some of it re-enters ester linkages to regenerate fat, which is transported back to the depots. All these complex reactions are so balanced that the total amount and structure of the fat mixture in depot, blood and organs remain constant."

The metabolism of phospholipids deserves a fuller treatment than they are given in this book, especially as we are indebted to isotope studies for nearly all the new and important information on this difficult subject. There is only a cursory sketch of the intensely rapid processes in which the phospholipids are fragmented into their fatty acid, phosphate and choline or ethanolamine components and as rapidly resynthesized.

Essentially the same general picture was obtained of protein metabolism. Here $N_{15}$ was the tracer most commonly used. It was demonstrated that amino acids are continually and rapidly being deaminized and reaminated. Free ammonia is extensively used for reamination. The peptide bonds of the protein chains are similarly continually being broken and reformed. Synthesis of amino acids and protein occurs both when these are abundantly supplied in the diet and when the animal is made to lose weight through inadequate nitrogen in the diet.

It has been argued by die-hard adherents of the older theory that only the so-called "reserve" or "fixed" proteins undergo this rapid disintegration and re-synthesis. Against this argument it was shown that proteins with specific functions, specific antibody proteins, for example, undergo the same rapid synthesis and disintegration as the average immunologically inert serum proteins. Recently it was proved that extensive and rapid resynthesis of protein is continually in progress even in the fasting animal. This and other evidence has destroyed the last vestiges of support of Folin's theory of "endogenous" and "exogenous" protein metabolism.

The important contribution of these studies with isotopes is that they provided direct and incontrovertible evidence for the concept of the organism as a dynamic steady state in which, for the time being at any rate, there is little utility in attempting to distinguish between the chemical changes in the structure of the engine and its fuel. Structural substance and fuel substance are continually interchanging on a large scale and very rapidly.

It is a disservice, however, to the classical pre-isotope methods of physiological chemistry to overlook, as many workers with isotopes and others do, that this concept regarding the proteins in the animal body was enunciated explicitly with a wide variety of supporting evidence before the advent of isotopes.

This criticism applies also to the claims made for the information gained regarding the formation of a variety of amino acids from each other and of urea and creatine. The isotope studies, in most instances, provided only corroborative evidence of facts which had already been firmly established and in more detail by other methods.

In fact, isotope studies have yielded little evidence regarding mechanism. In the two cases they have thrown light on mechanism, the formation of creatine and the transfer of methionine sulfur to form cystine, the same facts were established by direct evidence and in more detail, independently and contemporaneously by non-isotope methods. The latter methods also located the organs in which these changes occur.

The conclusions regarding the dynamic state of body constituents are stated in this book lucidly and eloquently. These ideas are so important that we must regret the book is too short mainly because it is a one-sided account even of the isotope evidence. A broader treatment including earlier non-isotope studies would have shown, on the one hand, more clearly the power of the new tool the physiological chemist has acquired in his use of isotopes and, on the other, the great utility and wide range of the concept of the organism as a dynamic steady state. In contrast to the mechanical nineteenth century concept it has replaced, the new concept is biological. It explains, without strain, the inter-relation between the metabolism of carbohydrate, phosphate and protein, the regeneration of plasma protein, certain aspects of the formation and disappearance of antibodies from the blood, the changing size of organs and muscles in different dietary states. The new concept has given us a view of the organism as a chemical system in which protein, fat, carbohydrate, minerals, vitamins and water are continually and rapidly interacting and yet maintain "la fixité du milieu intérieur" which is "la condition de la vie libre." Our former obscure wonder is replaced by a greater and informed humility and even greater admiration of the marvelous coordination of the complex chemical mechanisms by which living matter sustains itself.

HENRY BORSOOK
CALIFORNIA INSTITUTE OF TECHNOLOGY

## MODERN PHYSICS

*Introduction to Modern Physics.* By F. K. RICHTMYER and E. H. KENNARD. Third edition. xv + 723 pp. 234 figures. New York and London: McGraw-Hill Book Company. 1942. $5.00.

