Life Sciences Research Report 1

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THE MOLECULAR BASIS OF *CIRCADIAN RHYTHMS

J. W. Hastings, Harvard University, and H.-G. Schweiger, Max-Planck-Institute für Zellbiologie, Wilhelmshafen, Editors, with an introduction by C. S. Pittendrigh.

Report of the Dahlem Workshop on The Molecular Basis of *Circadian Rhythms, Berlin 1975 November 3 to 7.

*Circadian Rhythms are defined as those rhythms with the following basic features:

They persist for some time in the absence of diurnal fluctuations in temperature and illumination; their phase can be altered by a brief disturbance of the constant regimen; and their period is relatively independent of the constant external temperature, at least within the physiological range.

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Life Sciences Research Report 2

NEW

Prepublication Offer
(valid until 1976 April 30)**

APPETITE AND FOOD INTAKE

T. Silverstone, Editor
St. Bartholomew's Hospital, London

Report of the Dahlem Workshop on Appetite and Food Intake
Berlin 1975, December 8 to 12

The report of this interdisciplinary workshop evaluates present knowledge regarding the factors concerned with eating behaviour and its control. It contains individual contributions on the state of the art by some of the most distinguished scientists working on these problems, and the group reports formulated during the workshop.

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Source of constructive thinking

Marcel Florkin

The Evolution of the Bioenergetic Processes. By E. Broda. Pp. vii+211. (Pergamon: Oxford and New York, 1975.) £8.30; \$20.

In this much needed synthesis about the sources of free energy and their evolution in organisms, Professor Broda has collected and integrated a vast body of knowledge. He begins with a detailed exposition of current views on the origin of 'eobionts' and considers as most ancient those bacteria which are able to make ATP (the universal source of free energy in metabolism) anaerobically in a solution of organic compounds without direct participation of light. Such 'fermenters' (found among *Clostridia* and among methane formers, both gram positive) could only depend on the chemical energy of solutes. As the biomass increased, critical conditions arose—the production of compounds with high energy content by radiations, and so on, falling behind the rate of consumption of redox compounds useful in metabolism. At this point additional sources of free energy were acquired by photosynthetic bacteria through emergence of photosynthetic phosphorylation: in light, useful carbon compounds were regenerated from waste, and life could persist on the basis of antagonistic dark and light reactions.

Photo-organotrophs such as purple non-sulphur bacteria use as electron donors in the light, in anaerobic conditions, those organic electron donors which were used by fermenters in the dark. In addition to ATP, the expansion of life required, for the assimilation of CO₂, an external supply of electrons. Photolithotrophs such as *Thiorhodaceae* or purple sulphur bacteria and *Chlorobacteriaceae* or green sulphur bacteria) learned, through photochemical promotion, to use inorganic reductants as electron donors.

Photolithotrophs are removed from fermenters by one more step than photo-organotrophs. As photolithotrophic bacteria never produce oxygen (they do not extract electrons from water) the atmosphere remained anoxygenic, but sulphate (a mild oxidant) became plentiful in the bio-

sphere. Oxygen increased in the atmosphere after the emergence of the ability of green plants (phytotrophs) to photolyse water and use it as reductant. Oxygen is toxic for anaerobes and it must be considered that a progressive oxygen tolerance was acquired by aerobic organisms who developed enzymes (oxygenases) through which oxygen was first exploited in biosynthesis. The author concludes that all respiring bacteria (relying on electron chains) have developed from photosynthetic bacteria and that the electron chains of respiratory phosphorylation were derived from the electron chains of photosynthetic phosphorylation.

It should be noted that non-photosynthetic lithotrophs (chemoautotrophs) as well as respiratory organotrophs, rely on oxidation in air to obtain ATP, resulting, in both, from respiratory phosphorylation, with the distinction that in the case of non-photosynthetic lithotrophs, the reductants are inorganic. The author also discusses the evolutionary positions of the variants of respiration (anaerobic and aerobic) in prokaryotes. He suggests that sulphate respirers (using sulphate instead of oxygen as the terminal electron acceptor in the electron flow mechanism characterising 'respirers') arose from some purple non-sulphur bacteria.

Bacteria and blue-green algae are prokaryotes; all other algae, higher plants, fungi, *Protozoa*, *Metazoa* are eukaryotes. Eukaryotes possess specific organelles (mitochondria, chloroplasts) housing the enzymatic machinery or respiration or photosynthesis. All eukaryotes are aerobic and are derived from eukaryotic protists (*Metazoa*, or higher animals, derived from *Protozoa*; *Metaphyta*, or higher plants, derived from green algae).

Professor Broda discusses the evolution of intracellular organelles in eukaryotes and the theories considering mitochondria and chloroplasts and endosymbiotes.

The book is completed by a discussion of the aspects of differentiation of tissues in the frame of oxygen need, that is, the further line of bioenergetic evolution among animals and plants. The author also considers the incidence of paleontological and geological evidence on the path of bioenergetic evolution deduced from the properties of extant prokaryotes and eukaryotes, and in the last chapter, retraces the history of atmospheric oxygen.

All students of evolution must be grateful to Professor Broda for providing such a lucid and documented discussion of this important topic. His book fills a gap in the literature on evolution and will certainly remain for a long time a source not only of bibliographic information, but also of constructive thinking. □