December 7, 1893.

The LORD KELVIN, D.C.L., LL.D., President, in the Chair.

A List of the Presents received was laid on the table, and thanks ordered for them.

The President announced that he had appointed as Vice-Presidents—

The Treasurer.
Sir John Lubbock.
Dr. Perkin.
The Marquis of Salisbury.

The following Papers were read:—

I. "The Organogeny of *Asterina gibbosa*." By E. W. MacBride, B.A., Demonstrator of Animal Morphology to the University of Cambridge. Communicated by Adam Sedgwick, F.R.S. Received September 13, 1893.

Having been engaged in studying the development of *Asterina gibbosa* during the past year, I think it advisable to publish an account of the results already obtained, as these are of considerable interest, and it may be long before I can complete my investigation. As this is only a preliminary account, I shall ignore statements which conflict with my results, noticing only the results of other workers in so far as they confirm my work.

The classic research of Ludwig* on this subject is well known. The advances I have been able to make on his work concern chiefly the later larval stages and the metamorphosis.

Ludwig finds a regular segmentation, giving rise to a ciliated blastula; typical embolic invagination follows, and the blastopore, placed at first in the centre of the ventral surface, is carried by growth to near the posterior end, and functions for a short time as larval anus. In the meantime the archenteron becomes divided into an anterior thin-walled portion, and a posterior thick-walled one. The latter becomes separated as the definitive gut, which is soon joined by the larval œsophagus, which arises as an ectodermic invagination, the former becomes the cœlom, sending back a horn on each side of the gut. On the left side, in the præoral portion of the cœlom, we find a pore opening to the exterior—the madreporic pore.

* "Entwicklungsgeschichte der Asterina gibbosa." 'Zeitschrift für Wiss. Zoologie,' vol. 37.

My results diverge from those of Ludwig at this point. What follows is the result of my own work. The *cœlom becomes segmented, as shown in fig.* 1, *and the arrangement of its divisions strongly recalls that*

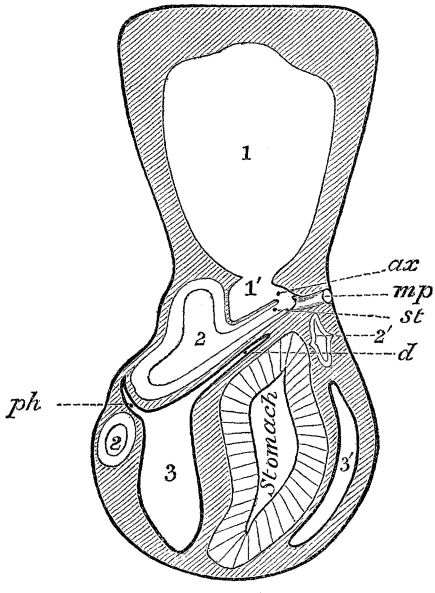

FIG. 1.—Diagram of a Longitudinal Horizontal Section through a late Larva of *Asterina gibbosa*.

of Balanoglossus. By the outgrowth of a pair of vertical transverse septa, a pair of posterior cœlomic cavities is separated off (3' 3', fig. 1), this separation being for a time incomplete ventrally. Simultaneously, two outgrowths from the anterior cavity appear, growing backward, and overlapping to some extent the posterior cavities. Of these, the left opens for a long while by a wide aperture into the anterior cavity, whilst the right is almost immediately completely segmented off.

These are the paired rudiments of the water-vascular system, the *right* and the *left hydrocœle. In one larva I found them equally developed*, but usually the right hydrocœle has the form of a small closed vesicle, which persists for life in the neighbourhood of the madreporite. These cavities I compare to the collar cavities of *Balanoglossus*, and find support for this view in the structure of *Cephalodiscus*, where the collar cavities are prolonged into *long, pinnately-branched arms*, comparable to the radial canals of the water-vascular system of Echinoderms, with their rows of tube feet.

There is no hæmocœle in Asterina gibbosa; *all cavities lined with*

epithelium are derived from the cœlom. The radial perihæmal canals and their connecting outer circular perihæmal canal are derived from interradial diverticula of the cœlom, one of which (*Ph.*, fig. 1) is shown in the figure. The longitudinal septa in the radial canals are due to the apposed walls of adjacent interradial rudiments. The axial sinus (*ax.*, fig. 1) surrounding the stone canal is the posterior division of the anterior body cavity into which the pore canal opens. Bury* states that in a future paper he will prove this, but he has not fulfilled his promise. The stone canal is a groove in the neck of communication between the anterior cœlomic cavity; it becomes constricted off, and forms a tube opening at its distal end into the axial sinus, close to the inner end of the madreporic pore canal. This arrangement has been seen by Ludwig, but what he has not seen is that it persists in the adult, and hence he failed to recognise the rudiment of the axial sinus.

