

Article VI. — THE MYZOSTOMES OF THE 'ALBATROSS'
EXPEDITION TO JAPAN.

By J. F. McCLENDON.

PLATES XV-XVII.

In the spring of 1903, Dr. W. M. Wheeler, under whom I was working at the University of Texas, gave me some Myzostomes to work over, consisting of two lots: first, a vial of Myzostomes from Pacific Grove, Cal., collected by Dr. Bashford Dean, and second, the Myzostomes taken by Dr. Hubert Lyman Clark from Crinoids and Ophiurans dredged by U. S. S. 'Albatross' off the eastern coast of Japan in the spring of 1900. I turned over the unfinished work to Dr. Wheeler, but when I saw him in June, 1905, he asked me to complete it. The material is now in the collection of the American Museum of Natural History, New York. Through the kindness of Honorable George M. Bowers, U. S. Commissioner of Fish and Fisheries, Dr. Hugh M. Smith, Director of Scientific Inquiry, and Miss M. J. Rathbun of the Smithsonian Institution, I was allowed to examine the remainder of the Crinoids dredged by the 'Albatross' off Japan, consisting of a large number of specimens of *Metacrinus rotundus*(?). Twelve of these were infested with *Myzostoma metacrinii* n. sp., and two of the twelve also with *M. clarki* n. sp. The California material was fixed in formalin and the Japanese in alcohol, but except for the shrinkage of some large eggs floating in the body cavity and the partial destruction of the cilia in the enteric canal, the finer structure of the specimens seemed fairly well preserved.

Before speaking of the morphology of these animals, I should say that throughout this paper I call the central part of the alimentary canal, between the pharynx and rectum, the *stomach*; and the cœca that arise from it, *intestinal diverticula* and *ramifications*; the cells that attach to the egg, *accessory cells*; and the segmentally arranged sacs on the ventral side, *suckers*; although they may have been called by other names by well-known workers on the subject. If we regard *Myzostoma* as a segmented animal, the suckers are placed midway between the parapodia in all the species I have examined, and when I say that the suckers are "midway" between the parapodia and the edge of the disc, I do not mean that the suckers are in line with the parapodia.

After the work of Wheeler (1897), von Stummer-Traunfels (1903), and earlier workers, what I have to say on the general internal morphology may be expressed in few words. The ovaries are not constant in position, but in all the species examined lie very near the wall of the stomach. As the animal increases in size, the mesoderm breaks down in large spaces, which become filled with growing eggs (primary oöcytes). With this disappearance of the mesenchyme, parts of the testes are isolated, thus cutting off the direct path of exit of the spermatozoa which are found wandering through the enlarged body cavity and even between cells of the ovary (previously observed by Wheeler), and probably some pass out through the uterus.

Dr. H. L. Clark says that *Metacrinus* infested with cysticolate myzostomes is not infested with ectoparasitic species, and *vice versa*, but I found a specimen of *M. metacrini* on each of the two crinoids on which I found a cyst of *M. clarki*.

In the cyst of *Myzostoma cysticolum* the small individual may take the place of the large one when the latter dies; at any rate, it could not get out through one of the pores. The small individual I sectioned did not function as "complemental male," for it contained no mature spermatozoa. It may have developed from one of the eggs of the large individual and utilized the narrow space left in the cyst as a convenient hiding place till it was too large to get out.

ENDOPARASITIC (CYSTICOLATE) SPECIES.

1. ***Myzostoma cysticolum*** von Graff, Challenger Reports, X, Myzostomida, p. 66, pl. xiii.

Von Graff found specimens in cysts in the arms of *Actinometra meridionalis*, dredged by U. S. S. 'Hassler' off Cape Frio, Brazil, January 22, 1872, and by U. S. S. 'Blake' during the winter of 1878-1879, at Station 249, off Grenada, West Indies. I have only one cyst, formed in the arm of *Antedon discoidea* P. H. C., dredged by U. S. S. 'Albatross' off the eastern coast of Japan, in the spring of 1900. It is larger than any of von Graff's specimens, being 5 mm. in length, while none of his was over 3 mm. in length, and shows slight morphological differences. For these reasons, and because they were found in different hosts and in different hemispheres, I consider them as distinct varieties.

***Myzostoma cysticolum* var. *orientale* var. nov.**

(Pl. XVI, Figs. 14, 15; Pl. XVII, Figs. 19, 26.)

One cyst in arm of *Antedon discoidea* P. H. C. Cyst 5 mm. in length with a pore at each end (unlike cysts of von Graff's specimens,

which had only one pore in each), containing two individuals very light brown in color, viz.: a large one occupying nearly all of the cavity of the cyst, and a small flat one, between the large one and the wall, near one of the pores.

Small individual (Pl. XVI, Fig. 14, and Pl. XVII, Fig. 26): Length 1.1 mm. Nearly circular in outline, a little longer than broad, very thin, and slightly concave; on the dorsal side. Mouth and anus opening into notches at fore and hind edges of the disc. Parapodia and hook apparatus well developed. Parapodia about midway between center and edge of disc, which is nearer the center than in von Graff's figure. Suckers and cirri absent. There are three intestinal diverticula on each side, which subdivide but do not extend to the edge of the disc. Testes well developed (but no mature spermatozoa) and opening by very short ejaculatory ducts at edges of the disc midway between the mouth and cloacal aperture. There are two pairs of small ovaries latero-ventral to stomach; no eggs.

