ena, in an era of much ignorance (by present-day standards) and great confusion in the study of macromolecular systems. Not only the colloid chemists but the organic chemists, including the great Emil Fischer, were unwilling to believe in the existence of really large molecules, held together by covalent bonds. Thus the resistance to the "chemical" view of such molecules as proteins was quite understandable, given the prevailing scientific background of the time. The greatest weakness of many of the colloid chemists, I believe, was that their theories were sufficiently vague and flexible to accommodate all sorts of experimental facts; they were not, in Karl Popper's sense, falsifiable. In any case Svedberg, the greatest of the 20th-century colloid chemists, later became the foremost champion of the view that proteins were definite molecules, as Florkin indeed points out.

This criticism of one small aspect of Florkin's book should not obscure the value of the total enterprise; those concerned with the development of biochemistry will look forward eagerly to the later volumes.

Those like myself who have been conducting seminars in the history of biochemistry will find these books valuable. Fruton's book in particular has provided me, for the first time, with a text that can serve as a core around which other aspects of the seminar can be built. For these purposes, I think, it needs to be supplemented with biographical material on major investigators, and of course with study of original sources. In any case the appearance of these books is a major event for those who are concerned with understanding the development of this area of science, which is now of such central importance to the whole of biology.

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Meyerhof and Successors

Molecular Bioenergetics and Macromolecular Biochemistry. A symposium, Heidelberg, July 1970. H. H. WEBER, Ed. Springer-Verlag, New York, 1972. vi, 198 pp., illus. $25.10.

In July of 1970 a symposium was held in honor of Otto Meyerhof at his place of work. The time was chosen to coincide approximately with the 20th anniversary of Meyerhof's death and with the creation of a Meyerhof chair at the Weizmann Institute of Science in Rehovot, Israel. The proceedings have been published to make it possible "for the admirers of Meyerhof who were not able to attend the symposium in person, to be present in spirit." Since I belong to the large group of admirers of Otto Meyerhof, having participated in his 65th birthday celebration in 1949, I undertook to review this little book. I am glad I did.

The book starts with a fascinating account of Meyerhof's work and life by H. H. Weber. Meyerhof was actively interested in philosophy and the arts (he wrote poetry until his last year of life). His imaginative genius led him to correlate heat measurements with chemical changes in muscle, studies which mark the beginning of modern muscle biochemistry and led to the award of the Nobel prize in 1922. At the time Meyerhof was only 38 years old and still an assistant at the University of Kiel. His later work in Berlin and after 1929 in Heidelberg attracted a large number of students who later became leaders in the field of biochemistry. Among them are Ochoa, Lipmann, Nachmansohn, and Blaschko, participants in this symposium.

It is only regrettable that Weber's fascinating account of Meyerhof's work and personality is written in German and thus lost to the majority of our present biochemistry students, who no longer need to pass language examinations.

An excellent review of "Meyerhof's aldolase—35 years later" is presented by B. L. Horecker. It is fascinating to follow the developments which started with the discovery of aldolase in 1934 and culminated in the sophisticated current approaches to the mechanism of action of this key enzyme of glycolysis, which is responsible for the cleavage of the hexose to trioses.

Meyerhof's approach to the resolution of the glycolytic process has inspired many other investigators. Feodor Lynen's brilliant account of the multienzyme complexes responsible for the synthesis of fatty acids and of methyl salicylate is another contribution that our Germanless graduate students will have to miss.

Two famous Meyerhof students, S. Ochoa and F. Lipmann, contribute papers on polypeptide synthesis. Ochoa gives a detailed, experimentally documented account of the ribosomal factors in polypeptide chain initiation. The factors F_1, F_2, and F_3 should not be confused with similarly named factors participating in oxidative phosphorylation. But the similarity points to the fact that these processes have complexity in common. Lipmann, who is convinced that the complex process of present-day protein biosynthesis has been preceded by simpler ones, has turned to the study of polypeptide synthesis that is not aided by nucleic acids. The biosynthesis of gramicidin S and tyrocidine is described as taking place by amino acid polymerization on multienzyme complexes from protein-bound amino acyl thioesters.

On the second day of the symposium scientific grandsons (and granddaughters) of Meyerhof participated. The first two papers, by K. C. Holmes and A. Weber, are on the molecular structure and physiological regulation of the actomyosin system. They are excellent summaries of our present knowledge in this important area of biochemistry. L. Sachs, the holder of the Meyerhof chair in Rehovot, presents his findings on the relationship of cell surface changes and malignancy (for example, the response to concanavalin A) and raises the question of the genetic basis of malignant cell transformation.

The third day of the symposium was devoted to ion translocations and excitable membranes. R. Winkler and M. Eigen discuss the two classes of alkali-ion carriers: the neutral macrocyclic compounds (such as valinomycin), which selectively combine with a charged alkali-ion and therefore respond to an electric field, and the charged open-chain compounds (such as nigericin), which participate in an electrically neutral transport of ions. Experimental data on the use of murexide for the study of alkali-ion complexes and the interaction of monactin with Na^+ are presented. The chapter closes with a list of valuable conclusions about carrier molecules and a list of "problems to be solved."

A thorough review of the problem of the Ca^{2+} pump of sarcoplasmic reticulum and particularly the reversal of the pump action resulting in generation of adenosine triphosphate is presented by W. Hasselbach.

In the last chapter D. Nachmansohn lucidly states his views in favor of acetylcholin as an intracellular trigger which initiates and controls the permeability changes and ion movements during electrical activity.