The dorsal organ, the heart or "central-blutgeflecht," is nothing more than an ingrowth of the left posterior cœlom into the septum separating the posterior cœlomic cavities from the axial sinus (*d*, fig. 1). It soon becomes solid. From its upper end in the adult the genital rachis grows out, as Cuénot† inferred, and I have elsewhere proved.‡

Since the genital organs are formed later, as local swellings of this rachis, the ultimate origin of the sexual cells, in *Asterina* as in Vertebrata and Annelida, is cœlomic epithelium. The aboral sinus surrounding the genital rachis is formed from a special diverticulum of the cœlom.

As Ludwig has pointed out, the præoral part of the larva becomes converted into a special locomotor organ. It is foot-shaped, has long cilia, and also functions like a tube-foot, as a temporary fixing organ. Ludwig did not observe, however, that during the metamorphoses, having given up its locomotor functions, is *converted into a permanent fixing organ or stalk.* This arrangement persists for some time after the larva has acquired the adult form, *for it is for a time unable to use its tube feet, and when displaced from its attachment floats helplessly about.* Bury§ has shown that the stalk of Crinoids is likewise the præoral lobe, and the free swimming larva of *Antedon* strongly resembles that of *Asterina*, the main difference being that the larval mouth, which soon closes in *Asterina*, is never formed in *Antedon*, in which also the anterior body cavity is of less extent,

* "Studies in the Embryology of Echinoderms," H. Bury, 'Quart. J. Mic. Sci.,' 1889.

† "Contributions à l'Étude Anatomique des Asterides," L. Cuénot. 'Archives de Zoologie Expérimentale,' T. v. *bis.*

‡ "The Development of the Dorsal Organ, Genital Rachis, and Aboral Sinus of *Asterina gibbosa*," E. W. MacBride, 'Zool. Anzeiger,' No. 419.

§ "The Early Stages of *Antedon rosacea*," H. Bury, 'Phil. Trans.,' 1888, B.

and is completely separated from the hydrocœle. The just fixed larva in both cases we take to represent the ancestor of Echinoderms, just after it had given up its free-swimming life (fig. 2). The curious, and

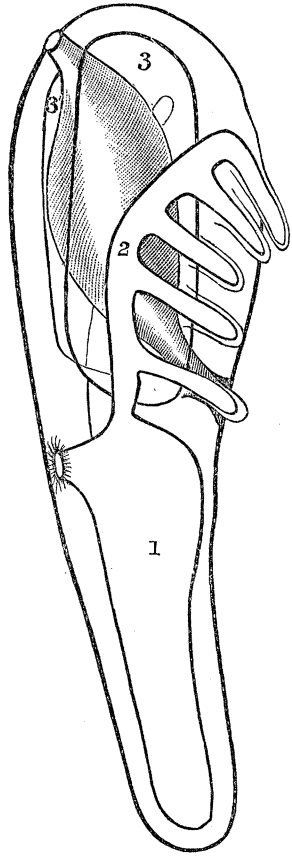

FIG. 2.—Supposed Ancestor of Asterids and Crinoids.

as yet unexplained, peculiarity of Echinoderms, the predominance of the left side (left hydrocœle and left posterior body cavity), soon made itself felt. Starting from this point, however, ontogeny plainly teaches us that *Asterina* and *Antedon* have diverged in two opposite directions. In *Antedon* an excessive growth of the ventral surface has rotated mouth and hydrocœle backwards and upwards away from the stalk (fig. 3). A precisely similar change to this takes place, as we know, in *Ciona* and *Pedicellina*, and it is to place the mouth in a favourable position to catch pelagic prey. In *Asterina*, on the other hand, the body is flexed ventrally on the stalk (fig. 4), so

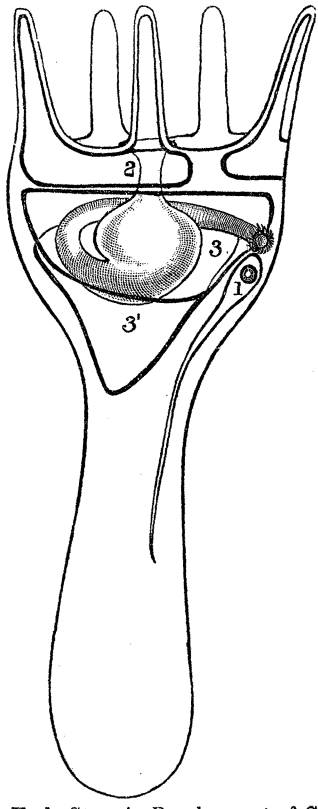

FIG. 3.—Early Stage in Development of Crinoids.

