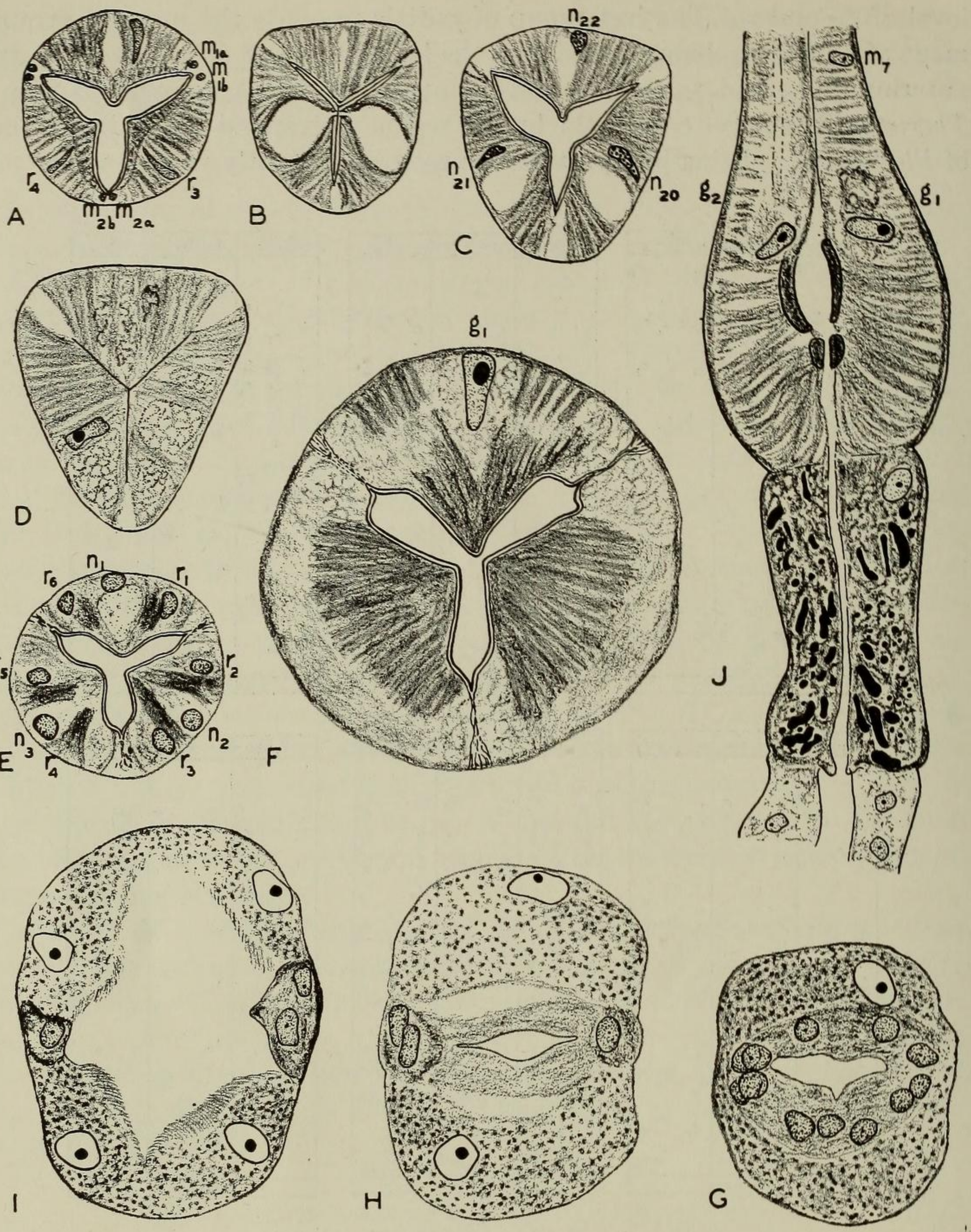

Fig. 4.—A–D, *Theristus setosus*. E–I, *Terschellingia pontica*. E, corpus; F, bulbar region; G–I, serial sections through esophago-intestinal valve. J, *Desmolaimus zeelandicus* v. *americanus*, longitudinal section through bulb, and esophago-intestinal valve.

SABATIERIA VULGARIS (Comasomatidae) Figs. 2, K–M; 3

The esophagus of *Sabatieria* is like the esophagi of *Axonolaimus* and *Dorylaimopsis* in that well developed marginal "tubes" are present. In the gross morphology, shortness and relatively great development of the esophageal glands is more nearly like *Dorylaimopsis* than *Axonolaimus*. Un-

like both of the mentioned forms, the posterior part of the stoma is collapsed and completely surrounded by well developed esophageal tissue.

The nuclei of the esophagus agree substantially with *Dorylaimopsis* both in number and distribution (See Figs. 3, 5). The lumen of the esophago-intestinal valve is triradiate anteriorly, laterally elongated posteriorly; 12 nuclei are present in the valve.

The dorsal esophageal gland has its orifice near the level of m_{1-3}, i.e., posterior to the base of the collapsed stoma. The subventral glands have their orifices at the level of n_{17}, i.e., the level of the nerve ring.

