The Embryological Origins of the Gene Theory

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The original support for the gene theory of inheritance came largely from the studies of E. B. Wilson, Theodor Boveri, and Thomas Hunt Morgan. Each of these scientists began his career as an embryologist. In this paper, the emergence of the gene theory out of embryology will be seen in the context of these researchers' attempts to solve the problem of which cellular compartment—the nucleus or the cytoplasm—directed development. Crucial to this transition from embryology to genetics was the discovery of the sex chromosome, a nuclear structure believed to direct sexual development. We shall see that the constant questioning and retesting of the chromosomal theory of sex determination inadvertently formed the basis for Morgan's proof that the genetic factors were physically located on the individual chromosomes.

Finally, the research into the chromosomal models of inheritance displays many examples of how the adherence of scientists to older ideas causes them to interpret new data so as not to conflict with previously held assumptions. This conservative tendency is seen in the case of McClung, who insisted on the environmental determination of sex even though he had discovered the mechanism for its intrinsic determination, and especially in T. H. Morgan's ten-year refusal to espouse the Mendelian genetics which he would later champion.

Morgan's refusal to accept the Sutton-Boveri synthesis of Mendelism and cytology becomes a chief concern in this essay. His arguments against this view are seen to arise from his previous embryological experiences, which convinced him that chemical reactions in the cytoplasm were responsible for development, rather than morphological changes within the nucleus. This view contrasts with other analyses, which relate Morgan's refusal to his "empirical" attitude, his dislike for theorizing, or to his "romantic" temperament.

Wilson's rapid acceptance of the Sutton-Boveri hypothesis is seen to result from his prior conviction that the nucleus controlled development. The reasons for these differences between Morgan and Wilson are traced back to two of Wilson's embryological beliefs which were not
shared by Morgan. First, Wilson believed that the cell was the primary unit of development. Morgan had insisted that developmental forces molded the embryo irrespective of cellular boundaries. Secondly, Wilson believed that the development of all organisms was essentially the same. He abolished the distinction between “mosaic” and “regulative” egg cleavage, stating that this was merely an artifact of how early the nucleus programed the cytoplasm. This allowed him not only to accept Morgan’s data, but also to extrapolate from unicellular organisms to embryos. Hence, Wilson was able to see the nuclear control of protozoan morphogenesis as an instructive analogue of those processes occurring during embryogenesis.

The embryological origin of the gene theory demonstrates how the biases of one discipline are effectively carried over into a new field. It shows, too, how a relatively small group of investigators pursuing a problem in one area can generate the foundations of an entirely new science.

Therefore, unlike most histories of genetics, which begin with the experiments of Mendel or other breeders, this essay will maintain that the proper context in which to view the origin of the gene theory is embryology. The entry of Wilson and Morgan into genetics will be seen as an attempt to answer fundamental embryological questions, and their opposing positions—Wilson’s acceptance of the chromosome theory and Morgan’s long-standing rejection of it—will be seen in the context of their commitments to certain embryological theories.

Other analyses have been made of Morgan’s and Wilson’s work prior to the gene theory. Garland E. Allen has carefully documented Morgan’s disagreements with the chromosomal theory of sex determination, but although he states that this view was typical of other embryologists, he does not relate Morgan’s views to their larger embryological context. Allen constructs his analysis from a cytological-genetic perspective rather than viewing Morgan as a participant in, and heir to, recent embryological controversies. As will be shown here, Morgan’s rejection of the Sutton-Boveri hypothesis stemmed from his prior belief in the cytoplasmic control of development.

There are two studies which have investigated the embryological researches of Morgan and Wilson as a precondition for their subsequent work. Wagers discusses Morgan’s embryological studies, and claims that Morgan became a Mendelian after W. E. Castle’s 1909 paper