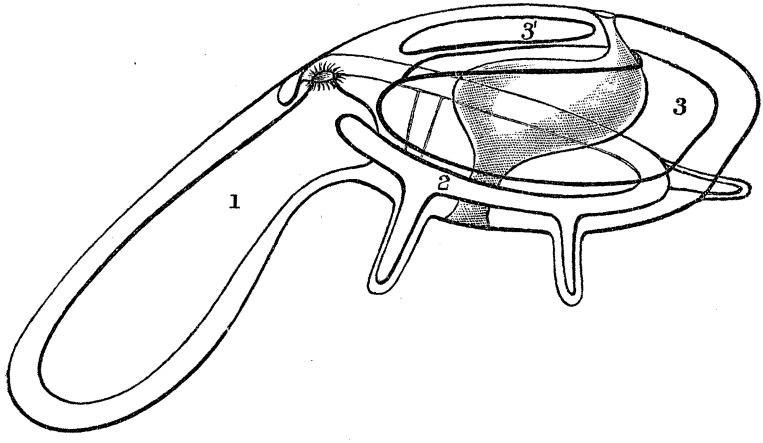

FIG. 4.—Early Stage in the Development of Asterids.

that the ends of the hydrocœle meet round it, and the mouth is approximated to the substratum, so that the animal can feed on the mud beneath it, which is impregnated with organic matter.

It follows that *the abactinal poles of* Asterina *and* Comatula *are not comparable with each other*, and that all conclusions based on the supposed homology of the dorsocentral in Echinids and Asterids, and that in Crinoids, are incorrect.

II. "Reptiles from the Elgin Sandstone:—Description of Two New Genera." By E. T. Newton, F.R.S. Received November 2, 1893.

(Communicated by permission of the Director-General of the Geological Survey.)

(Abstract.)

Since the reading of the previous paper "On some New Reptiles from the Elgin Sandstone" ('Phil. Trans.,' B, 1893), the author has received several additional specimens from the same formation in the neighbourhood of Elgin, but not from the same locality, and representing other groups of Reptiles. Two of these specimens, being new and interesting forms, are described in detail. One of them is the property of Mr. James Grant, of Lossiemouth, and is contained in a small irregular cube of sandstone. The bones themselves having been dissolved out, as in the earlier described fossils, their forms have been reproduced by gutta-percha casts taken from the cavities left in the stone. This reptile was evidently a small Parasuchian Crocodile, allied to *Stagonolepis;* it is now represented by the skull, which is about 3 inches long, and the anterior half of the body, with the pectoral arch and both the fore limbs. The skull is depressed, has a pair of supratemporal fossæ and a pair of orbits completely surrounded by bone, and in front of the latter, on each side, a large prelachrymal fossa; the two nasal openings are small, and placed near the end of the muzzle. The palate is narrow and deeply grooved, with primitive posterior nares placed far forwards. The teeth vary in size, are slender, conical, and recurved, and restricted to quite the anterior part of the upper jaw. The vertebræ are slightly biconcave; the 9th has distinct double articulations for the ribs, but how far this character extended forward is uncertain. The scapulæ are long and slender, while the coracoids are short and wide. There is an interclavicle. The humeri have each a strong pectoral crest, and are Crocodilian in form; the radius and ulna are slender bones; the carpals are indistinct; five metacarpals are present on each side, but only a few of the phalanges are to be seen. Above the vertebræ there is a double row of small, pitted, and closely-set scutes. This small Parasuchian is named *Erpetosuchus Granti.*

