contains an intron and *K. africana* has a 4.3-kilobase-pair inverted repeat. The *Neurospora* mitochondrial genome is reported to contain a gene homologous to the yeast mitochondrial gene coding for the dicyclohexylcarbodiimide-binding protein despite the fact that in *Neurospora*, in contrast to yeast, the gene that is actually expressed for this protein is nuclear in location (van den Boogaart *et al.*). The *Neurospora* large rRNA gene contains an intervening sequence capable of coding for a protein of 258 amino acids, but splicing of this intron depends on nuclear gene products (Yin *et al.* and Garriga *et al.*). In *Aspergillus*, the genes coding for the large rRNA and cytochrome *b* each have single introns whereas the CO1 gene contains two (Küntzel *et al.*, Davies *et al.*). Amplification of specific parts of the mitochondrial genome appears to be responsible for senescence in *Podospora* (Belcour *et al.*).

The fourth and fifth parts of the book are brief and deal respectively with the mitochondrial genomes of Protozoa and higher plants. In trypanosomes a single, giant mitochondrion contains the kinetoplast DNA. The kinetoplast DNA consists of thousands of circles joined together in a single massive network. Of these, 95 percent consist of minicircles of 0.8 to 2.5 kilobase pairs and the rest of maxicircles (true mitochondrial genomes) of 20 to 38 kilobase pairs (Simpson *et al.*). Minicircles are first released from the center of the network for replication and following replication reattach to the periphery of the network (Englund *et al.*). Thus the replicating network grows from the periphery toward the center.

Higher-plant mitochondrial genomes are the largest known. A heterogeneous population of circular molecules ranging from 0.5 micrometer to 30 micrometers has been identified corresponding to a maximum size of 112 kilobase pairs. Restriction enzyme digests are surprisingly complex and yield minimum sizes of 227 to 757 kilobase pairs. A heterologous probe from yeast has been used to identify the COII mitochondrial gene in maize. The gene contains a 794-base-pair intron (Leaver *et al.*). Isolated mitochondria from maize make 18 to 20 polypeptides (Leaver *et al.*). These include COI, COII, and the dicyclohexylcarbodiimide-binding protein. If one estimates the total molecular weight of these proteins plus the mitochondrial tRNA's and rRNA's, the coding capacity accounted for is only 22 kilobase pairs. Cytoplasmic male sterility in maize (cms) is very likely caused by alterations in mitochondrial DNA, and correlates can be found among polypeptides made by the isolated mitochondria.

In conclusion, this book summarizes a wealth of interesting information about mitochondrial genomes, and I recommend it highly to anyone interested in this subject.

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Developmental Neurobiology

Neuronal Development. NICHOLAS C. SPITZER, Ed. Plenum, New York, 1982. xxiv, 424 pp., illus. $45. Current Topics in Neurobiology.

Developmental neurobiology is particularly interesting at the present time because of the recent development and exploitation of new preparations and techniques. This book is a collection of 11 scholarly essays, each of which focuses on a particular subject in the field.

Five of the papers deal with development in invertebrate systems. Two of these are comprehensive reviews that describe the advantages of the particular invertebrate, the organization of the adult nervous system, and what is known about neural development in the organism. In the first of these papers, Stent, Weisblat, Blair, and Zackson detail their studies on cell lineages in the leech using a novel tracer technique. The second paper, by Goodman, reviews somewhat later events in grasshopper development, including the lineage and differentiation of particular identified neurons. Both papers underscore the importance of cell lineage in invertebrate neural development and provide superb introductions to the leech and grasshopper for anyone who is not an invertebrate aficionado or a linealogist. An additional paper on analysis of development in the nematode *Caenorhabditis elegans*, another invertebrate system that is proving useful, might have been appropriate. The other papers that describe invertebrate development are less global and focus on particular developmental issues. Palka describes the use of genetics to perturb normal developmental processes in *Drosophila*. His paper also serves as an excellent introduction to the subject by defining the issues relevant to genetic manipulation of development, the advantages of *Drosophila*, and the terminology used by *Drosophila* geneticists. Palka then details a number of such genetic experiments and points out the lessons that can be learned from each. Flaster, Macagno, and Schehr describe the neuronal organization of the compound eye of *Daphnia*, its development, and the mechanisms that allow the formation of appropriate connections between the eye and the lamina. Edwards describes the development of sensory neurons in the cricket and the role of pioneer fibers in establishing peripheral axon pathways. The growth cone or the growing tip of the axon is responsible for pathway selection, and Letourneau summarizes current knowledge of growth cone structure and function, concentrating on knowledge gained from examining the growth cones of vertebrate neurons in culture.

The remaining papers in the book are not so easily categorized. Jacobson has applied tracer techniques similar to those used in the leech to the developing amphibian embryo and presents evidence suggesting that founder cells that arise early in development and whose descendants will form compartments play an important role in establishing the primary morphological pattern of the vertebrate central nervous system. Information concerning the possible role of cell lineages in the vertebrate nervous system may come not only from studies of cell injection such as these but also from the application of monoclonal antibody techniques. Barald describes how such antibodies have been raised against ciliary ganglion cells: two antibodies are able to detect a subpopulation of crest-derived cells that are otherwise identical to their neighbors. Cell death and synapse elimination serve important functions in vertebrate neural development, and these phenomena are well reviewed in two additional papers. Berg describes the occurrence of cell death, outlines the case that nerve growth factor functions as a trophic factor, and details recent work on the search for other target-derived trophic factors, in particular those that would act on parasympathetic neurons. Van Essen reviews synapse elimination at the neuromuscular junction, makes reference to the existence of the process elsewhere, and presents a case in support of the idea that polyneuronal innervation is controlled by bidirectional signaling between nerve and muscle. Finally, Cowan and Finger describe the heretofore largely ignored ability of the embryonic central nervous system to regenerate and regulate.