Large individual (Pl. XVI, Fig. 15, and Pl. XVII, Fig. 19): Length 4.2 mm. Differs from small individual in being much more robust, having the anterior and posterior ends more deeply notched and the body folded so that the two halves of the dorsal surface approach each other, leaving a cavity in which, according to von Graff, the eggs develop. The parapodia are vestigial. The mesenchyme, too, has nearly disappeared, being represented only by a few strands, while the vacated space is filled with growing eggs, some of which have begun to crowd into the uterus. The two pairs of ovaries have grown, and by the folding of the body have been brought nearer the intestine. Von Graff figures a section of a cyst, cutting both individuals, and shows testes in the large individual in the position in which I found ovaries. But I am sure I am not mistaken, for the distal end of the ovary, when examined with high magnification (Zeiss Apochromat. imm. ob. 1.5 mm., oc. 12) is seen to contain oöcytes, each with two accessory cells having darkly staining nuclei, an appearance never seen in the testes. In many *Myzostomes* spermatozoa wander through the ovaries (Wheeler) and are very misleading. No testes were found.

2. *Myzostoma clarki*¹ sp. nov.

(Pl. XV, Figs. 7-10, and Pl. XVII, Figs. 17, 29.)

Seven cysts formed by enlargements of arms of *Metacrinus rotundus* Carp., dredged by U. S. S. 'Albatross,' Suruga Gulf and Sagami Sea, Japan, 1900, each containing a solitary individual. The cysts

¹ Named after Dr Hubert Lyman Clark.

vary from 6 to 10 mm. in length. Each cyst is an oval enlargement on the ventral side of the arm, with a pore at each end. The animal is very light brown in color. It differs from *M. cryptopodium* Wheeler in having the parapodia only partially pressed into the body, and not entirely hidden in grooves, as in the latter. The specimens examined ranged from 4.5 to 7.3 mm. in length. The body is very robust and the lateral margins are curled dorsally, while the concave dorsal surface is wrinkled longitudinally. It lies in the cyst with its mouth near one pore and its cloacal opening near the other. There is a pair of vestigial cirri at each end. The parapodia decrease in size from before backward. Hooks are well developed. The suckers have very small necks (Pl. XVII, Fig. 17, s). The mouth and cloacal orifice are minute; the former is at the anterior end, the latter in a notch at the posterior end. The pharynx extends backward nearly to the middle of the body. There are three pairs of intestinal ramifications, which subdivide. The mesenchyme wastes away as the animal grows, and becomes filled with eggs. There are two pairs of ovaries on diagonal strands connecting the bases of the internal diverticula with the ventral wall of the body. I sectioned specimens measuring 4.5, 5, 6.5, and 7.3 mm. in length and found ovaries in all of them, but no testes. It is probable that they are hermaphroditic, but that all the specimens were so old (large) that the testes had disappeared. In the smallest, young eggs were found in the body cavity, and in the others the number and size of these increased with the size of the individual. In the largest specimen eggs were being produced very rapidly. Masses of a hundred or more very small oöcytes were detached from the ovary and distributed through the body cavity. The nuclei of the accessory cells could be distinguished in the eggs after they had reached a considerable size (Pl. XVII, Fig. 29), but large numbers of them were floating free or surrounded by a thin film of cytoplasm, in the body cavity.

ECTOPARASITIC SPECIES.

3. *Myzostoma metacrini* sp. nov.

(Pl. XV, Fig. II, and Pl. XVII, Fig. 20.)

One specimen with some cirri lost and the body folded, taken by Dr. H. L. Clark from *Metacrinus rotundus* Carp., dredged by U. S. S. 'Albatross,' eastern coast of Japan, 1900.

On looking over the remainder of the above lot of Crinoids, I found seventeen specimens on what I believe to be *Metacrinus rotundus*. These specimens as well as the Crinoids are in the Smithsonian Institution.

Length 2.5 to 6 mm. About one and a half times as long as broad. Flattened, and light greenish brown in color, with a clear margin. Parapodia attached midway between the center and the edge, very extensible and swollen at their bases. The base of each bears a minute cirrus, possibly homologous with a neuropodial cirrus in the Polychæta. Suckers situated a little nearer the edge than the parapodia. Ten pairs of marginal cirri; posterior pair much longer, and anterior pair somewhat longer than those intervening. There is a penis on each side under the base of the median parapodium. The mouth is near the anterior, the cloacal aperture at the posterior end.

In a specimen 5 mm. long, that I sectioned, the stomach and intestinal epithelium was much thicker on the dorsal than on the ventral side. The mesenchyme had nearly all disappeared and the vacated space was filled with eggs. There was a single pair of ovaries, elongate in shape, each attached by one end to the dorso-lateral wall of the stomach. Testicular follicles, probably only remnants of the testes of earlier stages, were distributed chiefly around the intestinal ramifications.

4. *Myzostoma antennatum* von Graff.