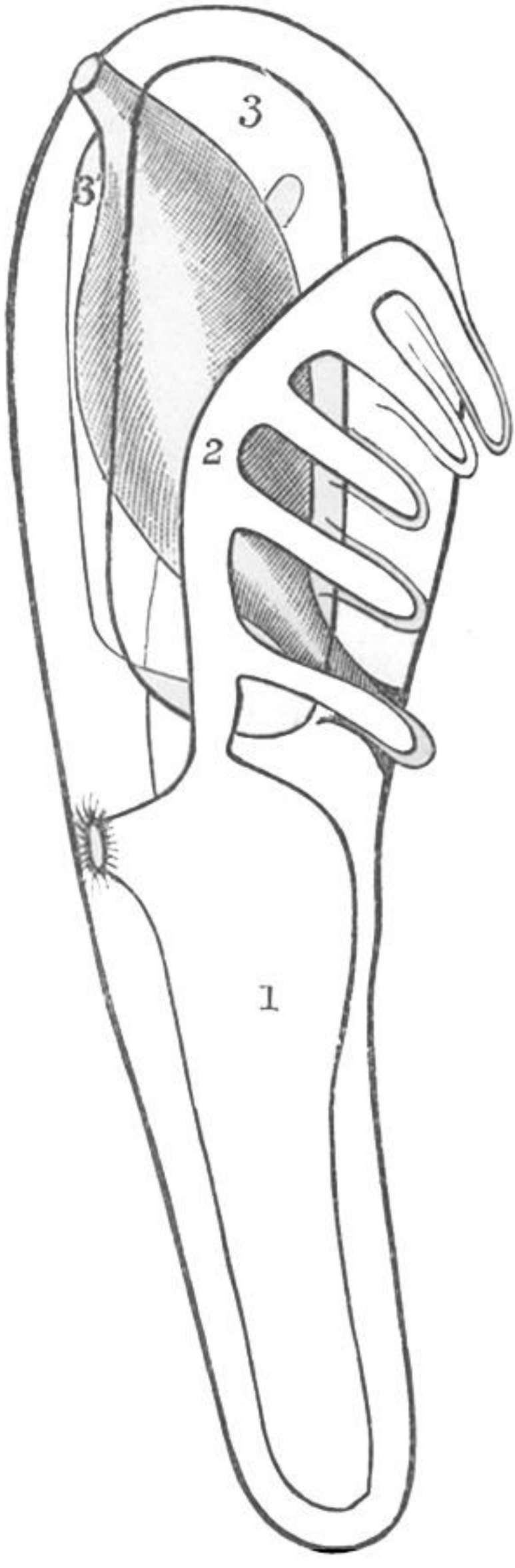

FIG. 2.—Supposed Ancestor of Asterids and Crinoids.

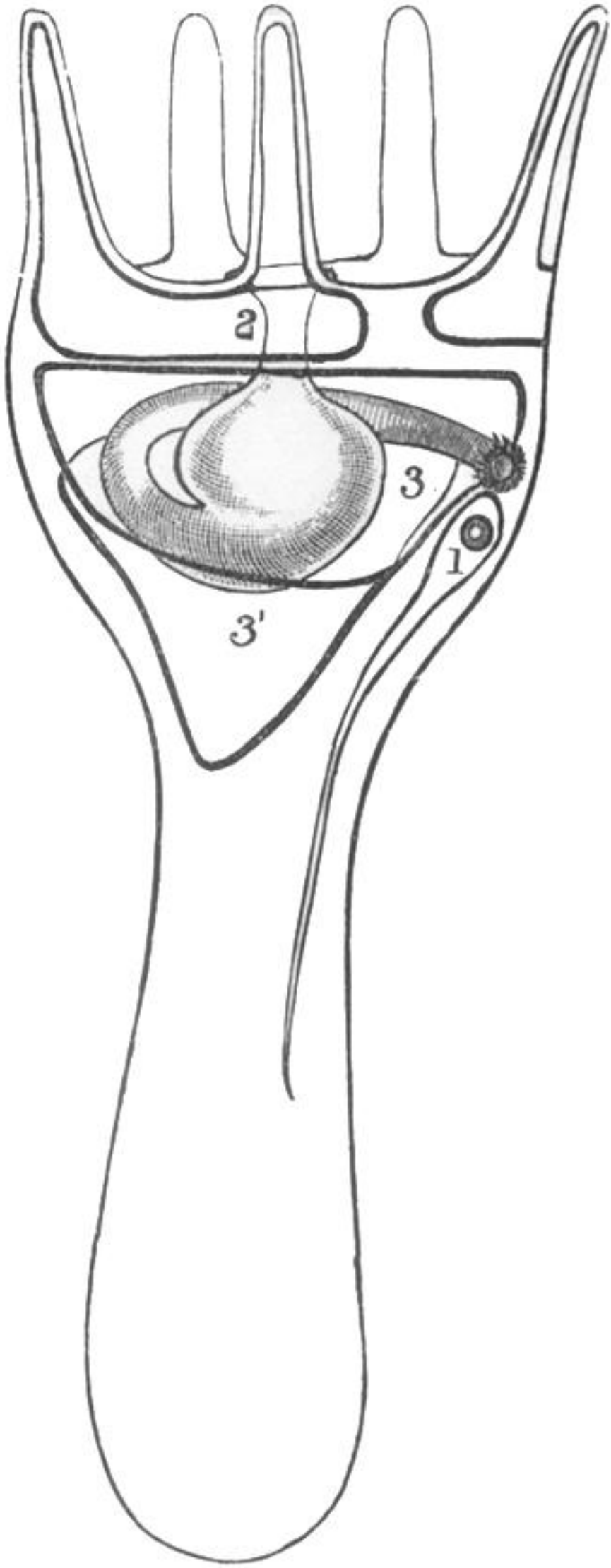

FIG. 3.—Early Stage in Development of Crinoids.