Although this collection of papers does not constitute a complete review of the field of developmental neurobiology, it covers a relatively broad range of

topics. Each of the contributions is well written, and most do not require the reader to be familiar with the complexities of the particular system. In addition, many of the authors discuss the reasoning behind the design of their experiments and the interpretation of their results.

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Ancient Earth Processes

Origin of Life. Proceedings of a meeting, Jerusalem, June 1980. YECHESKEL WOLMAN, Ed. Reidel, Boston, 1981 (distributor, Kluwer Boston, Hingham, Mass.). xvi, 614 pp., illus. $73.50.

Mineral Deposits and the Evolution of the Biosphere. Papers from a workshop, Berlin, Sept. 1980. H. D. HOLLAND and M. SCHIDLOWSKI, Eds. Springer-Verlag, New York, 1982. x, 334 pp., illus. $19. Dahlem Workshop Reports. Physical and Chemical Sciences Research Report 3.

The geologic record indicates that life was present on earth about 3.5 billion years ago. However, because of the absence of terrestrial rocks older than about 3.7 billion years, there is no direct evidence available that can be used to determine either how or when it began or what the preexisting chemical conditions were. Even when a geologic record does exist (starting about 3.75 billion years ago with the Isua formation in southwestern Greenland) its interpretation is complex and often controversial. These two volumes of conference proceedings present some of the recent concepts, experiments, and theories used to reconstruct the processes and events that may have been involved in the origin of life on earth and in the formation of some of the earth's most ancient geological deposits.

Origin of Life is the proceedings of the latest in a series of international symposia on this subject begun in 1957 in Moscow. Reflecting the complex interaction of scientific disciplines that is important in research into the origin of life, the coverage is highly interdisciplinary, the topics of the 77 papers ranging from interstellar and prebiotic organic chemistry to the origin of chirality to possible early metabolic pathways. The papers vary considerably in rigor (and perhaps in validity) and some are highly speculative. They are short (most are from four to six pages long) and can be rapidly read or skimmed, and the collection gives the reader the opportunity to be exposed to some of the latest research and controversies associated with the question of how life on earth originated. Several papers deal with the synthesis of peptides, and the wide scope of experimental conditions that are used is a good illustration of the difficulties encountered in attempting to formulate a reasonable mechanism for peptide synthesis under the presumed primitive earth conditions. Also the papers on whether circularly polarized x-rays produced from β-particles had any role in the origin of chirality demonstrate that this continues to be a subject of controversy. In some cases the papers describe experiments or observations that may not have any significance with respect to our understanding of the origin of life on earth. For example, there is a paper concerned with the resolution of underivatized amino acid enantiomers by high-pressure liquid chromatography and one on the adaptation of microbes to cold saline environments. One asset of this volume is that the papers contain a large number of references, which make the volume a useful guide to the recent literature on the origin of life. Readers might also find it interesting to compare the papers in this volume with those in the previous proceedings volumes in order to see how research into the origin of life has itself evolved during the last 25 years. One particularly important development has been the realization that some meteorites contain abiotic organic compounds and thus provide excellent natural systems for testing some of the ideas proposed concerning pathways for the prebiotic synthesis of organic compounds. The suggestion that abiotic synthesis is a common interstellar process has also emerged within the last several years.

Mineral Deposits and the Evolution of the Biosphere contains 12 state-of-the-art papers concerned with some of the processes thought to be important in the formation of the earth's early geologic deposits and with how life itself has affected the chemistry of the earth. Many of the papers deal directly with the ancient rocks and mineral deposits. There are papers on stratified sulfide and banded ironstone deposits and on the distribution of both sedimentary deposits and mineral formations through geologic time. Another paper deals with the organic geochemistry of Precambrian rocks and the problems associated with ascertaining what organic molecules might be syngenetic with these deposits. There are also papers on present-day processes, especially those thought to be involved in the formation of certain minerals, such as the sulfides and iron oxides, and how these might be used in interpreting the ancient geologic record. The effects of microbial processes on the organic chemistry of recent sedimentary systems and how some organic molecules might be used to evaluate the environmental conditions that prevailed when ancient sediments were deposited are discussed in detail by Eglinton and co-workers. One paper (by S. L. Miller) is concerned with the organic chemistry of the primitive earth and how it can be used to establish the conditions that existed before life was present and before a relevant geologic record exists. The papers are, in general, well written and highly informative, and they constitute one of the better recent collections in this field of geochemistry. At the Dahlem conferences, from one of which this volume originated, workshops or discussion groups are held in addition to the presentation of the formal papers, and the reports of these are given at the end of the book. These four reports are probably the most valuable component of the volume. They indicate what areas of research may be important in the future and also give some cautionary advice about previously published research, perhaps most notably the claim that carbon isotopic data from the Isua rocks confirm the existence of life about 3.75 billion years ago. The report entitled "Biogeochemical evolution of the ocean atmosphere system" seems particularly significant, and a careful reading of it is recommended to the authors of some recently published papers who have proclaimed that the early earth's atmosphere was never reducing and may have actually contained oxygen, a scenario that is clearly at odds with the conclusions reached by the participants in the Dahlem conference.

Together these volumes contain an extensive amount of information about the processes, both geochemical and biological, that may have operated on the early earth. *Mineral Deposits and the Evolution of the Biosphere* is clearly the superior of the two and would be a valuable acquisition for scientists interested in this area of earth science. *Origin of Life* is more specialized and should be considered mainly by scientists actively engaged in research into the question it deals with.

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