(Pl. XV, Fig. 5, and Pl. XVII, Figs. 21, 30.)

Myzostoma ambiguum VON GRAFF, Challenger Reports, X, Myzostomida, p. 54, pl. viii; *Ibid.*, XX. *Myzostoma* Supplement, p. 10, pl. ii.

Von Graff had but one imperfect specimen of *M. antennatum*, from Amoy, host uncertain.

Only one imperfect specimen of *M. ambiguum* found loose in spirit with two species of *Actinometra* and five of *Antedon*, from the Moluccas.

Von Graff distinguishes these two by the length of the ninth pair of cirri, which are longer in *M. ambiguum* than in *M. antennatum*; by a difference in breadth of the clear border; and by the color. I have twenty-four specimens from *Actinometra* sp., and one from *Metacrinus rotundus* Carp., dredged by U. S. S. 'Albatross' in Suruga Gulf and Sagami Sea, Japan, 1900. The one from *Metacrinus* was dark brown, like von Graff's *M. antennatum*; the others bright yellowish brown, like *M. ambiguum*; but in form they showed variations between the two species of von Graff. One may have been darkened by tannin from the cork, or by substances from the Crinoids, and in the absence of morphological distinctions, I do not think the color worth much

consideration; in fact, I believe von Graff's two species are synonymous.

The body is a flattened disc, almost circular in some specimens, more or less elongated in others, bordered by a clear area of variable width, into which the intestinal ramifications do not penetrate. There are ten pairs of cirri, of which the first, second, ninth, and tenth are about twice as long as the others. The parapodia are prominent and have well developed hook apparatus. They are inserted about half way between the center and the edge of the disc. Under the bases of the third parapodia there is a pair of penes that may be extended a little beyond the edge of the disc or retracted until scarcely visible. The suckers are elongated in a radial direction, and placed about half way between the bases of the parapodia and the edge of the disc. There is a single pair of ovaries lateral to the stomach (Pl. XVII, Fig. 21). I sectioned specimens 1.6, 2.2, and 3 mm. in length, and they each had one pair of ovaries, eggs in all stages of growth, and testes with mature spermatozoa.

5. *Myzostoma wheeleri* sp. nov.

(Pl. XVI, Fig. 16, and Pl. XVII, Fig. 25.)

Eight specimens on pinnules of *Metacrinus rotundus* Carp., dredged by U. S. S. 'Albatross,' Suruga Gulf and Sagami Sea, Japan, 1900.

Each specimen is about 4 mm. in length and brown in color. The body is stout and its lateral margins are bent downward, probably to grasp the pinnæ, making the dorsal surface very convex and the ventral very concave. In this condition, the body is about four times as long as broad, and its broadest diameter about one-third its length from the anterior end. There are ten pairs of short, slender cirri. The parapodia are well developed but usually partially hidden by the lateral margins of the body. Suckers are absent. The mouth and cloaca open at the ends of the body. The pharynx is slender. There are three pairs of intestinal diverticula which subdivide, and a single pair of elongated ovaries, each attached by one end to the dorso-lateral wall of the stomach. The body cavity contains eggs of various sizes. The testes branch widely in the lateral regions of the body and contain some mature spermatozoa.

6. *Myzostoma deani*¹ sp. nov.

(Pl. XV, Fig. 6, and Pl. XVII, Fig. 27.)

A number of specimens measuring .5 to 1.5 mm. in length, killed

¹ Named after Dr. Bashford Dean.

in formalin, from *Antedon* sp., dredged off Pacific Grove, Cal., July, 1897, and sent to Dr. Wheeler by Dr. Dean.

Color very light brown. The body is a thick disc, nearly circular in outline; anterior and posterior margins slightly concave. The two halves of the body are bent slightly downward, making in cross-section the dorsal surface convex and the ventral slightly concave. There are ten pairs of very short cirri with swollen bases. The parapodia, which are attached about one-third the radius from the edge of the disc, sometimes extend beyond the edge in small specimens, but do not reach it in large ones. They sometimes enclose the end of the hook and thus become curved at the end. Hook apparatus well developed. Suckers elongated radially, situated about half way between the bases of the parapodia and the edge of the disc. The mouth is on the ventral side very near the anterior end, whereas the cloaca opens at the posterior end. The pharynx is very much retracted (probably due to killing the animal in formalin). The intestinal ramifications do not reach the edge of the disc. The single pair of ovaries is attached to the dorso-lateral walls of the stomach. In a specimen .5 mm. in length the ovaries and testes are small and contain mature spermatozoa, but there are no eggs. In one 1 mm. in length the ovaries and testes are larger, and mature spermatozoa and small eggs are present.

7. *Myzostoma smithi*¹ sp. nov.

(Pl. XVI, Fig. 12, and Pl. XVII, Fig. 18.)

Five specimens from *Antedon discoidea*, dredged by U. S. S. 'Albatross' in Suruga Gulf and Sagami Sea, Japan, 1900.