Perhaps the only note of disappointment that may be voiced concerns the title of the symposium. It may mislead prospective readers as it did this reviewer. A modern symposium on molecular bioenergetics cannot ignore energy-transducing mechanisms in mitochondria, chloroplasts, and bacteria without being challenged. Finally, more careful proofreading would have avoided printing errors, particularly the embarrassment of misspelling Meyerhof's name in the index. As a book containing stimulating articles in several important areas of biochemistry, this volume is highly recommended. The price is much too high for the size of the book.

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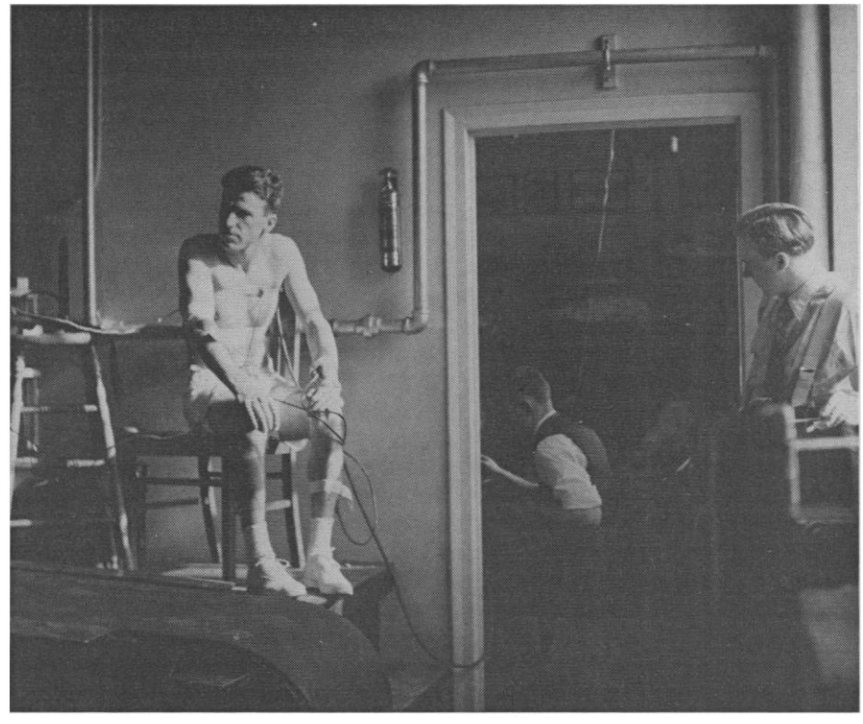
Henderson's Lab

The Harvard Fatigue Laboratory. Its History and Contributions. STEVEN M. HORVATH and ELIZABETH C. HORVATH. Prentice-Hall, Englewood Cliffs, N.J., 1973. x, 182 pp., illus. $9.95. International Research Monograph Series in Physical Education.

This book recounts the history of the Harvard Fatigue Laboratory, a remarkable organization that existed from 1927 to 1947. Although it grew (in association with the Harvard Business School), flourished, and then died over a quarter of a century ago, it has had far-reaching effects since then. Many of its scientists and trainees are busy operating somewhat comparable laboratories in many parts of the world.

The original name "Henderson's Lab" recalls a person well known to all medical students from the Henderson-Hasselbalch equation, though known to his contemporaries as "Pink Whiskers." Later the work was dominated by D. B. Dill, a "scientist's scientist" who was always experimenting on himself and anyone who could be corralled.

The laboratory was involved in applied physiology in various situations. The conditions of work of people in the Mississippi delta, at the Boulder Dam, or in the South American Andes were being investigated partly from the point of view of the physiological interest, but partly to find out whether there were ways in which the workers could be made to function more efficiently. Such a situation can lead to extreme suspicion, and this close association with industry clearly affected the proper functioning of the laboratory. For example, the Andean miners refused to be tested on the bicycle ergometer; thus their maximum work capacity could not be measured. However, many very important contributions were made relating to exercise physiology, climatic stress, high-altitude acclimatization, nutritional requirements, aging, and other matters.



The first treadmill at the Harvard Fatigue Laboratory, 1938. The subject is believed to be Glen Cunningham. Observers are Ashton Graybiel and J. Yule Bogue. [From *The Harvard Fatigue Laboratory: Its History and Contributions*]

Much secret work was done during World War II, but it is shocking to read (pp. 164–65), "We would be remiss if we did not note that many nutritional problems were investigated in the years 1941 to 1945, the results of which were not published in the open literature. They provided much valuable information on nutrition and the methods that could be utilized in large population surveys." If true, it is surely scandalous that such information obtained 30 years ago is not now available when the need for proper food and knowledge of nutrition has never been greater throughout the world.

This book can be read with interest both by historians of science who are interested in how a particular laboratory comes to be created, functions, and finally dissolves and by those interested in exercise physiology in a variety of stressful states, because so much of the crucial experimentation came from this laboratory.

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Life of Broom

Dr. Robert Broom, F.R.S. Palaeontologist and Physician, 1866–1951. A Biography, Appreciation and Bibliography. G. H. FINDLAY. Balkema, Cape Town, South Africa, 1972. xvi, 158 pp. + plates. R7.50. South African Biographical and Historical Studies, vol. 15.

In the fields of vertebrate paleontology, comparative anatomy, and physical anthropology, Robert Broom is so closely comparable in stature and influence to the monumental naturalists of the 19th century that it is hard to realize that little more than 20 years has elapsed since his death. Like many of the giants who preceded him, Broom was educated as a physician, and it was mostly as a practicing physician that he supported self, family, and scientific career for more than 60 years.