not by butting, but by fighting with their fore feet. Likewise Henslow claims that similar structures in widely different plants in similar environments prove that these structures were directly produced by the environment. On the other hand, it can not be denied that some of these cases may be due to the similar selective action of similar environments.

Even Weismann was prepared to admit the inheritance of acquired characters in Protozoa, but Jennings[4] has thrown experimental doubt upon that also. In a second paper[5] he shows that the environment is, indeed, a large factor in determining the size of *Paramecium*, but, as yet, he has found no proof that these effects are inherited. Even selection seems powerless to affect the size within a "pure line." However, pure lines differing in size can easily be isolated by selection, thus confirming by a zoological example the results reached by several botanists, notably Johannsen. The variation curve of size is considered to be formed by a mixture of pure lines whose dimensions are modified by the environment and growth factors.

FRANK E. LUTZ.

EXPERIMENTAL ZOOLOGY

Hybridology and Gynandromorphism.—Raepke[1] has made a detailed examination of some of the hybrids (bastards) between certain species and varieties of Smerinthus (ocellata, populi and its variety Austanti). The material was obtained from the famous hybridologist Standfuss.

The anatomical results may be summed up as follows:

The internal genitalia of the normal male moths show much variation but in the hybrids the variations are more extreme; and often amount to "anomalies," and monstrosities, in the internal organs. Sperm elements are present and reach different stages of maturity, most of them degenerate later, producing a few imperfect spermatozoa. The female hybrids show also greatly modified sexual anomalies, both the germinal region as well as the ducts may be abnormal or even absent. Hand in

[4] "Heredity, Variation and Evolution in Protozoa. I. The Fate of New Structural Characters in Paramecium, with Special Reference to the Question of the Inheritance of Acquired Characters in Protozoa." *Journ. Exp. Zool.*, 5, pp. 577–632, 1908.

[5] "Heredity, Variation and Evolution in Protozoa. II. Heredity and Variation of Size and Form in Paramecium, with Studies of Growth, Environmental Action and Selection." *Proc. American Phil. Soc.*, XLVII, 190, 1908.

[1] Raepke, W. *Jena. Zeitsch. f. Naturwissens.*, XLIV, 1908.

hand with these modifications there appear male secondary sexual characters in the female as more or less rudimentary male genital appendages at the end of the body. It would seem to follow that the female is heterozygous, a fact of some general interest. The discovery raises once more the question of the cause of gynandromorphism in insects, for obviously these hybrid moths show adumbrations at least of such a condition. In this connection it is of interest to give Raepke's summary of Standfuss's results regarding the sex of hybrid moths and the occurrence amongst them of gynandromorphism.

He classifies the results under five headings:

First, those hybrids that are so abnormal (atypic or sexless) that their sex can not be determined.

Second, those hybrids in which only one sex develops, generally the male; females also rarely appear, but these so imperfect that reproduction is impossible. The males also are sterile.

Third, those hybrids in which both sexes appear in normal proportions; the females sterile, the males crossed back to the parent species fertile in various degrees. The offspring of such a union are, however, very abnormal and monstrous both in their primary and in their secondary sexual organs. *In certain series gynandromorphs appear in surprisingly large numbers.*

Fourth, those hybrids in which the females although appearing normal lay either no eggs or abnormal eggs. The males are like those in the last category or like those in the next.

Fifth, those hybrids in which the females produce fertile eggs. These eggs produce only embryos or if the caterpillar stage is reached at all the young are weak. Whenever it has been possible to rear moths by crossing back these females to the parent species (or from the male hybrids of the same cross) only males develop but in such scanty numbers that they have not been tested further.

Whether in the last instance only males are produced because they are hardier than the females or because of some more fundamental relation is not evident from the results.

On the other hand the italicized statement in the third category calls for further examination. What is the cause of the production of so many gynandromorphs?

Two hypotheses have been suggested in recent years along cytological lines that offer at least a formal solution of the problem. Boveri suggested that the entering sperm fuses not with the female pronucleus, but with one of the nuclei derived

from the first division of that pronucleus. Morgan suggested that the result could equally well be "explained" on the assumption of polyspermy—one sperm nucleus fusing with the egg nucleus and the other (or others) producing cells independently of the segmentation nucleus. The gynandromorphs described by Toyama seemed to be a test case. An analysis of his results gave evidence in favor of my suggestion. In connection with the occurrence of two kinds of spermatozoa in moths—"male and female producing"—the question arises whether on my view the male parts of the gynandromorph are due to a male or to a female producing sperm. In my paper I suggested that since the female sperm is the homologue (from the chromosomal point of view) of the egg nucleus minus its two polar bodies that such a "female-producing" sperm might produce the male parts. This suggestion fits in completely with the view of sex-determination recently adopted by Wilson. It sounds paradoxical at first that a "female-producing" sperm could produce a male soma, yet if we look to the chromosomes alone as sex producers such a view is tenable. Moreover if in the bee there is produced only female-producing sperm—as the evidence strongly indicates—then on my view the male parts must come from a female-producing sperm. On Boveri's view the nucleus that makes the male parts is the same (after one division) as the egg-pronucleus which is also male producing and the homologue of the "female-producing" sperm.

T. H. MORGAN.

ECHINODERMATA

Red Sea Crinoids.[1]—Mr. Herbert C. Chadwick has just published the first account of the crinoid fauna of the Red Sea, his paper being based upon a collection made by Mr. Cyril Crossland, under the direction of Professor W. A. Herdman, of the University of Liverpool. From time to time notices have appeared relating to various Red Sea comatulids, but they have been widely scattered, and some of them more or less forgotten, so that before the appearance of this paper an idea of the Red Sea crinoids could only be obtained by a most laborious search through a large number of more or less rare and inaccessible volumes.

Mr. Chadwick found six species in the material submitted to

[1] Reports on the Marine Biology of the Sudanese Red Sea.—VII. "The Crinoidea." By Herbert C. Chadwick, A. L. S., Curator of the Port Erin Biological Station. Journ. Linn. Soc. (Zool.), vol. **31**, pp. 44–47.