A TWO-DIMENSIONAL GROWTH PROCESS

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1. Introduction

It is the purpose of this paper to examine certain of the properties of populations of cells, in particular, properties relating to the architecture of cell colonies. We imagine that the underlying process in the growth of an organism begins with a single cell (perhaps derived from the fusion of two germ cells), and then continues by a process in which the initial cell divides into daughter cells. These in turn divide into other cells, these divide further, and so on. The rates of division, the rates of growth of the individual cells, the ultimate size of each cell, its life span, the cellular form, and the procedures of differentiation are constrained by the "information" contained in the cells at any time t and by the environment of each cell, that is, the nutrient medium and the cells surrounding it.

That the process of morphogenesis is not entirely determined is fairly obvious. Evidence in favor of the conception that the development of form contains certain indeterminate features is found in studies of twins. Monozygotic twins are initially endowed with identical genetic "information," and if this information were to control the generating process completely, then the twins should be identical in every detail. It is true that by and large there is a greater correlation between morphological properties of monozygotic twins than those of fraternal twins. Still, so-called monozygotic offspring do not exhibit perfect correlations even in rather gross features such as in the dermal ridge count of fingerprints [1], the scute (scale) counts in nine-banded armadillo quadruplets [2], or the skin color patterns in cow twins [3]. There is less correlation in considering finer features such as patterns of retinal venation. There is little evidence available but it is to be anticipated that, on a cellular level, there would be little more correlation between twins than between any other members of a given species population. That is, it seems reasonable to assume that the "blueprint" of structure does not extend down to the position of every cell in the organism. Indeed, workers in the field of neural networks have made an operating principle of the assumption that the connections of individual neurons are essentially random.

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