

A Case of Hermaphroditism and Viviparity in *Echinocardium cordatum*.

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With 4 Figures in the Text.

IN May, 1933, during routine gonad examinations, a hermaphrodite specimen of *Echinocardium cordatum* was observed. It was collected in the sandy beach of Port Erin Bay at low water of ordinary spring tides, and was 4.7 cm. in length, which corresponds, in a normal specimen, to an age of about four years. The external colour was dark, although not more so than in other specimens in the batch, but the gonad was exceptionally pigmented—almost black. In this locality the colour of the test and gonad becomes progressively darker with increasing age, and affords some measure of the latter.

The specimen was examined within half an hour of being collected, and portions of the gonad were fixed within ten minutes of being opened, so that fertilization and segmentation could not have advanced in the laboratory to the stage found. Smears from the gonad showed ova, of which about 50% were ripe, together with ripe spermatozoa. The gonoduct contained ripe ova, together with segmenting ova and early embryos. Figure 1 is a photograph of the contents of the gonoduct, taken immediately after opening, and showing ova with a four-cell stage and a blastula. Cultures were set up in sterile sea-water, from the contents of the gonoduct, and also from the gonad itself, as well as a control fertilization from normal urchins, and from all of these normal early plutei were reared. Those cultures from the hermaphrodite specimen did not, however, develop much further, possibly owing to premature fertilization in the abnormal conditions in the gonad.

Figure 2 shows a longitudinal section of a portion of the gonoduct containing a blastula as well as mature ova. No segmenting ova were seen actually in the follicles of the gonads (Fig. 3), but there were present a number of multinucleate bodies, about the size of an ovum, in which the protoplasm was partly broken down (Fig. 4), and no cell walls were visible. In more advanced stages the nuclei also seemed to have partially disintegrated. These bodies appeared to be fertilized ova in which

segmentation, or at least nuclear division had taken place, but which had failed to continue their development in a normal manner, and had begun

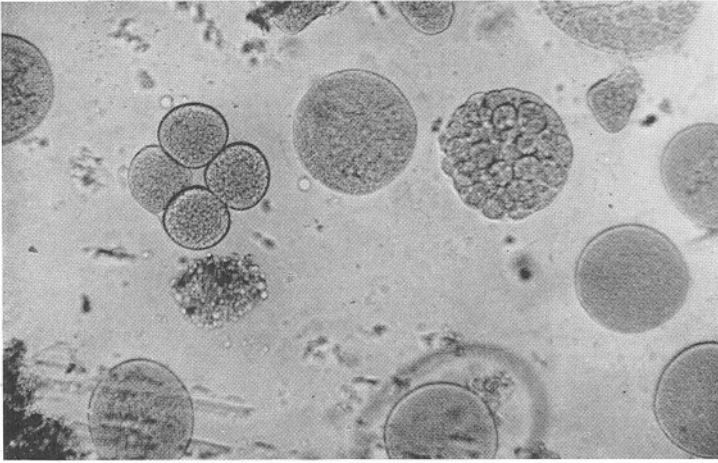


FIG. 1.—Ova and larvæ in gonoduct. $\times 100$.

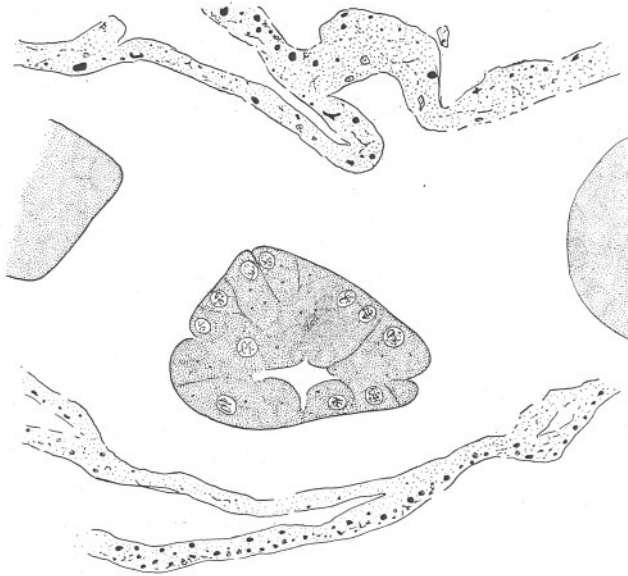


FIG. 2.—L.S. of gonoduct showing blastula. $\times 400$.

to dedifferentiate. Those larvæ which had reached the gonoduct appeared to be developing more normally.

Apart from the viviparity of this specimen, it is of interest because of

its hermaphroditism, as comparatively few cases have been described in the Echinoidea, and, so far as the author is aware, only one in the Spatangoidea. It is, however, a normal condition in some other echinoderms.

