

On F_2 *Echinus* Hybrids.

By

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AN investigation on inheritance in hybrids between the three English species of *Echinus* was carried out in the Marine Biological Laboratory, Plymouth, during 1909-1912 by C. Shearer, W. de Morgan, and H. M. Fuchs. In a paper published in the *Phil. Trans. Royal Soc.*, Ser. B, Vol. CCIV., p. 255, the results of this work were described in detail. At the time of publication, *E. miliaris* had been raised from the egg to maturity in the laboratory, in the course of one year, and a second generation had been obtained from these individuals, but none of the hybrid urchins had as yet reached maturity. This year, however, some of the hybrids have become sexually mature, and from them a second hybrid generation has been raised.

The urchins which have formed ripe genital products are four individuals of the cross *E. esculentus* ♀ X *E. acutus* ♂ (referred to below as *EA*), derived from fertilizations made in 1912. The largest of these urchins now measures 6 cm. in diameter, exclusive of the spines. On May 11th, 1914, two of these hybrids laid eggs in the tank in which they were kept. Naturally these eggs could not be used for experimental purposes, since they were deposited in the sea-water of the aquarium circulation, and therefore not under sterile conditions. On June 6th I induced three of the four to deposit genital products without cutting them open, under conditions which excluded the possible presence of foreign eggs or spermatozoa. It is hardly necessary to mention here that, as in all the previous work on *Echinus* hybrids, the fact of the complete absence of such sperm was made certain by controls of unfertilized eggs, none of which segmented. Two of the three hybrids from which genital products were obtained proved to be females and one a male. The sperm from the latter gave 100% fertilizations with the eggs of the former, yielding healthy larvæ.

From this it is seen that hybrids between the species *E. esculentus* and *E. acutus* are perfectly fertile and that a healthy F_2 generation can be obtained from them. When a larger number of these F_1 hybrids have been

reared, an examination of the characters of the fully grown urchins should decide whether the intermediate forms between the two species, which are found in the sea and which are quite fertile, are to be considered as hybrids or as extreme variants of one of the two species.

Besides making the cultures described above, I fertilized *E. miliaris* eggs with the sperm of the *EA* male, and used *E. miliaris* sperm to fertilize *EA* eggs. This was done in order to see whether the inheritance of the late larval characters (posterior epaulettes and green pigment) in these crosses would be the same as when pure *E. esculentus* or *E. acutus* was crossed with *E. miliaris*. Now, twenty-one cultures,* derived from fifteen fertilizations, have shown that the inheritance of these larval characters has this year been the same as it was in 1912: the *E. esculentus* or *E. acutus* characters are developed in the hybrids in both reciprocal crosses with *E. miliaris*. It was found that the two reciprocal combinations of *EA* X *miliaris* likewise gave this result. From the cross *EA* ♀ X *miliaris* ♂ large numbers of vigorous fully formed plutei developed, and a number of these "triple-hybrids" have already passed through metamorphosis.

Unfortunately the *F*₂ generation obtained from the *E. esculentus* X *E. acutus* hybrids can give no information as to the inheritance of the late larval characters, since the latter are alike in the two species. It is the *F*₂ generation from hybrids between *E. esculentus* or *E. acutus* and *E. miliaris* that will give this valuable information, but none of these hybrids have as yet reached maturity. A small number of *E. miliaris* ♀ X *E. acutus* ♂ hybrids (of which the largest measured 2¼ cm. in diameter, exclusive of spines), from fertilizations made in May, 1912, were alive and healthy this summer. After having tried unsuccessfully to induce these to deposit eggs or sperm, I cut them open on June 6th of this year. They contained, however, only small and quite immature gonads.

As it must be some time before more *E. acutus* (or *E. esculentus*) X *E. miliaris* hybrids will have grown large enough to be mature, I wish to record these results up to date. The success in bringing the *EA* hybrids to maturity has been largely due to the care taken by Mr. A. J. Smith, head assistant at the Plymouth Laboratory, in attending to the cultures after metamorphosis. The investigation was made with the assistance of a grant from the Royal Society.

* Some of these cultures were reared at Plymouth, others were transported as blastulæ to the Imperial College, London, and raised there in water which came from Lowestoft.