PARACANTHONCHUS sp. (Cyatholaimidae) Fig. 2, N–P

The esophagus of *Cyatholaimus* presents several interesting modifications. The stoma is completely surrounded by esophageal tissue, and a dorsal tooth projects into the anterior part of the lumen. This tooth probably corresponds to one of the three present in *Dorylaimopsis*. There is no evidence of its connection with the dorsal esophageal gland which appears to have its orifice at the base of the stomatal region. The slightly clavate esophagus presents no external peculiarities except that the lumen (Fig. 2, N) is rather unusual, the general appearance being that of an axonolaimoid or plectoid form (Figs. 1, 2, J) in which the termini of the margins have become converging after having once been tubular; this is best visualized by comparison of the illustrations.

Both the marginal and radial nuclei are practically marginal in position; the marginal nuclei of the corpus are double. Since our series are incomplete, no attempt to give nuclear distribution will be made. However, the general impression is very similar to that given by *Dorylaimopsis*.

The esophago-intestinal valve is short, markedly triradiate (Fig. 2, P) and consists of 8 nuclei which definitely belong to the valve, and 5 additional nuclei which also may belong to that structure; there are also 4 nuclei dorsal to the esophagus in a mass which apparently connects with the body wall.

BATHYLAIMUS sp. (Tripyloididae)

The esophagus of *Bathylaimus* is cylindrical, and surrounds the conoid stoma. The lumen is nearly of a simple triradiate character; the esophageal radii extend nearly to the external surfaces in *Theristus* but the margins are very faintly rounded showing a similarity to *Sabatieria*. The general outline of the esophageal cross-section is subtriangular, not unlike that of *Theristus* (Fig. 4, A) instead of nearly round as in the forms previously described. The position and form of the radial and marginal nuclei are also more like that of *Theristus* than of *Cyatholaimus*. The radial muscles are diffuse in attachment to the lining. Incompleteness of our series prevents us from giving further data on the structure of this form. The esophago-intestinal valve is triradiate.

THERISTUS SETOSUS (Monhysteridae) Figs. 4, A–D; 5

The esophagus of *Theristus* is cylindrical, its lumen simple, and the lining unmodified. The dorsal esophageal gland opens near the base of the conoid stoma, while the subventral esophageal glands open near the level of n_{15-16}. The radial and marginal nuclei differ greatly in size as well as in position (Fig. 4, A). When clearly observed, the first 2 groups of marginal nuclei are

