Book Reviews

History of Biochemistry Continued

Comprehensive Biochemistry. Marcel Florkin and Elmer H. Stotz, Eds. Vol. 32, A History of Biochemistry, Part 4: Early Studies on Biosynthesis. MARCEL FLORKIN. Elsevier, New York, 1977. xx, 362 pp., illus. $39.95.

The editors of *Comprehensive Biochemistry*, after publishing 29 volumes summarizing recent developments in the field, conceived the idea of a history "to retrace the long process of evolution of the science of biochemistry, framed in a conceptual background." After covering the early period (right back to the pre-Socratics) in part 1, and having given a general account of the transition from that period to the period of biochemistry proper in part 2, the author went on to examine the history of the identification of the sources of free energy in organisms in part 3. He has devoted the present volume to the concept of biosynthesis.

This account spans the period from Joseph Black's studies of "fixed air" in the 1750's to 1935, when R. Schoenheimer introduced deuterium into biochemical studies. It opens with an excellent outline of the pneumatic chemists' contributions to our understanding of the fixation of carbon by plants and of the experiments and debates concerning the fixation of nitrogen. By the 1850's it seemed clear that plants obtained their carbon and nitrogen from the atmosphere and that animals were dependent upon the synthetic powers of plants. Only much later (1893) were nitrogen-fixing bacteria discovered and uncertainty over the source of plant nitrogen dispelled.

Florkin agrees with Emil Fischer in seeing an initial phase of close connection between chemistry and biology in the work of such men as Liebig and Dumas. This was followed by the separation of organic from physiological chemistry, the result of which was to weaken the links between those who based their understanding of biosynthesis on syntheses in vitro and those who based theirs on studies in vivo. Florkin considers that both approaches tended to mislead, in vitro studies because speculations thereon were not controlled by an adequate knowledge of physiological processes and in vivo studies because they lacked the reliability of identification of metabolic pathways that radioactive tracers have since provided.

Florkin makes a clear distinction between theories of "direct assimilation," which gave no biosynthetic power to animals, and the modern view, in which the animal considerably modifies the constituents of its diet by its own biosynthetic powers. The globulists held a crude version of the direct assimilation theory. According to them all animals and plants were constructed from microscopic particles called "globules." Nutrition involved the intercalation of fresh globules, derived from the animal's food, between existing globules. After the great physiologist Johannes Müller had undermined this theory, direct assimilation survived in reference to the proximate principles—the chemical constituents of the diet. There grew up a literature, as a result, on analogies between plant and animal constituents highly suggestive of direct assimilation. Florkin cites the "legumin" found in peas and other legumes, which had the odor of cheese, and the remarkable cow tree of South America, whose milky juice clotted just like cow's milk. Only with the demise of direct assimilation did the concept of biosynthesis in animals begin to emerge.

On one side, physiological chemists like Eduard Pflüger treated biosynthesis in a dualist fashion, separating it from ordinary chemical reactions and attributing it to the special properties of the living protoplasm. Against this vitalist position, organic chemists like Adolf von Baeyer regarded biosyntheses as examples of organic reactions, and for carbon fixation von Baeyer suggested the well-known formaldehyde theory. Florkin includes an informative discussion of the views of Berthelot, Emil Fischer, and Sir Robert Robinson on the nature of biosynthesis, and he gives prominence to Fischer's call for a new alliance between chemistry and biology in his Royal Institution Lecture of 1907.

There are three chapters on the "xanthines" and related compounds (that is, purines, pyrimidines, urea, creatine, creatinine, and ornithine). These chapters summarize an intricate but important part of the history of organic and physiological chemistry, which has not been treated adequately before. The author has also tackled the difficult subject of protein synthesis by the reversal of hydrolysis. The general idea of "reversible zymohydrolysis" was based upon van't Hoff's suggestion of the reversal of catalyzed reactions under the law of mass action. It was believed that, when a proteolytic enzyme was added to a concentrated solution of the products from pepsin digestion of protein, biosynthesis occurred, resulting in the formation of "plasteins," which Savjalov regarded as protein in nature. We are indebted to Florkin for tackling the history of this murky and long-forgotten subject. No historian of protein chemistry can expect to go far without hitting his head against a wall of literature on the plasteins.

Despite some disclaimers, Florkin betrays a confident positivist bias in favor of those scientists who took their cue from the results of in vitro syntheses, and these were all chemists. "Chemists," claims Florkin, "were not involved in the vitalism-mechanism controversies"; "Dumas, Liebig and their followers . . . remained unwarped by the protoplasm myth"; "the chemists were not contaminated by the protoplasmic myth which led Pflüger and Bernard astray." It way be argued that to describe outworn and discredited concepts in this way does not help us to understand how the physiologists and physiological chemists of the day were thinking. This methodological approach may also warp our evaluation of the contributions that figures like Bernard and Liebig made in their day. Bernard's view of biosynthesis as a vital process must surely have seemed reasonable to the majority of his contemporaries in the light of the knowledge available to them. A great achievement of the 1860's was the overthrow of the contact theory of fermentation championed by Liebig and the establishment of the vitalist theory of "organized ferments." Why should Bernard be accused of "irrational tendencies" (p. 130)?

The author is to be congratulated for having completed so large a part of the grand scheme he has projected. He has made good use of recent scholarly researches by F. L. Holmes, M. W. Rossiter, and others. His breadth of coverage and command of scientific detail remind one of Partington's monumental *History of Chemistry*. When the fifth and last part of the history appears the reader will

have a very comprehensive account of the history of biochemistry that will also guide him or her to recent work by historians on the history of physiology and biochemistry.