THE late Professor Richtmyer's deservedly popular text on modern physics needs no introduction to the reading public. The progress of modern physics has been so rapid during the fifteen years since the first edition was published, however, that frequent revi-

sions of a book of this character have been necessary in order to keep it up-to-date. Thus a second edition was issued in 1934, and now a thoroughly revised third edition has been prepared by Professor Richtmyer's colleague, Professor Kennard, with the assistance of several of his associates on the Cornell University faculty.

The large amount of new material which had to be included if the text was to live up to its title, raised the difficult question of what to leave out. This matter has been admirably handled by Professor Kennard on the general principle that those topics in classical physics which are adequately treated in available general texts might well be skeletonized to the parts essential for future reference or omitted entirely. Thus the historical introduction has been abbreviated from 77 pages in the first edition to 50 pages, and the chapter on electromagnetism has been confined to those topics which are requisite for the subsequent developments and which are not usually contained in general texts. A short chapter on relativity has been added, but the greater part of the book is devoted to quantum phenomena, their description and their explanation. The chapter on x-rays has been completely revised, that on nuclear phenomena greatly extended, and a new chapter on cosmic-rays has been added.

In spite of these extensive revisions the character of the book has remained true to the standards set by Professor Richtmyer in the original edition. No attempt is made to give a logically complete development of modern theoretical physics. Rather the reader's attention is focussed on the phenomena of modern physics and on the understanding of modern concepts. Simple derivations of theory—often only for special cases—are given, but all complicated analyses are omitted. In this way the reader is led rapidly to the forefront of modern physics without having his attention distracted by mathematical details, which his awakened interest may lead him to fill in at a later time.

The book is designed as a textbook rather than as a treatise or a reference work. The large number of diagrams and photographic reproductions and the excellent printing add greatly to its usefulness. It is safe to predict that this revision will be welcomed with the same enthusiasm which greeted the earlier editions.

LEIGH PAGE

# SPECIAL ARTICLES

## DEMONSTRATING THE PRESENCE OF SULFONAMIDES IN THE TISSUES[1]

A PREVIOUS communication[2] reported the development of new vehicles (penetrasols) which increased the penetration of a large variety of substances through grossly intact skin (for example, protein allergens, iron, mercury, bismuth and the sulfonamides). One of the methods used to demonstrate the penetration of sulfonamides into and through the skin was excision of the area of inunction and the use of a newly developed histochemical technique, which produces a color reaction with sulfonamide in the tissues. We herewith report the details of this new method, since we believe that it may find many general applications.

### I. ANESTHESIA AND EXCISION

Before excising the skin, general ether anesthesia was used in the guinea pigs; and local procain anesthesia in the human subjects. In the latter, the procain solution was injected around and well away from the site of the sulfonamide inunction and eventual biopsy. This is an indispensable precaution, as the presence of injected procain solution, or even fluid alone, could produce erroneous results. The line of excision was made outside and at considerable distance from the site of inunction, in order to avoid displacement of the inunction-material with the scalpel.

### II. FIXATION

The usual liquid fixatives can not be employed, as the sulfonamides might be washed out or displaced by the liquid. Dry formaldehyde *gas* was therefore chosen as the fixative. Paraformaldehyde (trioxymethylene) powder is spread over the floors of small glass beakers. These beakers are roofed either with a piece of gauze fixed by a rubber band or by a small glass lattice. The biopsy specimens are spread flatly on these sieves. The small beakers are then placed in a larger glass jar, the floor of which has also been covered with a layer of paraformaldehyde powder. The top of the jar is closed with a well-fitting glass cover. The large jar containing the smaller beakers is kept tightly closed throughout the period of fixation by means of several windings of adhesive tape around the line of closure. (The layer of paraformaldehyde powder on the floor of the small beakers and of the larger jar should be about 1 cc in depth.)

At room temperature, fixation takes place in two to twenty-four hours, depending on the size and thickness of the specimens.

Microtome cutting is best carried out immediately after fixation; but we have, on occasion, obtained

[1] This research was made possible by a grant from the Wallace Laboratories, Inc., New Brunswick, N. J.

[2] Herrmann, Sulzberger and Baer, SCIENCE, 96: 451, 1942.