Length 1.9—3.5 mm. Color brown. The body is flattened, oval in outline, being a little longer than broad. Five pairs of very small cirri. The parapodia are very small, situated midway between the center and the edge of the disc. The hooks are nearly straight. The suckers have irregular stellate mouths about half way between the parapodia and the edge of the disc. The mouth opens below, near the anterior end; the cloaca at the posterior end. The pharynx is stout. There are three pairs of intestinal diverticula which subdivide many times and penetrate almost to the edge of the disc. There is a single pair of ovaries on the dorso-posterior side of the bases of the anterior pair of intestinal diverticula. The testes branch out between the intestinal ramifications. The ejaculatory ducts open at the bases of the median pair of parapodia. A specimen 1.9 mm. in length had ovaries, large testes, small eggs, and a few mature

¹Named after Dr. Hugh M. Smith.

spermatozoa. In another 2.4 mm. in length, the eggs were a little larger, and in specimens 3 and 3.5 mm. long, some eggs had grown to full size and were escaping through the uterus.

8. *Myzostoma chelonium* sp. nov.

(Pl. XV, Figs. 1, 2, and Pl. XVII, Figs. 22, 23.)

Twelve specimens from 1.5 to 2.1 mm. in length from *Antedon discoidea* Carp., dredged by U. S. S. 'Albatross' in Suruga Gulf and Sagami Sea, Japan, 1900.

Color yellowish brown. Body robust, nearly circular in outline when seen from above or below. The lateral margins are curled ventrally. The dorsal surface is divided by furrows into polygonal areas giving the appearance of the shell of a turtle in a much more striking manner than *M. testudo* von Graff. The dorsal surface is covered by a thick rough cuticle, honeycombed by perpendicular cavities, in each of which lies a cuticle-secreting cell (Pl. XVII, Figs. 22, 23, c). There are ten pairs of short conical cirri on the ventral side near the edge, probably pushed in by the overgrowth of the cuticle. The two anterior and two posterior pairs of cirri are smaller than the others. The parapodia are very large, with swollen bases. Hook apparatus well developed. The suckers are circular. There is a pair of penes under the median parapodia. The mouth and cloaca open below near the anterior and posterior ends of the body, respectively. There are three pairs of intestinal diverticula, which subdivide, and but a single pair of ovaries beneath the bases of the anterior pair of intestinal diverticula. I sectioned specimens 1.5 and 2.1 mm. in length, and found in each, ovaries and testes, with mature spermatozoa and eggs of all sizes.

9. *Myzostoma chelonoidium* sp. nov.

(Pl. XV, Figs. 3, 4, and Pl. XVII, Fig. 24.)

Ten specimens, 1.7 to 2.4 mm. in length, from *Antedon discoidea*, dredged by U. S. S. 'Albatross,' Suruga Gulf and Sagami Sea, Japan, 1900.

If we imagine *M. chelonium* stretched lengthwise until it is over three times as long as broad, we would have a form resembling *M. chelonoidium*. The number of polygons in linear series down the back is one more in the latter, the parapodia are weaker, and the posterior cirri are drawn forward a little.

The animal is yellow in color and of about the shape of *Myzostoma wheeleri*, which is found on the pinnules of the host. I believe that *M. chelonoidium* also is better adapted by its form to cling

to pinnules than to the arms or disc. The cuticle is like that of *M. chelonium*, but more regularly honeycombed. There are ten pairs of small cirri attached near the edge, but pushed in from the edge by overgrowth of the cuticle. The anterior pair of cirri is directed forward, the others inward. The parapodia and suckers are small. The mouth and cloaca open on the ventral side near the ends of the body. The stomach is much elongated. There is only a single pair of ovaries which are latero-ventral to the stomach. In both specimens sectioned (1.7 and 2.4 mm. long) I found ovaries, testes, mature spermatozoa, and eggs of all sizes.

10. *Myzostoma japonicum* sp. nov.

(Pl. XVI, Fig. 13, and Pl. XVII, Figs. 28, 31-34.)

Six specimens from *Ophiocreas* sp., eastern coast of Japan, and *Astroceras pergamena* Lyman, dredged by U. S. S. 'Albatross,' Station 3755, eastern coast of Japan, 1900.

Length 1 to 2.5 mm. Color clay yellow. Body flattened, oval, a little longer than broad, flat below and convex above. Ten pairs of very short conical cirri. Parapodia very small, attached about one-third the length of the radius from the edge. Hooks nearly straight and inclined inward, as in *M. smithi*. Suckers absent. Mouth opening below, a little behind the first pair of parapodia. Cloaca opening below near the posterior end. There are three pairs of intestinal diverticula, which subdivide many times but do not penetrate the clear margin of the disc. The ovaries are lateral to the junction of the pharynx and stomach. A specimen 1 mm. in length contained no eggs, others, 1.1 and 1.2 mm. long, contained small eggs, and still others, 1.5, 2, and 2.5 mm. in length, contained eggs of all sizes. All the specimens sectioned contained testes and mature spermatozoa. Plate XVII, Figures 31-34, show successive stages in the transformation of the spermatid into the spermatozoön. In Fig. 31, the nucleus has begun to elongate, the chromatin is in numerous granules. In Fig. 32, the elongation is greater. Fig. 33 shows only a short piece of the elongated nucleus in which the chromatin granules are being united into a single series of discs. Pl. XVII, Fig. 34, shows the discs fully formed. There are over a hundred in number,—more than in *M. glabrum*, which has about twenty-four, and *M. cirriferum*, which has about sixty. The tail has been described by Wheeler for *M. glabrum* and *M. cirriferum* in living specimens, where it is about twice the length of the head. I could trace it a short distance in some sections.