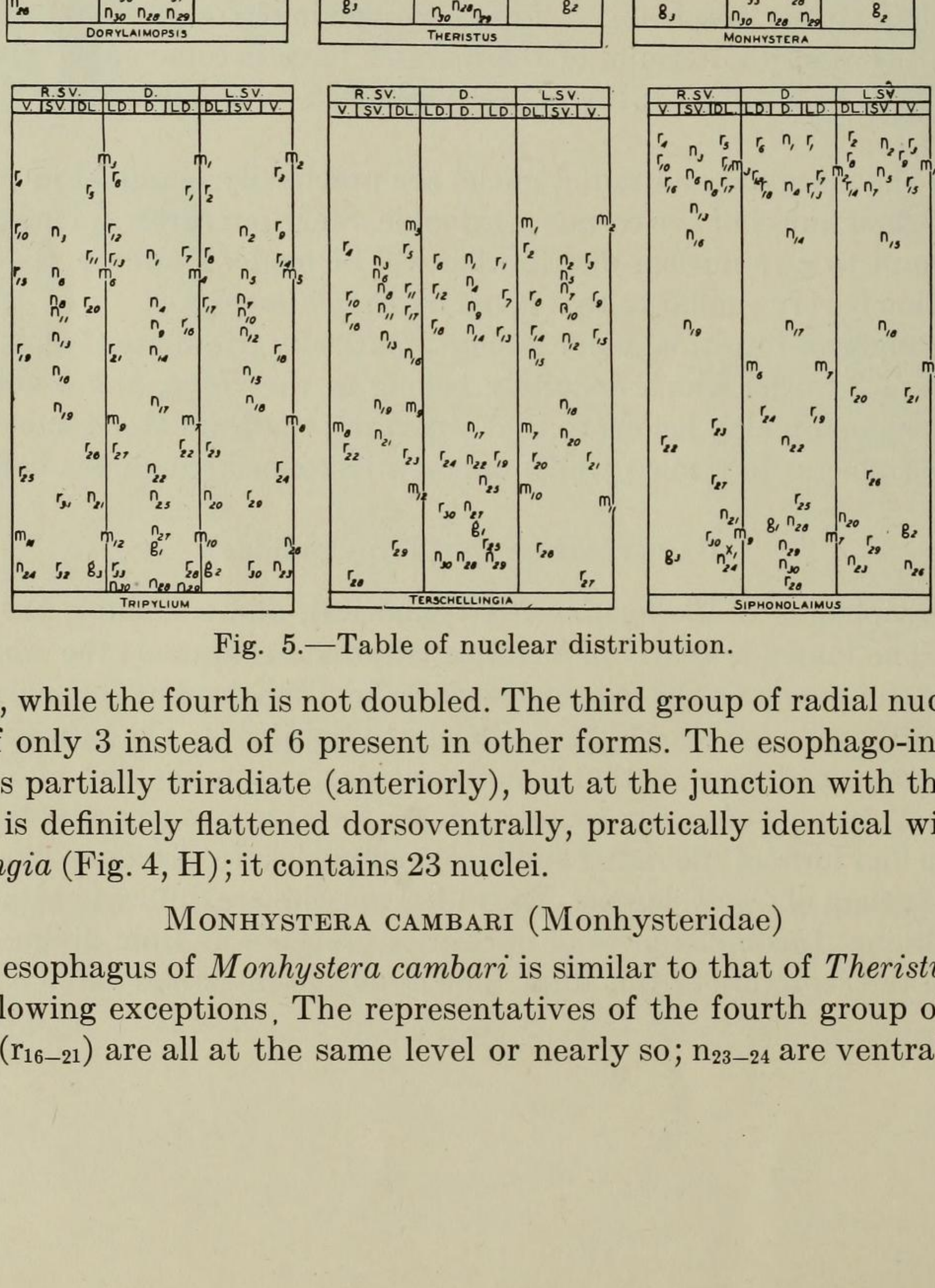

Fig. 5.—Table of nuclear distribution.

double, while the fourth is not doubled. The third group of radial nuclei consists of only 3 instead of 6 present in other forms. The esophago-intestinal valve is partially triradiate (anteriorly), but at the junction with the intestine it is definitely flattened dorsoventrally, practically identical with *Terschellingia* (Fig. 4, H); it contains 23 nuclei.

MONHYSTERA CAMBARI (Monhysteridae) Fig. 5

The esophagus of *Monhystera cambari* is similar to that of *Theristus*, with the following exceptions. The representatives of the fourth group of radial nuclei (r_{16-21}) are all at the same level or nearly so; n_{23-24} are ventrally sub-

marginal just posterior to the level of r_{30-31}; r_{29-32} and r_{30-31} are at levels in reverse of the levels at which they are, respectively, in *Theristus*; all of the marginals are simple except m_2 (not doubled). The esophago-intestinal valve is similar to that of *Theristus* and *Terschellingia*; 19 nuclei were observed.

TRIPYLIUM CARCINICOLUM V. CALKINSI (Linhomoeidae) Figs. 5, 6

The esophagus of *Tripylium* is cylindroid; anteriorly it surrounds the prismoidal stoma; posteriorly it is connected with the intestine through an enlargement commonly termed the "bulb" though this structure is not a

