of science: It was after all Alfredo Rocco, said to be Mussolini's favorite philosopher, who defined fascism as "feeling translated into action." American society will be rejuvenated by people who deal with its complexities by summoning every rational as well as moral resource. Every man is entitled to seek his refuge and to find comfort where he may, but he must not confuse retreat with revolution.

In the short run the system may actually be strengthened if the defection of enough upper-middle-class young people creates more room at the top for the sons and daughters of workers and the poor. The American corporate state will not collapse if those who are most offended by its evils desert it for dead. In the long run the nation may be obliged to support a sizable parasitic class which grows larger as it perceives that the self-righteous symbols of revolution are compatible with the behavior of impotent men. If enough pilgrims journey to Walden they will pollute the pond; but no matter, it is not these waters that can green America.

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Hormone Metabolism

Conjugates of Steroid Hormones. HARRY E. HADD and ROBERT T. BLICKENSTAFF. Academic Press, New York, 1969. xviii, 366 pp., illus. $18.50.

It was not so long ago that steroid biochemists and endocrinologists regarded steroid conjugates with great hostility. The reason for this is that efforts to isolate pure steroids were often frustrated by the difficulty of releasing the free steroid from its conjugated forms, which were usually a mixture of glucuronides and sulfates. The "enemy" conjugates were attacked with hot boiling acid to release the steroid, and when this approach was abandoned because much of the steroid was destroyed in the process, they were subjected to incubation with crude hydrolase preparations for days. A further deterrent to working with conjugates was the fact that owing to their greater polarity their purification was far more difficult than was the isolation of the nonpolar steroids. Also, conjugates were universally regarded as detoxication products lacking in biological significance and so became unworthy of serious attention.

Today the situation is completely reversed. Steroid conjugates are accorded lavish affection; there is no compulsion to hydrolyze them, techniques for their isolation and identification have been greatly improved, and their significance is clearly in the realm of metabolic conjugation and not detoxication. This remarkable transition was not made overnight but by dint of the accumulated hard work of a number of pioneers who now, no doubt, are blinking in amazement at the current popularity of steroid conjugates. In this connection, the eyes of S. L. Cohen, E.-E. Baulieu, S. Lieberman, E. Diczfalusy, A. E. Kellie, J. Schneider, and M. F. Jayle bear watching.

The steroid conjugates represent a challenge to the endocrinologist because, first, they can be the primary hormone product of an endocrine gland, for example dehydroisoandrosterone sulfate from the adrenal; second, they can be substrates for specific hydrolases which endow them with a role in the enterohepatic and in the feto-placental circulations; and third, they can be substrates for specific enzymes which transform the steroid moiety into metabolic products which, in turn, are the precursors of important steroid hormones.

Of late, an effort has been initiated to organize this wealth of knowledge. S. Bernstein and S. Solomon have edited a volume on *Chemical and Biological Aspects of Steroid Conjugation* which follows Bernstein, Dusza, and Joseph's compilation *Physical Properties of Steroid Conjugates.* Also, the treatise *Metabolic Conjugation and Metabolic Hydrolysis* edited by Fishman includes discussions of steroid conjugation.

The publication now of Hadd and Blickenstaff's *Conjugates of Steroid Hormones* provides a concise introduction to this field as seen by a single author-pair. The authors have succeeded in writing an interesting book for the investigator who is about to start working with conjugates of steroid hormones and who needs to know where and how to begin. One learns about isolating steroid conjugates from natural sources, separating sulfates from glucuronides, and the advantages and disadvantages of various techniques in the literature. Sulfates of steroid hormones are discussed in a chapter devoted to their enzymic and chemical synthesis, as are the glucuronides in a separate chapter. The treatment of the Koenigs-Knorr synthesis of glucuronides is especially good. Steroid hormone glucosides and phosphates are reviewed before the metabolism of steroid conjugates is discussed. In the appendix, a system of nomenclature is proposed for steroid glucosides which deals specifically with the naming of steroid compounds with more than one glycosidic link.

The authors have compiled useful and complete (to 1968) tables of the various steroid conjugates, numbering over 370, as a mini-laboratory Handbook of Steroid Conjugates. Inasmuch as these tables and others constitute more than half of the book, its ultimate value will be a function of the frequency with which it is consulted for specific information. On this basis alone one can expect it to occupy a position on the shelves of investigators interested in steroids and their conjugates.

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Neural Patterns

The Innervation of the Vertebrate Heart. EDWIN F. HIRSCH, Ed. Thomas, Springfield, Ill., 1970. xiv, 210 pp., illus. $16.50.

There are few anatomists who would deny the morphologic complexity of the intrinsic cardiac innervation and the incomplete state of our information about the subject. There are fewer, however, who would attempt to add to our knowledge by applying the difficult, tedious silver staining and degeneration techniques to the problem. This monograph reports on such efforts and is thus worthy of recognition.