In *Asterina gibbosa* the condition with regard to hermaphroditism

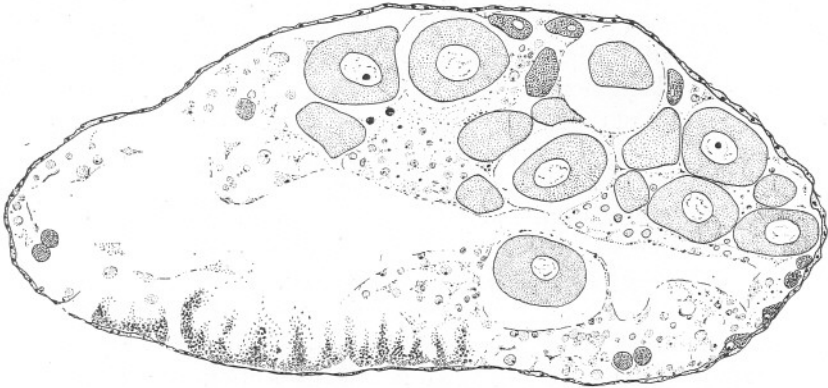


FIG. 3.—T.S. of gonad follicle showing male and female portions. $\times 750$.

varies according to the locality (Cuénot, 1898). At Roscoff, during the first one or two years of its life, it is male, although sperm are shed only once; the starfish then becomes and remains female. At Banyuls they

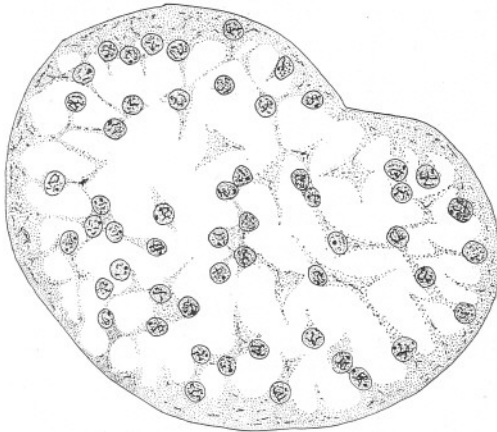


FIG. 4.—T.S. of degenerating embryo in gonad. $\times 100$.

are male for a longer period, shedding sperm for several successive years, and then becoming completely female. At Naples there is no fixed relation between size and sex, and males, females and hermaphrodite individuals may be found at all sizes. Cuénot says further that, although

individuals do not normally function as both male and female at the same time, he has found such specimens, with both ova and sperm ripe at the same time, at Banyuls and at Naples.

In the Echinoidea, hermaphroditism is recorded as occurring in several species. Heilbrunn (1929) describes a specimen of *Arbacia pustulosa* with four of the segments of the gonad alternately male and female, and the fifth an ovo-testis with mixed normal male and female tissue. A self-fertilization yielding normal larvæ was obtained. Gray (1921) describes another specimen of the same species in which four segments of the gonad had the normal female colouration, but proved, on examination, to be degenerate male tissue, while the fifth segment, mottled in appearance, contained the latter mixed with normal male tissue. He records also a specimen of *Paracentrotus lividus* with three segments of the gonad completely female, and the other two mixed female and male, both being ripe and fertilizable *inter se*. He does not state whether, as a result, the specimen was viviparous. Herlant (1918) also records a hermaphrodite individual of this species with three gonad segments normal male, one atrophied male, and one mixed male and female. He states that in the latter the male and female portions were mostly separate, but that in places they graded distinctly into one another, and showed oögenesis and spermatogenesis taking place side by side. He states further that the ova and sperm were ripe in the mixed gonad, and that they fertilized normally when mixed in sea-water, so presumably no fertilization had taken place within the follicles of the gonad. Drzewina and Bohn (1924) record another individual of this species from Roscoff, in which four segments of the gonad were male, and one female. Fertilization from these yielded healthy larvæ, which, however, began to develop abnormally in the pluteus stage. They also mention, but do not describe, a hermaphrodite *Echinocardium cordatum*.

Gadd (1906) records a hermaphrodite specimen of *Strongylocentrotus dröbachiensis* with one segment of the gonad male and the rest female. These were all ripe and fertilizable *inter se*. Viguire (1900) records a hermaphrodite individual of *Sphærechinus granulatus* but says little about it beyond the fact that it was the only one he had ever seen, and was self-fertilizable.

Hermaphrodite specimens of *Echinus esculentus* have been found occasionally. One of these (Moore, 1932) had three segments of the gonad ripe female, one unripe female, and the fifth ripe male. It also was self-fertilizable, and gave larvæ which developed into normal plutei. In most of these described cases the male and female portions of the gonad have been restricted to separate segments, and in none is it recorded that fertilization was taking place within the gonad.

Giard (1900) states that at Wimereux, *Echinocardium cordatum* is

normally a protandrous hermaphrodite, "ova beginning to appear about mid-July in gonads which have, up to then, been clearly male." Such a condition certainly does not hold at Port Erin, nor has the author been able to find it elsewhere in Britain. Of 358 specimens from Port Erin which were examined at a season when their sex could be determined from a smear of the gonad, 181 were males and 177 females. These were all animals in their third or subsequent season. At Port Erin, spawning does not occur in the first year. In second season urchins of the 1932 group, examined in January and February, 1934, when their gonads were maturing for the first time, a similar equal distribution of the sexes was found. And the hermaphrodite specimen described here was the only one which was found among several hundred examined. It would therefore be interesting if Giard's statement could be confirmed elsewhere.

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