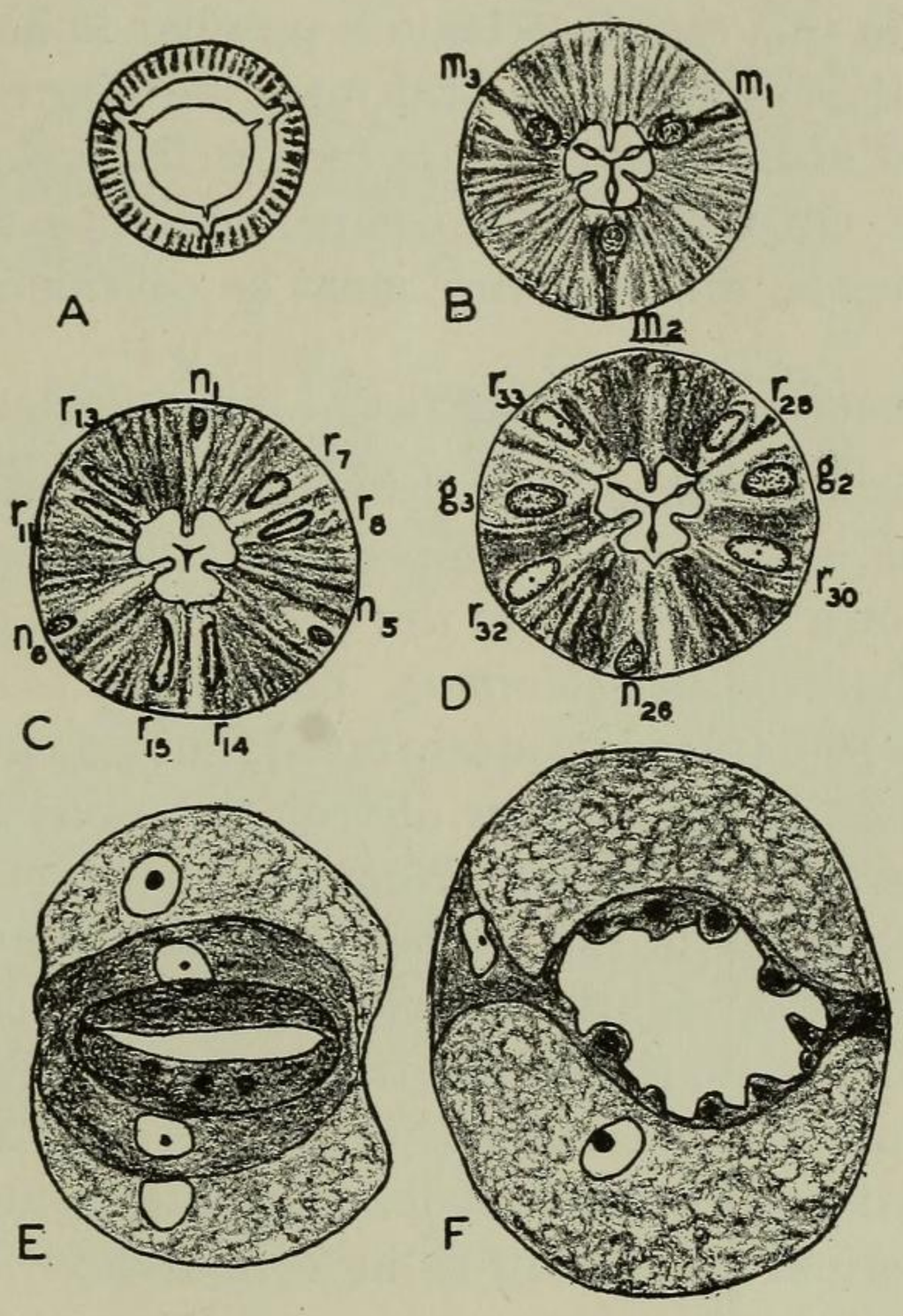

Fig. 6.—*Tripylium carcinicolum* v. *calkinsi*. A, stomatal region; B–C, corpus; D, bulbar region; E–F, esophago-intestinal valve.

part of the esophagus. The lumen is modified throughout due to the thickened cuticular attachment points of the lining (Fig. 6, C). This type of lumen appears to be derived from a plectoid or rhabditoid type in which there has been a disappearance of the marginal tubes and a development of attachment points for the radial muscles; such a phenomenon occurs in the development of forms such as *Oesophagostomum*.

The nuclei are distributed as in *Theristus*, with the following exceptions. The marginal nuclei are not doubled and are directly marginal in position (Fig. 6, B); r_{22} and r_{27} are at the same level as r_{23} and r_{26}; r_{28} and r_{33} are posterior to r_{29} and r_{32}; n_{23-24} are ventral submarginal and immediately anterior to the level of n_{28-30}, n_{26} being just anterior to n_{23-24}.

The esophago-intestinal valve is dorsoventrally flattened (Fig. 6, E–F), but some explanation regarding this region is necessary. Baylis (1915) and

Cobb (1920) have considered the swelling as an esophageal "bulb," and actually this structure is formed by the esophago-intestinal valve and the intestine. At least 12 nuclei are ectodermal in origin; the external tissue forming the "bulbar" enlargement, probably endodermal in origin, contains 4 nuclei. The cytology of the latter is identical with that of the intestinal cells following it.

In the related linhomoeid, *Desmolaimus*, there is a cylindrical elongated structure (Fig. 4, J) between the esophagus and intestine; the definite ectodermal valve tissue makes up only a small part of the esophago-intestinal cylinder. However, in this case the tissue is peculiar in being basophilic and differing both from the esophagus and the intestine. The esophagus is similar in all respects to that of *Tripylium* except for a well developed chromodoroid swelling at its base. On the basis of comparison with the postesophageal structure of linhomoeids, this structure must be considered as a new organ.

TERSCHELLINGIA PONTICA (Linhomoeidae) Figs. 4, E–I; 5

The esophagus of *Terschillingia* consists of a cylindrical corpus, following a rudimentary stoma, and a well developed bulb; the latter is actually a part of the esophagus, not a homologue of the so-called bulb of *Tripylium* but a homologue of the bulb of *Desmolaimus*. The lumen is subdistally dilated (Fig. 4E, F); the musculature is concentrated, but no cuticular thickenings of the lining are present. The nuclear distribution (Fig. 5) is rather similar to that of *Tripylium*, *Theristus*, and *Monhystera*, but only three groups of radial nuclei were observed in the corpus; n_{23-24} and n_{26} were not observed. The dorsal gland orifice is slightly anterior to the level of the first group of marginal nuclei (m_{1-3}) while the subventral gland orifices are at the level of n_{15-16}. The esophago-intestinal valve (Fig. 4, G–I) is very strongly dorsoventrally compressed and contains at least 19 nuclei, probably more. It is surrounded by intestinal epithelium as in *Tripylium*.

SIPHONOLAIMUS CONICUS (Siphonolaimidae) Fig. 5

Siphonolaimus is a peculiar form concerning the stoma and esophagus of which there has been much discussion. Being limited to a study of a single series of sections, the writers present the results of their study of this form with as little interpretation as possible. The minute stoma seems to be in the form of a stomatostyle surrounded by muscular tissue which consists of 6 strands passing posteriad and closely applied posteriorly to the anterior end of the esophagus, then passing to the body wall where they are inserted sublaterally. The stomatostyle overlies the anterior end of the esophagus in which 3 distinct cavities are present. Whether or not these cavities represent the 3 esophageal glands is not known; only the dorsal cavity is traceable posteriorly past the isthmus.

In the corpus a total of 37 nuclei were observed, 16 corresponding to n_{1-16} of other forms, while the remainder are marginal and radial nuclei. The lat-

ter probably correspond to m_{1-3}, r_{1-6}, r_{7-12} and r_{19-24} other forms, i.e., the third radial group and second marginal group are apparently absent. The bulbar region contains 32 nuclei. The esophago-intestinal valve is dorsoventrally flattened and contains 6 nuclei which definitely belong to the valve.

