CHAPTER II

THE MOLAR BEHAVIOR OF CELLS IN DEVELOPMENT

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Molar Behaviors of Cells in Development

Metazoan development poses among the most severe epistemological problems confronted by scientists. The aim of this chapter is to sketch these issues; in the next chapter I will discuss two complementary, but still naive approaches to some of the major problems raised.

It is now well established that the diverse cell types in a metazoan almost always differ by virtue of differential expression of genes and their products, rather than by selective loss, or amplification, of genetic material from distinct cell types during ontogeny. Among the kinds of evidence which support constancy of genetic material are these: Constancy in the karyotypes of most or all cell types in an organism; presence of the same amount and kinds of DNA sequences in different cell types of an organism; the capacity of nuclei derived from cells at relatively late stages of embryogenesis, to support normal development after injection into enucleate eggs; the capacity of single differentiated cells of some adult plants to generate a complete new plant; a large number of metaplasias, in which cells on one developmental pathway give rise to those on a separate developmental pathway. At the same time, a very large body of evidence establishes that the patterns of gene activity differ in different cell types.

These results pose the core problem of developmental biology, since if cells differ by virtue of the patterns of activities of genes and their products, then in order to understand development, we must inevitably understand how the system of genes and their products are able to coordinate their patterns of activity to generate an adult from a zygote. The number of structural genes in a higher metazoan is unknown. Based on the typical size of proteins, mammalian cells contain enough DNA to code for well over \(10^6\) distinct proteins. Even if attention is