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I. Introduction

Embryogenesis may for convenience be resolved into two separate, although not independent components, viz., morphogenesis proper, and the various chemical processes which occur simultaneously.

As to the former, it may be characterized as a spatio-temporal process, in which cells and supracellular structures are involved. The mechanisms involved in sea urchin morphogenesis are known in great detail, not the least due to the recent work of GUSTAFSON and his collaborators (cf. reviews HÖRSTADIUS 1939; DAN 1960; GUSTAFSON 1961; GUSTAFSON and WOLPERT 1963).

The chemical activities in the egg can be regarded from two different angles, each presenting problems of great interest. First, compared with other cells, the oocyte is a very large cell in which most of the substances present represent inert reserves to be used for sustaining the embryonic development up to the time when the larva can begin to take up food from the environment. Among the reserves in the egg one may distinguish two fractions, one which is degradated in order to supply the energy necessary for the embryogenetic processes, and one which is transformed from inert substances to integral parts of the embryo. This differential utilization of the reserve materials will be discussed in the present paper.

However, the chemical changes may also be regarded from another point of view. The chemical activity leading to changes in the embryonic body comprises two different processes, growth and differentiation. The former leads to the increase in cell number, as well as to increase in the contents of the individual cells. The second, and more interesting process is represented by the sorting out of the total cell population into various groups of cells with different properties. Since the latter must depend upon the constituents of the cells, it follows that differentiation is associated with the acquisition of new synthetic capacities, different for each of the new kinds of cells which arise.

Correlation between morphogenesis and chemical activity may thus give information about the chemical nature of the differentiation processes on the cellular level. In a recent review of the biochemistry of morphogenesis, WRIGHT (1964) expressed the view that as to the interpretation of this correlation "a consistent picture is not yet obvious" (l.c. p. 59). It is my belief that this shortcoming in part depends upon the fact that too little attention has been focused upon the cell transformations and differentiations occurring at the cellular level. Since the chemical differentiation is directly dependent upon differential cellular activity it is necessary to embark upon the analysis of the chemical patterns with very clear notions about the pattern of cell differentiation. Before we discuss the chemistry of the developing sea urchin embryo we shall therefore devote some attention to this question.

II. Cell differentiation

WILLMER (1960) has pointed out that all cells may be referred to a few basic cell types, and has emphasized the importance of these cells for ontogenesis and phylogenesis. If WILLMER'S views are accepted then it follows that cell differentiation may be resolved into two phases, first a segregation with respect to the basic cell classes, and subsequently differentiation of the cells within each class along separate lines, to give rise to various types of tissue cells. I have recently shown that in the amphibian embryo the first differentiation process, called cell transformation, corresponds to the phase of determination or primary differentiation, whereas the second stage is that of functional or tissue differentiation. It could furthermore be shown that the pattern of cell segregation is a function of the polarities in the egg (1966).

I shall not here enter upon a similar discussion pertaining to the sea urchin embryo, but for the subsequent discussion it will be necessary to outline the cell class concept.

If the properties of a certain cell type, including its potential transformation into other cell types, has formed the basis of phylogenetic evolution, then these same properties must be responsible for ontogenetic development. In other words, the archaic cell type which once gave rise to metazoan evolution, must be represented today by the egg cell. I have previously suggested that the egg is an amoebocyte, supporting this view on recorded observations on eggs and isolated blastomeres (for references cf. 1965b). The mobility of certain oocytes, the separation of the early blastomeres in many cases, and the absence of desmosomes during the first hours of development (WOLPERT and MERCER 1963) are other traits favouring this suggestion. Further support of the view that the amoebocyte represents the basic omnipotent cell type, which through transformations, reversible as well as irreversible, may be changed into various differentiated cell forms, can be found in textbooks of zoology, very well known cases are regeneration in coelenterates and planaria. It should just be mentioned that the typical traits of an amoebocyte is that it is a solitary cell, and that it forms lobopod pseudopodia. The shape is very varying, but it may be postulated that the fundamental cell shape is spherical.

The arguments advanced here pertain only to the egg cell, not to the spermatozoon, which is an epitheliocyte (flagellate form). Although the reversible transformation amoebocyte $\rightarrow$ epitheliocyte is known to occur in protozoa (cf. WILLMER 1960), there is reason to believe that a similar, but irreversible transformation occurs during ontogenesis. Whether or not the transformation leading to the formation of spermatozoa is reversible remains