MONOPOSTHIA HEXALATA (Desmodoridae) Figs. 7, 10

The esophagus of *Monoposthia* is, in general, typical of the Chromodoroidea and Desmodoroidea. The prismoidal stoma (Fig. 7, A) is surrounded by esophageal tissue which protrudes anteriorly into the lumen in

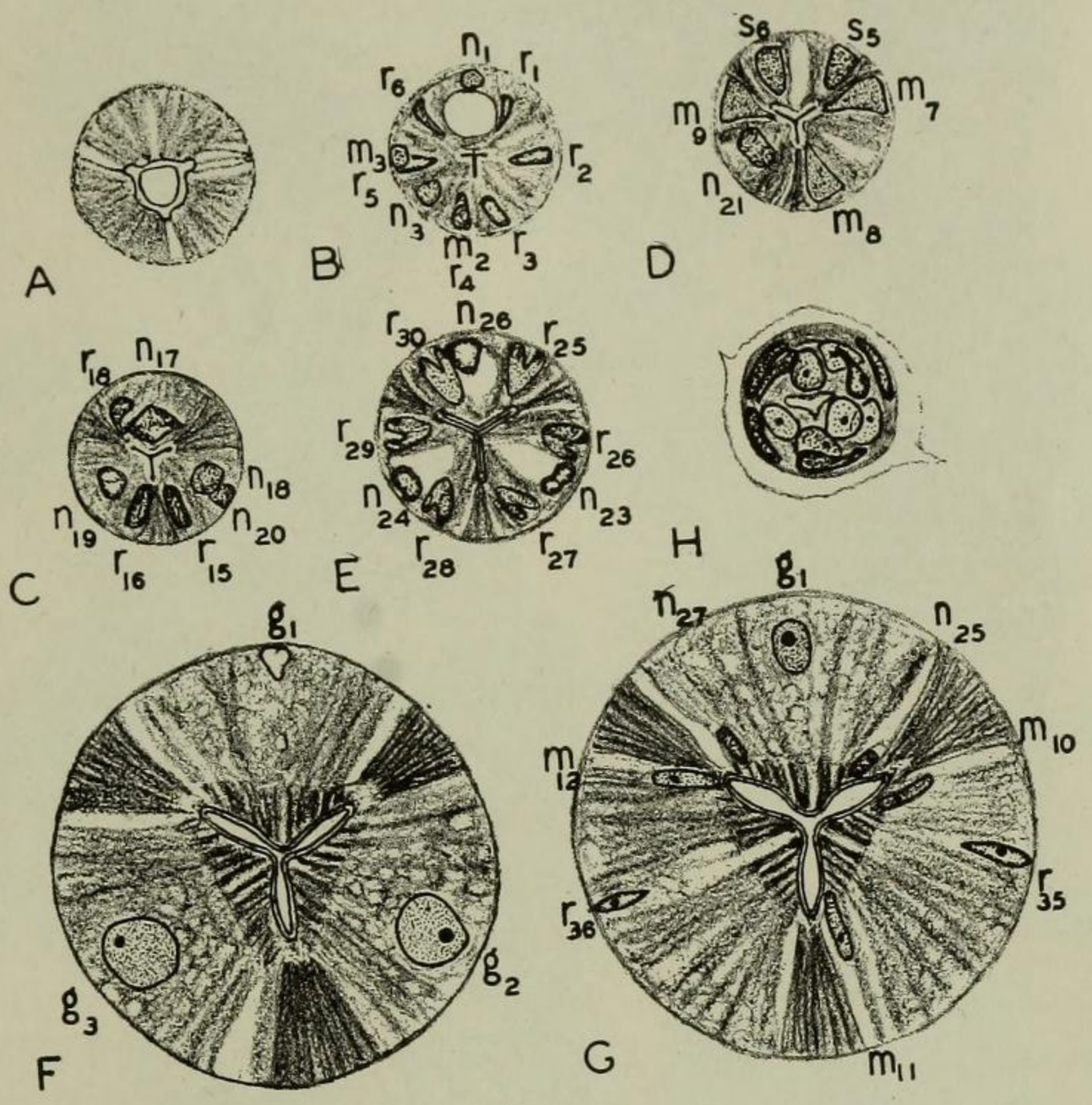

Fig. 7.—*Monoposthia hexalata.* A–C, corpus; A, in stomatal region; B, just posterior to orifice of dorsal gland; C, near base; D–G, bulbar region; H, esophago-intestinal valve.

the form of a large dorsal tooth. The post-stomatal region of the esophagus consists of a cylindroid corpus gradually enlarged posteriorly and joined directly to the short thick bulb. The lumen of the corpus is very minute, showing but faint indications of terminal "tubes."

The corpus contains 55 nuclei as follows: 2 groups of 3 marginal nuclei (m_{1-3} and m_{4-6}); 4 groups of 6 radial nuclei ($r_{1-6,\ 7-12,\ 18-24}$); 19 nuclei (n_{1-19}) presumably of nerve cells; and 4 nuclei (s_{1-4}) possibly of nerve cells.