BIBLIOGRAPHY.

1884. BEARD, J. On the Life History and Development of the Genus *Myzostoma*. *Mit. Zool. St. Neapel*, V, p. 544, Taf. 31-32.
1894. — On the Nature of Hermaphroditism in *Myzostoma*. *Zool. Anz.*, XVII, p. 399.
1897. — The Sexual Conditions of *Myzostoma glabrum*. *Mit. Zool. St. Neapel*, XIII.
1888. BRAUN, M. Die Myzostomiden. Zusammenfassender Bericht. *Centralbl. Bact. Parasit.*, III.
1804. CARAZZI, D. Ricerche Embriologiche e Citologiche sull' Uovo di *Myzostoma glabrum*. *Monitore. Zool. Italiano*, XV.
1884. CARPENTER, P. H. On Crinoids of N. Atlantic. (Note by von Graff.) *Proc. R. Soc. Edin.*, XII.
1902. CLARK, H. L. New Host for Myzostomes. *Zool. Anz.* XXV, No. 683.
1887. VON GRAFF L. Das Genus *Myzostoma*. Leipzig.
1883. — Verzeichnis der von 'Hassler' u. 'Blake' ges. Myzostomen. *Bull. Mus. Comp. Zool. Cambridge*, XI.
1884. — Challenger Reports, X, Myzostomida.
1887. — Challenger Reports, XX, Myzostomida (Supplement).
1898. VON KOSTANECKI. Die Befruchtung des Eies von *Myzostoma*. *Arch. Mik. Anat.*, LI.
1842. LOVEN, S. *Myzostoma cirriferum* Leuck., ein parasitischer Wurm. *Arch. f. Naturg.*, VIII, p. 306, Taf. 8.
1895. VON MARENZELLER. *Myzostoma asteriæ* sp. nova. *Anz. k. Akad. Wiss. Wien*, XVIII.
1866. METCHNIKOFF, E. Zur Entwicklungsgeschichte von *Myzostomum*. *Zeit. Wiss. Zool.*, XVI, p. 236, Taf. 13.
1885. NANSEN. Bidrag til Myzostomernes Anatomi og Histologi (English Résumé), Bergen, 1885.
1892. PRUHO, H. Sur deux Myzostomes parasites de l'*Antedon phalangium* Müller. *Comp. Rend.*, Tome 115, p. 846.
1895. — Diöcité et Hermaphroditisme chez les Myzostomes. *Zool. Anz.* 1895, No. 486.
1857. SEMPER, C. Zur Anatomie und Entwicklungsgeschichte der Gattung *Myzostoma*. *Zeit. Wiss. Zool.*, IX, p. 48, Taf. 3 and 4.
1903. VON STUMMER-TRAUNFELS. Beiträge zur Anatomie und Histologie der Myzostomen, *M. asteriæ*. *Zeit. Wiss. Zool.*, 75.
1887. VON WAGNER. *Myzostoma buccichii* n. sp. *Zool. Anz.*, X, No. 225.
1894. WHEELER, W. M. Protandric Hermaphroditism in *Myzostoma*. *Zool. Anz.*, XVII, p. 177.
1895. — The Behavior of the Centrosomes in the Fertilized Egg of *Myzostoma glabrum* Leuck. *Jour. Morph.*, X, p. 305.
1896. — The Sexual Phases of *Myzostoma*. *Mit. Zool. St. Neapel*, XII, p. 227, Taf. 10-12.
1898. — The Maturation, Fecundation, and Early Cleavage of *Myzostoma glabrum* Leuck. *Arch. d. Bio.*, XV.
1899. — J. Beard on the Sexual Phases of *Myzostoma*. *Zool. Anz.*, XXII.
1905. — A New *Myzostoma* Parasitic in a Starfish. *Biol. Bull.*, VIII, No 2, Jan. 1905. pp. 75-78, 1 fig.

EXPLANATION OF PLATES.

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|-----------------------------------|------------------------------------|
| <i>c</i> — cuticle, surface view. | <i>od</i> — uterus. |
| <i>e</i> — eggs in body cavity. | <i>s</i> — sucker (segmental sac). |
| <i>o</i> — ovary. | <i>t</i> — testis. |

All the figures except 7, 8, 9, 10, and 17 were drawn with camera lucida, with transmitted light. The black ground is merely for contrast.

PLATE XV.

- FIG. 1. — *Myzostoma chelonium* sp. nov., dorsal view.
 FIG. 2. — The same specimen, more highly magnified, ventral view.
 FIG. 3. — *M. chelonoidium*, sp. nov., dorsal view.
 FIG. 4. — The same, ventral view.
 FIG. 5. — *M. antennatum* von Graff, ventral view.
 FIG. 6. — *M. deani* sp. nov., ventral view.
 FIG. 7. — *M. clarki* sp. nov., dorsal view.
 FIG. 8. — The same, lateral view.
 FIGS. 9, 10. — Cyst of the same, with a portion of the arm of the host attached

PLATE XVI.