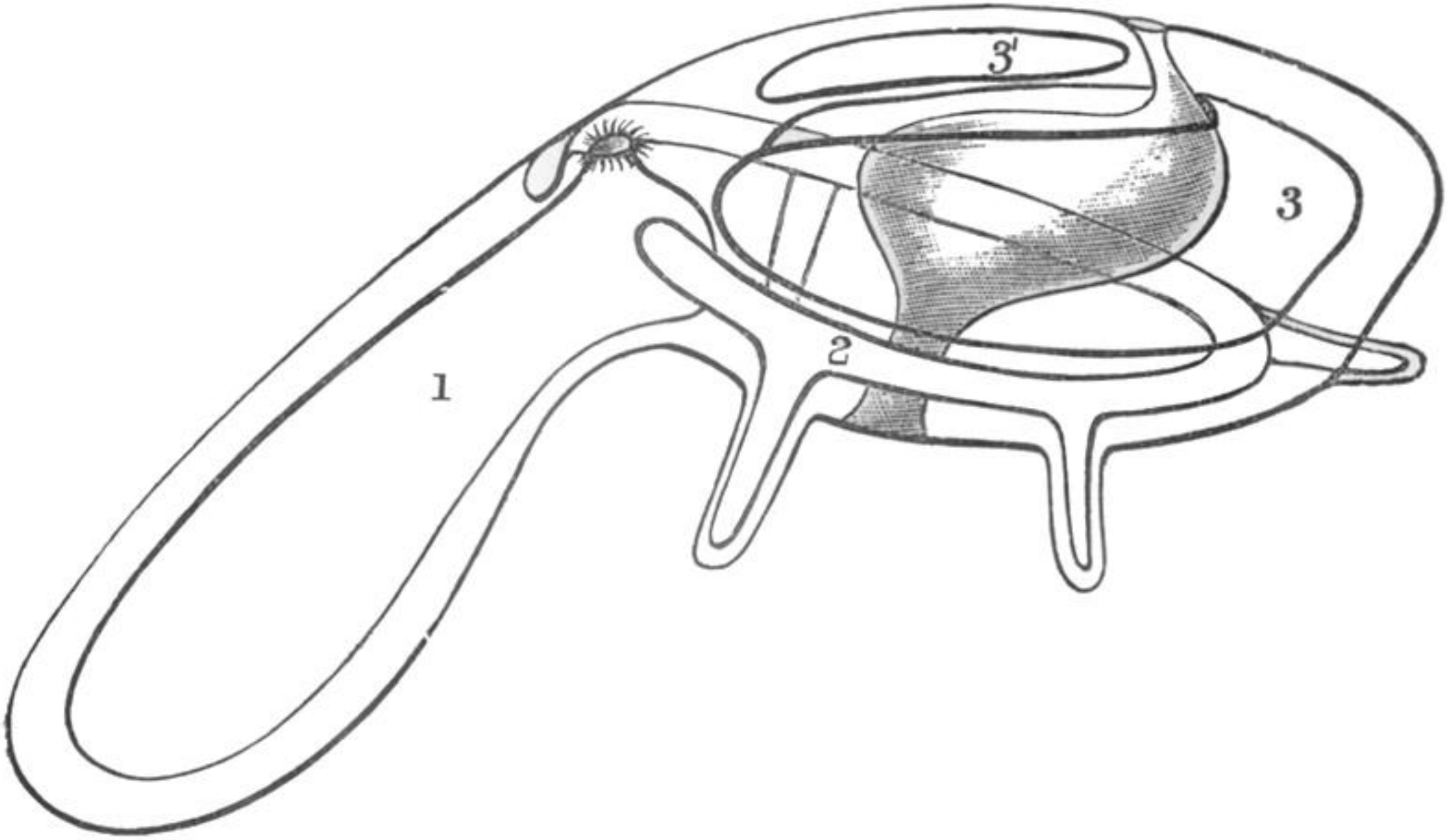

FIG. 4.—Early Stage in the Development of Asterids.