The bulb contains 40 nuclei as follows: 2 groups of 3 marginal nuclei (m_{7-9}, m_{10-12}); 12 radial nuclei in 3 groups (r_{25-30}, r_{31-33}, r_{34-36}); 3 gland nuclei (g_{1-3}); 10 presumptive nerve cells (n_{22-30}); and 8 possible nerve cells (s_{5-12}); and 1 nucleus of uncertain type (x_1).

The dorsal esophageal gland appears to open into the lumen of the esophagus near the level of n_1, while the subventrals appear to open near the anterior end of the bulb (around the level of n_{20-21}).

The esophago-intestinal valve is short, more or less triradiate, and contains about 12–15 nuclei (Fig. 7, H).

Metachromadora, a closely related form of the same family, has an esophagus similar in a general way to that of Monoposthia but the esophageal lining has well developed thickenings for the attachment of radial muscles, particularly well developed in the bulbar region.

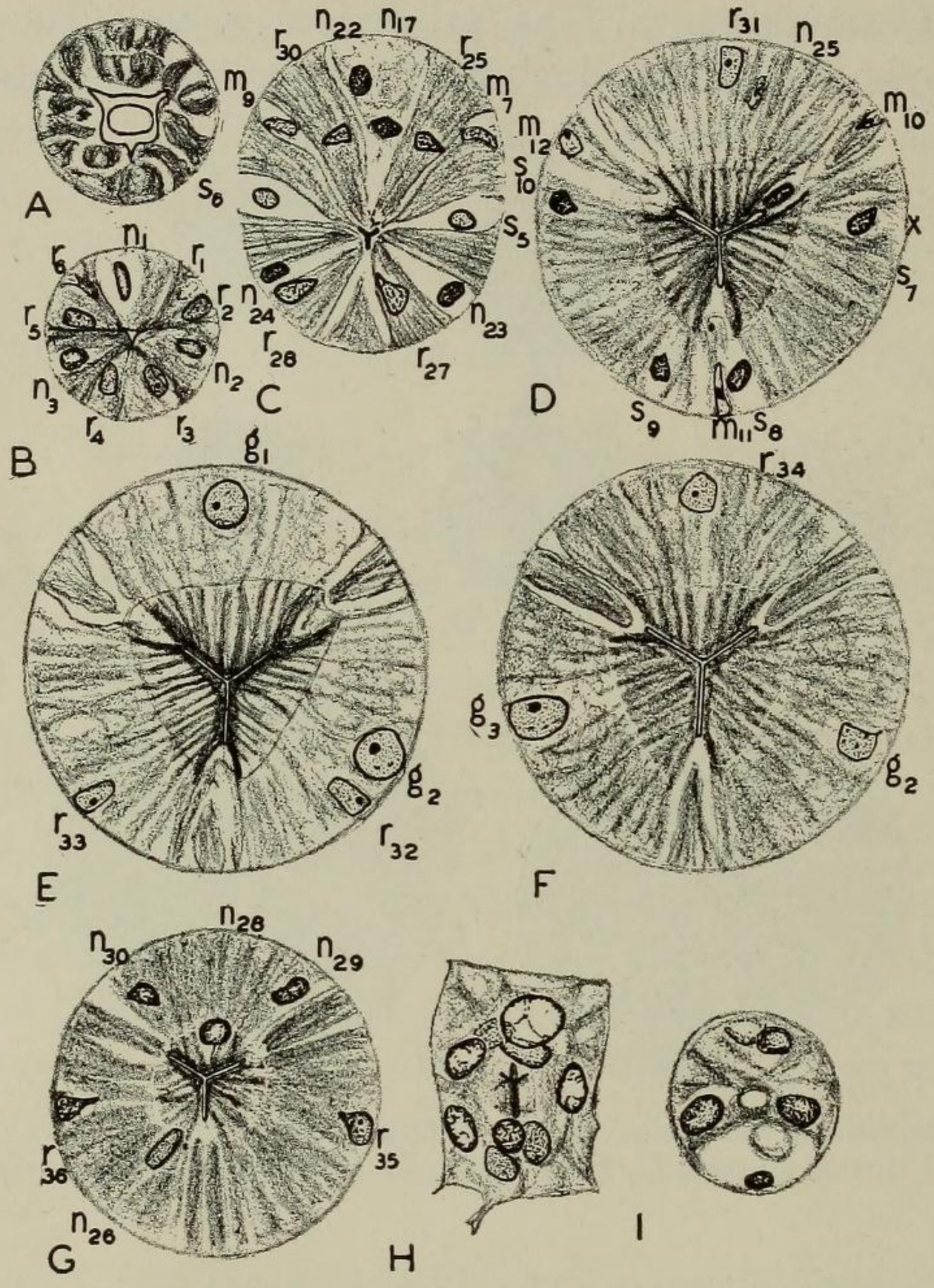

Fig. 8.—*Ethmolaimus rivaliensis*. A, stomatal region; B, corpus; C–G, bulbar region; H–I, esophago-intestinal valve.

ETHMOLAIMUS RIVALIENSIS (Chromadoridae) Figs. 8, 10

This form is nearly identical in esophageal structure with *Monoposthia*. The stoma, lumen and gross morphology are similar. The nuclei of the corpus (55) appear to be similar in character and distribution, there being 6 marginal nuclei, 24 radial nuclei, and 4 questionable (s_{1-4}). Most of the nuclei (total 39) of the bulb likewise correspond to those of *Monoposthia*, with the following exceptions, s_{5-6} were not recognized but 2 additional nuclei were sometimes observed in the left subdorsal sector.

