

GENETICS AND THE STUDY OF DEVELOPMENT

Organisers and Genes

By Dr. C. H. Waddington. (Cambridge Biological Studies.) Pp. x + 160 + 2 plates. (Cambridge: At the University Press, 1940.) 12s. 6d. net.

THE student of heredity is confronted with two different groups of problems. The first group, including such questions as: 'Why do two white mice produce another white mouse, but not a black or a brown one?' has been answered, at least up to a point, by the geneticists. The second, typified by such a question as: 'Why do two mice produce a mouse, and not a rabbit, a mass of Protozoa, or a sarcoma?' has been answered much less satisfactorily. Genetical results have great practical value in the fields of agriculture, eugenics, and evolution, even if they are not applied to the study of development. But genetics will remain a somewhat isolated branch of biology until this is done.

So far the most systematic attempt to link up genetics and developmental physiology has been that of Goldschmidt. However, just because Goldschmidt has been a pioneer, his theories require careful criticism. It is perhaps impossible to go as far as he had gone without sometimes losing one's way. We can, therefore, welcome Waddington's monograph, which attempts to link up genetics and embryology from a somewhat different point of view from Goldschmidt's.

The first five chapters are a summary of the causal analysis of development which has grown up from the work of Spemann. Then follow two chapters on the action of genes, and the remainder of the book is concerned with the integration of the data of embryology and genetics. Geneticists will find Waddington's classification of the kinds of localization of gene effects, and of the types of genic interaction, in Chapter vi, particularly stimulating, though it is not certain that his terminology will be finally adopted. The discussion would have been still more valuable had he given more weight to data of plant genetics, such as Anderson's account of the interaction of the gene causing leafy bracts with those controlling leaf shape in *Primula sinensis*, which offers a close parallel to Waddington's account of the interaction of the genes for aristopedia (leg-like antennæ) and those controlling leg development in *Drosophila melanogaster*. Waddington's account of the development of the wings in mutant forms of this species differs substantially from Goldschmidt's, and until this vexed question is settled, a final judgment on the validity of some of his theories is impossible.

One of the central ideas in the book is the "epigenetic landscape". Development may follow

a normal track symbolized as a river valley, or any of a number of branches which diverge from it at different points, and into which development may pass as the result of an appropriate stimulus at a suitable moment. Intermediate paths are more or less completely excluded. The main valley is broad and shallow in its early stages when regulation is possible, but the later stages are sharply defined. Like other symbols in biology, I expect that this one will prove valuable for a time, but may later be rather misleading.

On the whole, however, the book is distinguished by a critical discussion of possibilities rather than a formulation of new theories. It will be indispensable to workers who are engaged in research on developmental physiology or genetics, but will prove rather indigestible by students preparing for an examination or lecturers who are rapidly preparing a course.

The last chapter is devoted to a discussion of theoretical problems, and again is slightly disappointing. After describing Bohr's theory of complementarity in its application to biology, Waddington states that "although there are undoubted technical difficulties in performing a full physico-chemical analysis on biological entities without killing them, there is no theoretical reason why this should always be so". Is this quite fair to Bohr? He at least thinks that there is such a reason, and his opinions deserve consideration. In the same chapter an unnamed dialectical materialist (perhaps Lysenko) is credited with the view that the Soviet system has affected the chemical structure of human genes. It would surely have been well to give a reference for this theory. Undoubtedly, the Russian revolution has affected human genes in many ways, notably by breaking up inbred village communities, and thus reducing the frequency of rare recessive homozygotes, and the amount of selection against them. In the next paragraph dialectical materialism is praised.

In fact this chapter exhibits a critical mind in search of a satisfactory philosophy, and is of interest for this reason. I should welcome a book by the author on philosophy in relation to biology. But I am not so sure that the discussion sheds much light on the parts played by genes and organizers in development.

Perhaps it is inevitable that such a book should be incomplete in many respects. But those who buy it as a report on progress in a most interesting field will not be disappointed.

J. B. S. HALDANE.