- FIG. 11. — *M. metacrini* sp. nov., ventral view.
 FIG. 12. — *M. smithi* sp. nov., ventral view.
 FIG. 13. — *M. japonicum* sp. nov., ventral view.
 FIG. 14. — *M. cysticolum*, small individual, ventral view.
 FIG. 15. — Large individual of the same, lateral view.
 FIG. 16. — *M. wheeleri* sp. nov., ventral view.

PLATE XVII.

- FIG. 17. — *M. clarki* sp. nov., half of cross-section of body of individual 4.5 mm long.
 FIG. 18. — *M. smithi* sp. nov., half of cross-section of body of individual 3 mm. long.
 FIG. 19. — *M. cysticolum* von Graff, half of cross-section of large individual 4.2 mm. long.
 FIG. 20. — *M. metacrini* sp. nov., three-fourths of cross-section of individual 5 mm. long.
 FIG. 21. — *M. antennatum* von Graff, half of cross-section of individual 3 mm. long.
 FIG. 22. — *M. chelonium* sp. nov., half of cross-section of individual 2.1 mm. long. At *c* a piece of the cuticle is shown in surface view.
 FIG. 23. — Enlarged section of cuticle of same.
 FIG. 24. — *M. chelonoidium* sp. nov., half of cross-section of individual 2.4 mm. long.
 FIG. 25. — *M. wheeleri* sp. nov., half of cross-section of individual 4 mm. long.
 FIG. 26. — *M. cysticolum* sp. nov., half of cross-section of small individual 1.1 mm. long.
 FIG. 27. — *M. deani* sp. nov., half of cross-section of individual 1 mm. long.
 FIG. 28. — *M. japonicum* sp. nov., half of horizontal section of individual 2 mm. long.

[May, 1906].

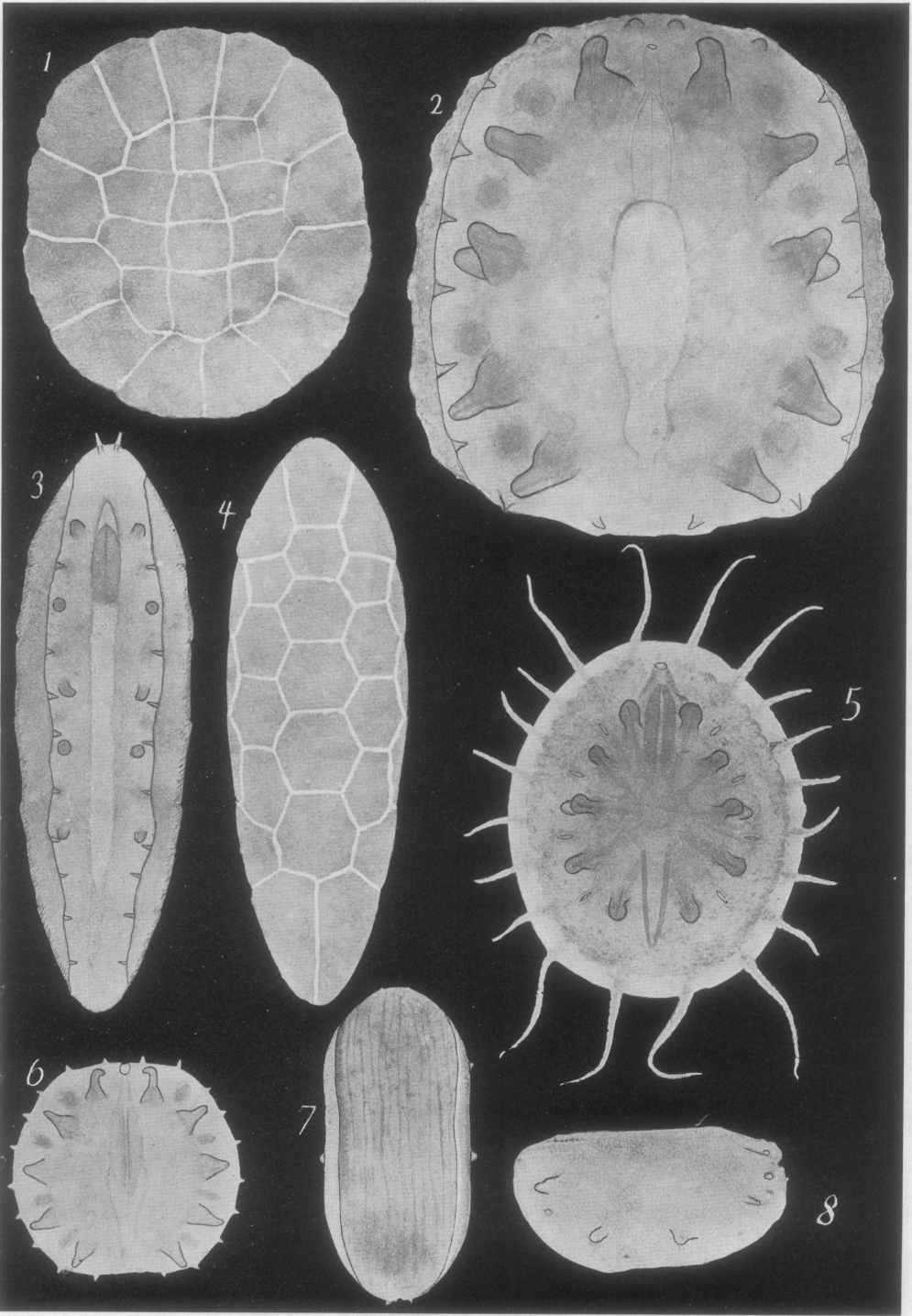
The following figures were drawn at stand level, camera lucida, Zeiss oil imm. ob. (Apochromat.) 1.5 mm.; oc. 12, and then reduced to $\times \frac{1}{4}$.