The esophago-intestinal valve is short, dorsoventrally elongated, and contains 13 nuclei.

CHROMADORA sp. (Chromadoridae) Figs. 9, D–K; 10

The esophagus of this form is similar to that of *Ethmolaimus* and of *Monoposthia*, with the following exceptions: Grossly the stomatal region is not set off from the remainder of the esophagus and the bulbar region is relatively much shorter and smaller; the distinction between marginal and radial regions is more marked; 6 additional nuclei were observed in the corpus (x_{1-6}); the third group of radial nuclei is double (hence 6); s_5, s_6, n_{22a}

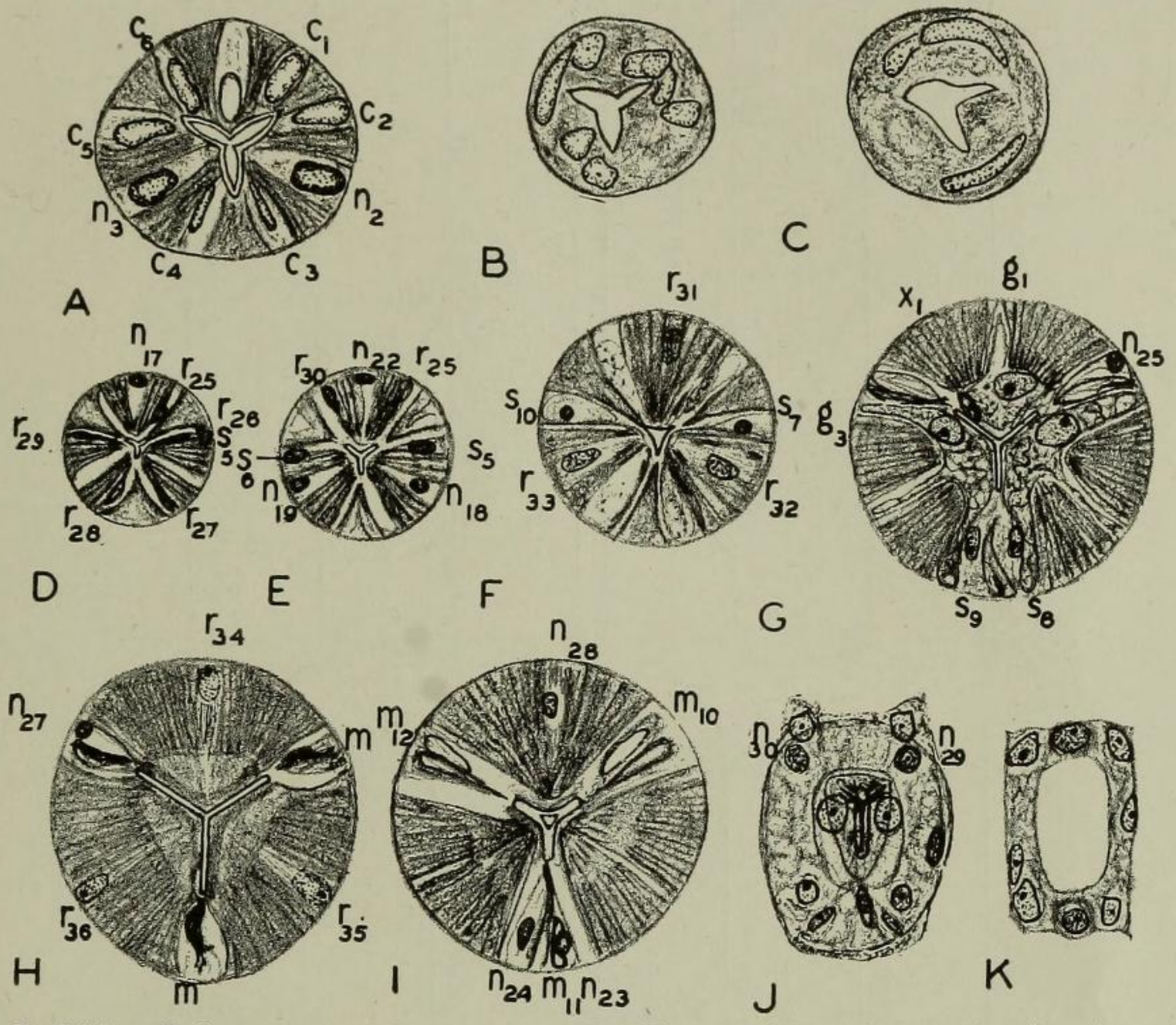

Fig. 9.—A–C, *Microlaimus* sp. A, corpus; B–C, esophago-intestinal valve. D–K, *Chromadora* sp. D–I, serial sections through bulbar region; J–K, esophago-intestinal valve.

