Chapter 9
Induction and the Origins of Developmental Genetics

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If ever a history of ideas in developmental genetics were to be written . . . it would no doubt include as one of its most important chapters an account of the intellectual role that "inductive interaction" between the fields of genetics and embryology has played in the analysis of developmental mechanisms and their genetic control in higher organisms.

former graduate student Nettie Stevens both provided evidence that the nucleus did indeed contain the determinants of genetics and development. They both correlated the XX chromosome composition with female animals and the XO or XY chromosome complement with male animals (5). If this were true, then the nucleus determined the sex of the individual.

Morgan responded by investigating a parthenogenetic species of aphids, eventually correlating chromosome number and sex. However, he interpreted his results as still being consistent with the cytoplasm having the controlling role in development (6). However, by 1910, Morgan had found mutations in Drosophila that could be best interpreted as segregating with the X chromosome. Although he initially resisted this interpretation, he eventually came to see the genes as physically linked on the chromosomes. What had begun as an investigation as to whether the nucleus or the cytoplasm controlled development ended in the founding of the gene theory.

Immediately after 1911, genetics arose as a discipline within experimental embryology, but it soon evolved its own techniques, favored organisms, rules of evidence, and specialized vocabulary which separated it from the rest of embryology. Eventually, it acquired its own sources of funding and new journals (7,8). In his 1926 book, The Theory of the Gene, Morgan (9) formalized the split by declaring that genetics dealt exclusively with the transmission of hereditary traits, while embryology concerned the expression of those traits. He claimed that “the sorting out of characters in successive generations can be explained without reference to the way in which the gene affects the developmental process,” and that much confusion had arisen “from confusing the problems of genetics with those of development.” Genetics and embryology began to go their separate ways.

But Morgan remained an embryologist, publishing Experimental Embryology the year after The Theory of the Gene. When he left Columbia University to head the biology division at the California Institute of Technology, he returned to study the problems of ascidian development. Thus, when Morgan published Embryology and Genetics in 1934, many biologists hoped that it would reunite these disciplines. This was not to be the case. It was more a joint textbook than an attempt to resynthesize the field. The synthesis would be left for others to create. In 1939, Richard B. Goldschmidt and Ernest E. Just published their respective attempts to unify the fields. Goldschmidt would have had embryology subsumed under genetics, while Just saw genetics as a rather minor subset of embryology (7). At the same time, at least three other researchers, Salome Gluecksohn-Schoenheimer (later S. Gluecksohn-Waelsch; 1907–), Conrad Hal Waddington (1905–1975), and Boris Ephrussi (1901–1979), were attempting more balanced syntheses of the two disciplines. Burian, Gayon, and Zallen (Chapter 10, this volume) have written an account of Ephrussi’s synthesis of embryology and genetics. This chapter will focus on the work of Gluecksohn-Schoenheimer and Waddington.

This discussion is framed by two questions: First, what were the conceptual foundations of developmental genetics and how did they come into existence? Second, how did developmental biologists learn about the operon model of microbial gene regulation, which was soon to become the major paradigm of developmental genetics? Evidence will be presented that the conceptual founda-