

of alcohol. The residue thus obtained when dissolved in isotonic saline showed a total loss of the anticoagulant activity. The protein content of the residue at this stage was found to be about 48 mg%.

Simple dissolution of the crude extract of the leech heads in distilled water, separation of proteins by coagulation at 80°–85° C for 20–30 min, filtering and evaporating to dryness on a water bath, and leaving in a desiccator overnight gave very satisfactory results. Usually, after 8–10 such treatments, the residue obtained was easily soluble in water, yielding a clear solution. An isotonic saline solution of the residue showed an effective anticoagulant activity. The protein content of the anticoagulant at this stage was found to be about 90–100 mg%.

In yet another case the crude extract, after treatment at 80°–85° C for 20–30 min, was mixed with isotonic saline and left overnight. Next morning it was filtered; the solution showed an active anticoagulant

property, and the protein content was found to be approximately 80 mg%. This method seems capricious, however, as it gave variable results.

Attempts to obtain a completely protein-free substance were not successful. Even when the biuret test was negative, the estimations done by a biophotometer using Greenberg's phenol reagent method indicated the presence of small traces of protein. Glass-distilled water (pH 7–7.2) was used in the above experiments, which were performed at room temperature (100°–108° F), and thymol was used as a preservative. Further work on the biochemical estimations of the anticoagulant is in progress and will be published later.

Reference

1. LAL, M. B., and CHOWDHURY, N. K. *Nature*, **166**, 480 (1950).

Manuscript received July 26, 1951.

Book Reviews

Time's Arrow and Evolution. Harold F. Blum. Princeton, N. J.: Princeton Univ. Press, 1951. 222 pp. \$4.00.

"To what extent has the course of evolution been determined by strictly physical factors that have permitted no exercise of natural selection and to what extent have the former set limits within which the latter may act?"

"How, when no life existed, did substances come into being which today are absolutely essential to living systems, yet which can only be formed by those systems?"

Most readers will agree that Dr. Blum has made a profound contribution in his formulation of these questions and in his presentation of the facts bearing upon their answers. The problem is like a great jigsaw puzzle in which small areas of the picture have been put together but whose final solution will require many trials and failures before the correct combinations are discovered. The book will cause vigorous discussion, and its virtues lie in the areas where the author has offered clarification of these broad questions.

Blum suggests that "time's arrow," the second law of thermodynamics, is the unyielding warp upon which the great tapestry of evolution has been woven. Many experts in the field of thermodynamics will not wish to apply the second law to a single photon, in the form of an x-ray, acting upon a gene to alter the process of evolution. Irving Langmuir has called this a divergent phenomenon and concludes "In a world in which divergent or quantum phenomena occur we can have no absolute relation of cause and effect." However, the author is certainly correct in empha-

sizing the restrictions that chemistry and possible chemical changes have placed upon the course of evolution.

The origin of the compounds in the first living cell is, indeed, a problem of singular difficulty. In a cosmic cloud, with its large excess of hydrogen, the compounds in living matter are generally unstable with respect to methane, water, and ammonia. The earth's early atmosphere was doubtless water, carbon dioxide, and some ammonias. High energy photons acting upon these compounds certainly produced many free radicals, and the combination of these radicals gradually led to more and more complicated molecules. The author assumes that compounds as complicated as adenylic acid were formed in the first billion years. This conclusion also will be a point of controversy, but the existence of living matter surely gives weight to his contentions.

Time's Arrow and Evolution will interest readers from all fields of science and a discussion of its propositions should broaden the attack upon these fundamental problems.

WENDELL M. LATIMER

Department of Chemistry
University of California, Berkeley

Metallurgical Thermochemistry. O. Kubaschewski and E. L. Evans. New York: Academic Press; London: Butterworth-Springer, 1951. 368 pp. \$6.00.

This book presents an extensive collection of thermodynamic data, an introduction to their use in metallurgical calculations, and descriptions of experimental procedures by which they are determined. In explaining the title the authors state that