Book Reviews

Bonner, J.T., (ed.): Evolution and Development. Life Sciences Research Report *22*. Berlin, Heidelberg, New York: Springer 1982. 357 pp. 14 figs., 6 tabs. Hardbound DM 46,–, $ 21.50.

The synthetic theory of evolution was dominated by population geneticists who approximated organisms as aggregates of unordered genes that were selected during evolution either individually or in groups. Biologists, however, did not find such bags of genes, but instead met with highly integrated, hierarchically organized and developing systems. None of the evolutionists of the modern synthesis ever denied the system-like nature of organisms. However, within the framework of the modern synthesis only lip-service was paid to it. The emphasis on the integrative and regulatory nature of living beings constituted the background of the 22nd Dahlem conference which dealt with evolution and development.

The conference report is divided into four parts representing four levels: molecular, cellular, life history and evolutionary. Two main conclusions were generated at the conference. First, developmental processes strongly constrain the possible phenotypic variation. This means that in addition to natural selection the space-time organization of an organism also determines its future evolution. This is almost a truism, but in the view of the Dahlem meeting it was nevertheless not recognized by the evolutionists of the synthetic theory.

The second conclusion is the interesting one. From the beginnings of evolutionary theory, many evolutionists speculated about saltatory evolution – Thomas Huxley was one of them. Darwin always rejected their ideas: nature did not jump. Darwin's view was adopted in synthetic theory. However, when living beings are highly organised, small changes in the regulatory mechanisms (e.g. in the timing of developmental events) might lead to large phenotypic changes. According to Alberch (p. 330) the action of regulatory changes during development (e.g. paedomorphosis) has been invoked in most major transitions in evolution (e.g. the origin of vertebrates, angiosperms, humans, etc.). Thus, nature does jump and these jumps are far more important in the evolutionary process than the small Darwinian variations.

In its extreme, this position becomes the punctuated equilibrium model of evolution, which was proposed in 1972 by Eldredge and Gould. In short, they state that during the course of evolution established species do not change for a long time and that such periods of stasis are alternated by geologically very short intervals in which most evolutionary change is concentrated. Here, Darwinian gradualism is totally abandoned: evolutionary changes only occur in big leaps, no room is left for the accumulation of small mutations. Interestingly, the gradualist-punctuationalist controversy is not only encountered in evolutionary theory, but in all historical sciences. Some historians of science, for example, consider the growth of science as an alternation of normal science (stasis) with revolutionary science which generates a totally new conceptual framework. Painstaking analysis revealed, however, that although discontinuity can be observed to some extent, it is not as large as was though on the basis of more superficial studies. This shows that the punctuationalists should be more reserved. In 'Evolution and development' no mention is made of the broad context of the punctuationalists' views.

Whether punctuationalists are right or wrong, developmental mutations will likely turn out to be of major importance in evolution thereby solving a lot of unanswered questions. There exists, for example, an extensive literature on the adaptive value of reduced body hair in humans. Herein, it is assumed that reduced hairgrowth itself is a direct result of natural selection. According to Gould (p. 338), however, it is the result of a change in developmental timing (neoteny) which itself was adaptive for other reasons: the locations of hairgrowth on the human body (capillary, axial and pubic) are exactly where we should expect it from the fetal pattern of other anthropoids.

At the conference biologists working on many fields were present, even one studying non-existent animals. My main criticism is that the book is nevertheless too one-sided. Surprisingly, no population geneticist, no botanist, and alas no evolutionist of the synthetic theory were present at the meeting. In addition, the participants approached developmental organization too much as an isolated phenomenon. Exactly the same points can be made with regard to structural organization. The structural properties of nucleic acids, for example, also strongly constrain the course of evolution.

One of the contributors, Dawid, remarks that whenever fundamentally new doors are opened, we find big surprises. The book stresses the recent surprises that were found in developmental biology; their consequences for evolutionary theory are still speculative and less extensively treated. In spite of minor shortcomings the book is excellent and exciting. It shows that evolutionary theory itself is not in a stasis, but in a process of fascinating evolution. G.J.M. de Klerk, Nijmegen