(of *Monoposthia*) were not observed; additional nucleus (x_7) right laterodorsal was observed near the level of g_1, otherwise the nuclei in the bulbar region are as in *Monoposthia*. The esophago-intestinal valve is dorsoventrally elongated, consisting of 12 nuclei. *Chromadora* exhibits a pair of subdorsal pigment spots which consist of masses of brown granules in the subdorsal marginal and submarginal areas of the esophagus just posterior to the stomatal region; no special cells were observed in association with the spots.

MICROLAIMUS sp. (Microlaimidae) Figs. 9, A–C; 10

The esophagus of Microlaimus resembles that of Chromadora more closely than any other of the forms studied. The subtriangular stoma is surrounded by esophageal tissue, the corpus is cylindrical, the bulbar region quite enlarged and the esophago-intestinal valve elongated. The lumen (Fig. 9, A) is without marginal tubes and the lining without thickened cuticular attachment points though the radial fibers are highly concentrated. The number of nuclei and their disposition is clearly most like *Monoposthia*, *Ethmolaimus*

and *Chromadora* (compare Figs. 7–10). However, in addition to the nuclei s_{1-10}, there is a group of 6 nuclei (c_{1-6}) apparently resulting from further division of the second radial group (r_{7-12}). The elongate form of the esophago-intestinal valve grossly recalls the form of that structure in *Camacolaimus*, *Plectus*, or *Terschellingia*, but the cross section (Fig. 9, B–C) clearly indicates other relationships since it is plainly triradiate. It contains 11 nuclei.

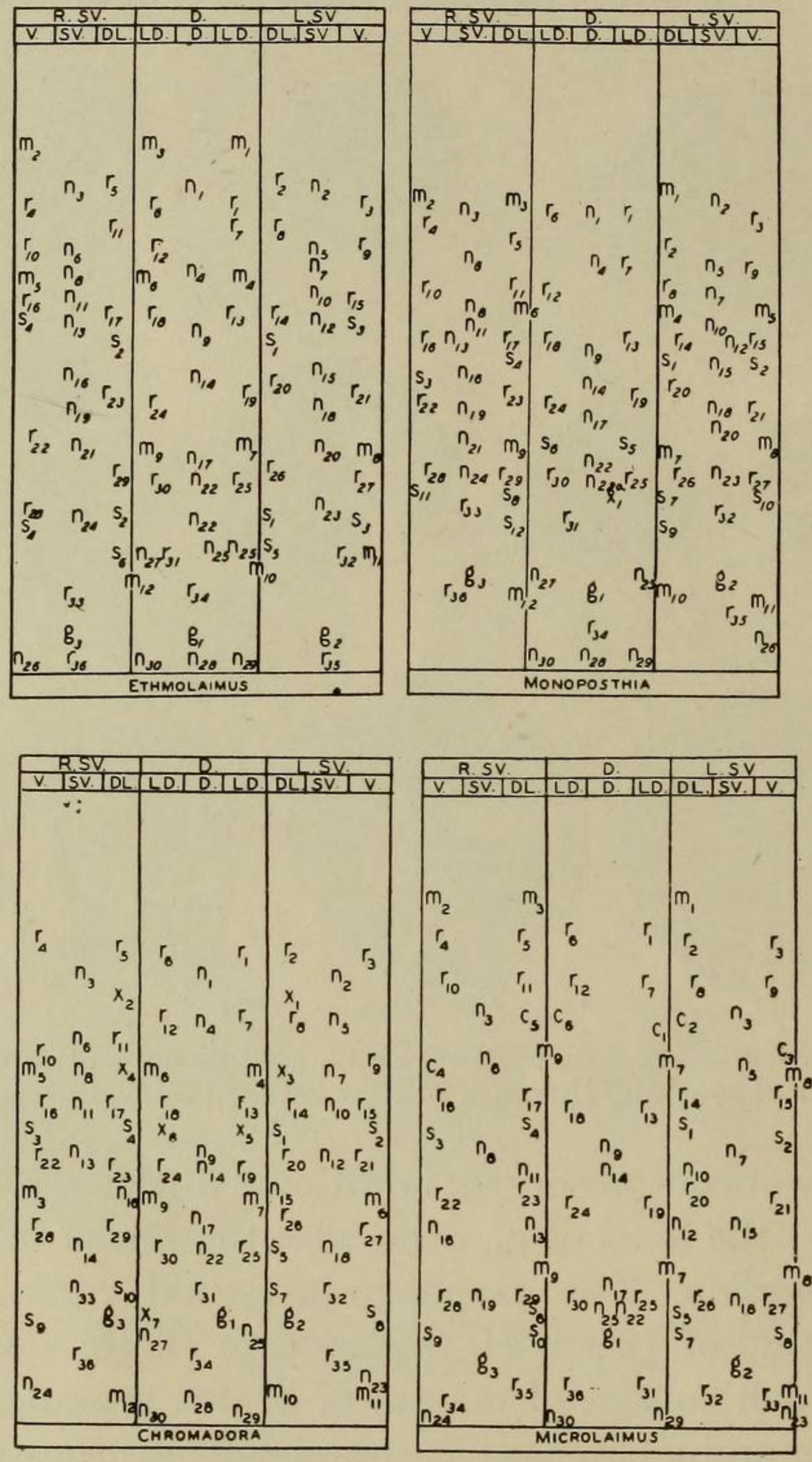

Fig. 10.—Table of nuclear distribution.

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