FIG. 29. — *M. clarki* sp. nov., egg (primary oöcyte) in body cavity, showing the small dark nucleus of one of the accessory cells, imbedded in the cytoplasm of the egg.

FIG. 30. — *M. antennatum* von Graff. Two eggs (primary oöcytes) from distal portion of ovary each showing the nuclei of the two accessory cells, the cytoplasm of which is not distinct from that of the eggs. One germinal vesicle shows the chromatin in a spireme, the other at nodes of the linin reticulum.

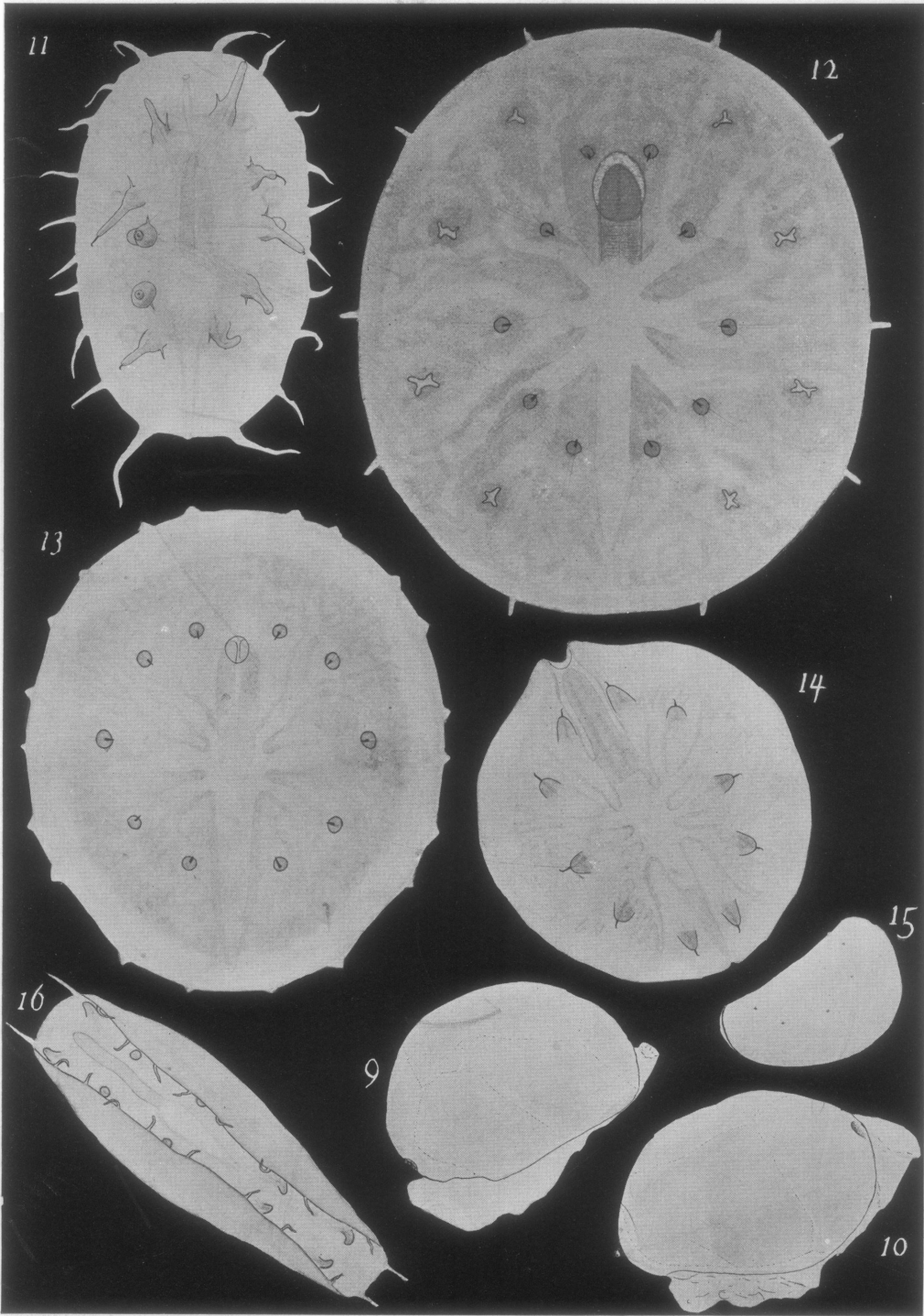
FIGS. 31-34. — *M. japonicum* sp. nov., stages in the transformation of the spermatid into the spermatozoön. Only a short portion of the tails could be traced out, and could not be completed in the figures. In Fig. 31, the nucleus is beginning to elongate. The chromatin is in the form of numerous granules, probably in a reticulum of achromatic substance. In Fig. 32, the nucleus has elongated further. Fig. 33 is a piece of the elongated nucleus showing stages in the fusion of the granules to form the series of chromatic discs shown in the spermatozoön (Fig. 34).