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Control of Insect Pests

Theory and Practice of Biological Control. C. B. HUFFAKER and P. S. MESSENGER, Eds. Academic Press, New York, 1976. xxii, 788 pp., illus. $42.50.

This is the third major book on biological control that has been written or master-minded since the middle 1960's by researchers at the University of California. Like the other major books, it is a many-authored volume, and a galaxy of world experts have contributed chapters. Virtually all of the book is concerned with insect pest control by natural enemies. The book also briefly introduces other, wider aspects of the biological control of insect pests, including control by host-plant resistance, cultural controls, and control by autocidal methods as well as integrated control. Only one 14-page chapter discusses the very important subject of the biological control of plant pathogens, and there is no treatment of other subjects, such as the direct biological control of animal pathogens. To call such a book *Theory and Practice of Biological Control* perpetuates the myth that disciplines other than entomology have relatively little to offer to the theory and practice of biological control.

For the entomologist, the book provides a valuable updating of general information on biological control but does not offer much that is new in the way of philosophy or exciting ideas. Thus, except for a valuable chapter by Hagen and others on "The biology and impact of predators," those on philosophy, scope, theory, and empirical bases for biological control are mostly shorter versions of stimulating and provocative chapters on these topics in the two previous major books (*Biological Control*, C. B. Huffaker, Ed., Plenum, 1971, and *Biological Control of Insect Pests and Weeds*, P. de Bach, Ed., Chapman and Hall, 1964). Opportunities have been missed; it would be more valuable, for example, to critically examine the future role of biological control in relation to the vital topic of integrated control (which is discussed in chapter 27) than to deal with integrated control, as the book does, mostly in terms of its independent components.

The book is certainly a tribute to the outstanding work done by entomological protagonists of biological control since it all began in California in the late 1800's, and it also provides evidence of successes in the last 20 years, demonstrating the continued importance of the biological control of pest insects by natural enemies. However, the philosophy and practice of biological control have remained little changed for several decades. The emphasis in the present book on success stories and the absence of critical analyses of inadequacies or apparent failures suggests that the protagonists of biological control still feel they have to defend or at least to vindicate their approach. Yet few people would disagree that biological control is fundamental to the rational control of most insect pests as well as of many other kinds of pests and diseases. We still need an objective analysis of the role of biological control, including appraisals of its strength and limitations and, in particular, some fresh approaches in biological control research. This will be the task of the new generation of young scientists dedicated to this field of endeavor both in California and elsewhere.

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Toxic Effects

Biological Reactive Intermediates. Formation, Toxicity, and Inactivation. Proceedings of a conference, Turku, Finland, July 1975. DAVID J. JOLLOW, JAMES J. KOCSIS, ROBERT SNYDER, and HARRI VAINIO, Eds. Plenum, New York, 1977. xii, 514 pp., illus. $49.50.

This book presents one of the more intriguing phenomena of toxicity, the production of highly reactive intermediates as a result of attempts by the body to inactivate and rid itself of foreign chemicals. When these intermediates react with critical cellular components, the biochemical lesion produced can cause toxicity in the form of morphological and physiological changes. These are most often seen as cancer and organ damage. This collection of papers comes from an international symposium at which most of the major laboratories studying reactive intermediates were represented. Although several books dealing with specific aspects of reactive intermediates have appeared recently, this is the most comprehensive volume available. The coverage, however, varies immensely from chapter to chapter; some chapters are comprehensive reviews of a topic, whereas others deal with very narrow and specific experimental problems. Despite the shortcomings of such a format, the whole is very readable, and the reader is made aware that, despite the seeming completeness of the background information, there are many problems that need to be solved.

The book is divided into seven sections, although the subjects covered in each seem somewhat arbitrarily assigned. The discussions that took place at the symposium are not reported verbatim, but the summaries retain some of the spontaneity characteristic of a scientific meeting.

An excellent start to the book is provided by a section on the role of covalent binding in toxicity and carcinogenesis. In this section, one chapter by Gillette deals with theory and others, by Miller and Miller and by Jollow and Smith, use specific experimental examples to illustrate general concepts. In the section Formation of Reactive Intermediates, the comprehensive coverage in the contributions by Ullrich on the oxidation mechanisms, Schenkman *et al.* on the induction of aryl hydrocarbon hydroxylase, and Gelboin *et al.* on the metabolism of benzopyrene is particularly noteworthy. Similarly, in the section Inactivation of Reactive Intermediates the chapters by Oesch *et al.* on epoxide hydratase and Jerina and Bend on glutathione *S*-transferases and elsewhere in the book the chapters by Sims on polycyclic hydrocarbon expoxides and Brookes on the role of covalent binding in carcinogenicity provide excellent backgrounds to aid in the understanding of chapters concerned with more specific problems of individual drugs and foreign compounds. The chapter by Högberg on the use of hepatocytes in a toxicity study provides some exposure to a model system for which there is great potential. Two chapters, one by Conney *et al.* linking reactive metabolites with mutagenicity and carcinogenicity and the other by Regan documenting cellular repair mechanisms, remind the reader that a demonstrable detrimental change resulting from the initial binding event, not the binding of a reactive intermediate to a cellular constituent, is the true indicator of toxicity.

Overall, the volume blends past problems and the way they were solved with present problems and the way they are being attacked to form an overview of reactive intermediate toxicology that will