For the past decade, Hirsch and his colleagues have studied the innervation of the heart in a variety of animal forms from fish to man. The approach has been simple and classical. Serial sections of whole hearts or, in the case of larger forms, selected regions of hearts, have been stained with one or more silver reduction methods. The pattern of innervation has thus been laboriously traced from section to section and region to region. In some forms, these same procedures have been done following bilateral vagectomy, bilateral thoracic sympathectomy, and total denervation, some degree of verification of the normal anatomical findings being thus provided. In this specific objective, the work has achieved some success. It has affirmed the common

pattern of cardiac innervation from hagfish to primate as well as the differential distribution of the sympathetic and parasympathetic nerves, the former predominantly ventricular and the latter mainly atrial in termination. At a finer level, the extensiveness of the terminal varicosities is also described in the book, along with the fact that every muscle cell appears to receive a nerve terminal. This point can be verified in the micrographs in spite of the somewhat murky reproduction of many of the illustrations.

The broader objective of the work, however, is to provide the anatomic details which "are necessary for a reevaluation of cardiac physiology in health and disease." It is in the attainment of this goal that the book has fallen short. The same decade which saw the light microscopic studies of Hirsch also saw the fluorescent histochemical amine studies of the Karolinska group and the more recent electron microscopic observations of Thaemert, Burnstock, and others. These works are quite pertinent to the monograph and would have made possible meaningful interpretation of the results. There was an opportunity in this monograph to demonstrate the continuity between classical and modern anatomical studies and the dependence of one upon the other. Because the opportunity was missed, because the bridge between the two morphologies was not built, the monograph fails to reveal the applicability of current anatomical knowledge to cardiac physiology and is, overall, a disappointment.

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Neuropharmacology

The Pharmacology of Synapses. J. W. PHILLIS. Pergamon, New York, 1970. xii, 360 pp. + plates. $16. International Series of Monographs in Pure and Applied Biology: Zoology, vol. 43.

At a time when synaptic pharmacology has become highly fashionable, and correspondingly complex and controversial, Phillis has dared to write a monograph covering a large part of the total field. It is clear that he is a man of courage. Moreover, the result will be valuable to investigators as well as to students. However, it should be clear that the title is a misnomer. It used to be said that a drug could be defined as a substance which, when injected into a dog, produced a paper. Now, apparently, the substances that qualify, with few exceptions, are those that can be injected microionophoretically. Thus this book will disappoint anyone hoping to be enlightened about the mode of action of anesthetics, sedatives, or psychoactive drugs, all of which presumably act on synapses. Only with the final conclusions does the author explicitly state that he was concerned primarily with studies related to compounds which are putative synaptic transmitters.

The book divides roughly into three portions. Nearly half is concerned with acetylcholine and monoamine metabolism and with peripheral cholinergic and adrenergic synapses. About the same proportion is devoted to pharmacological studies on neurons in the central nervous system. To this is added a rather straightforward account of studies of junctional pharmacology in invertebrates, and there is also some consideration of candidates for transmitter function such as serotonin, histamine, substance P, and prostaglandins.

The discussion of amine metabolism and peripheral cholinergic and adrenergic systems lies somewhere between that found in most current pharmacology textbooks and that in many recent reviews; more extensive and documented than the former, it lacks much of the detailed consideration of controversial subjects to be found in the latter. It is disappointing that the author has largely omitted calling attention to the many gaping holes that still exist in our present understanding of even the most studied systems. For example, it is only since this book was published that the ionic mechanism of the muscarinic excitatory postsynaptic potential in sympathetic ganglia has been clarified. The student reading this book would be unaware that the problem existed. Surely it is in a monograph such as this that an author has the opportunity to consider not only those questions that have been answered but also those that have not.

The pharmacology of neurons in the central nervous system is the author's own area of special interest, and he provides an extensive review of the actions on neurons of ionophoretically applied acetylcholine, catecholamines, amino acids, and other substances which can excite or depress action potential frequency. It cannot be held against the author that the main effect on the reader is one of depression rather than excitation. After so much work, by so many investigators, one feels that by now there should be some unequivocal evidence as to the identity of transmitters at anatomically and physiologically defined central synapses. Even five years ago one could accept tentatively the simplifying assumption that when a substance inhibited or excited a neuron it did so by a direct action on that cell, and perhaps by interacting with receptors for an endogenous transmitter. At the time, everyone seemed aware that any action just might be indirect, secondary to an action on nerve terminals, glia, or even neighboring neurons. Today, however, one looks in vain for experimental evidence justifying that earlier assumption. Many investigators still seem to think that it is sufficient to accumulate counts of cells excited or inhibited by this or that agent, in this or that area of the brain. Is it possible they have become committed to techniques which are incapable of providing any real answers?

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Russian Survey

Molecules and Life. An Introduction to Molecular Biology. MIKHAIL V. VOL'KENSHTEIN. Translated from the Russian edition (Moscow, 1965) by Serge N. Timasheff. Plenum, New York, 1970. xiv, 514 pp., illus. $15.

"The purpose of this book is to explain molecular biophysics to all who might wish to learn about it, to biologists, to physicists, to chemists." This is the author's preface, written in Leningrad in 1964. The author is a distinguished Russian scientist, who has himself made extensive contributions to the theory of chain macromolecules. One might expect from this that the book would penetrate to the frontiers of our present understanding of the physics of the molecules of life, but it is apparent that Vol'kenshtein had a different aim in mind. This book is a survey of the whole field of molecular biology, starting with an elementary description of "cells, viruses, and heredity," amino acids and proteins, and the code. Biophysics is represented by chapters on the physics of macromolecules, of proteins, and of nucleic acids. Even the chapters that have "physics" in their