Biological Hall, Univ. of Pennsylvania,
January 3, 1906.



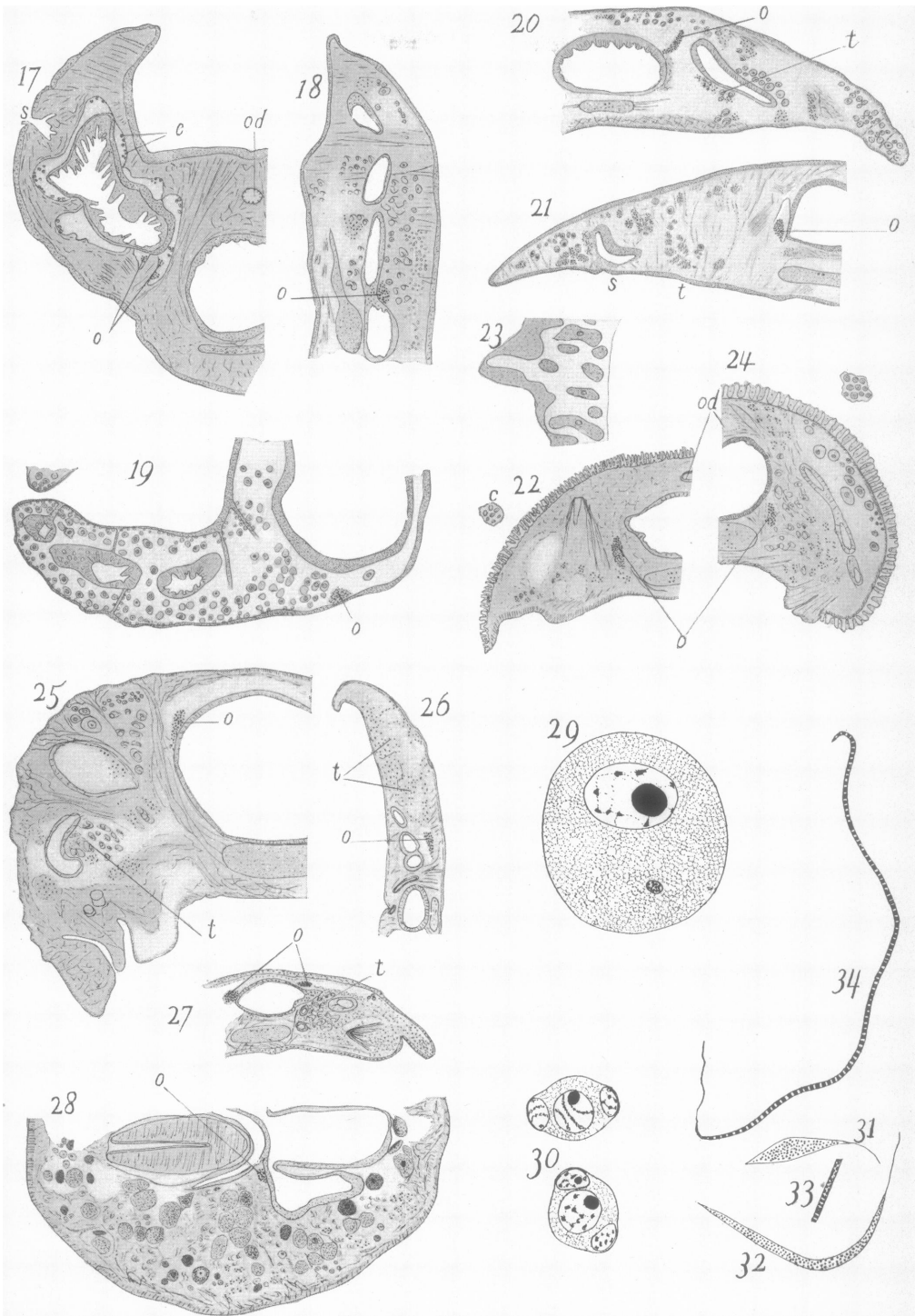
1, 2. *Myzostoma chelonium* sp. nov.
3, 4. " *chelonoidium* sp. nov.
5. " *antennatum* v. Graff.

6. *Myzostoma deani* sp. nov.
7-10. " *clarki* sp. nov.



11. *Myzostoma metacrini* sp. nov.
12. " *smithi* sp. nov.
13. " *japonicum* sp. nov.

14, 15. *Myzostoma cysticum*. v. Graff.
16. " *wheeleri* sp. nov.



MYZOSTOMA.
Cross-sections, and sex cells, various species.

