THE CHEMISTRY
OF THE
AMINO ACIDS AND PROTEINS

EDITED BY

CARL L. A. SCHMIDT, M.S., PH.D.

PROFESSOR OF BIOCHEMISTRY
UNIVERSITY OF CALIFORNIA

PREFACE

During the past twenty years information regarding the properties and the behavior of the amino acids and proteins has not only expanded considerably, but has also increased in exactitude. Extensive investigations have been directed to the study of the physico-chemical and thermodynamic properties of amino acids and proteins. This information has done much towards promoting a better understanding of these substances in life processes.

The hypothesis of the zwitterion structure of amino acids is now so generally accepted that it is no longer regarded as a theory. Better methods for isolating and synthesizing amino acids and peptides have been devised. Nutritional studies have not only shown the indispensability of certain amino acids, but have also led to the discovery of hitherto unrecognized ones. Important progress relative to the metabolism of the amino acids in the animal organism has been made. The cooperative efforts of biochemists and immunologists have brought out the importance of the chemical constitution of proteins to immunological specificity.

As is the case with other scientific subjects, the desired information as to the behavior of the amino acids and proteins is by no means complete. Large and important gaps need to be filled. A perfect method for hydrolyzing proteins that does not lead to destruction of or changes in the component amino acids has still to be devised. Very few analyses of the amino acid content account for all of the nitrogen present in proteins. This is probably due in part to the inaccuracies of the available analytical methods. Although better methods for synthesizing many of the amino acids have been described, the methods whereby racemic amino acids may be resolved into the optically active components have not been improved so as to give approximately quantitative yields.

The stereochemical structures of the proteins are unknown. With the discovery of the presence of carbohydrate-containing groups in certain of the proteins, the problem has become more complex. However, some progress in this direction has been made with the development of the carbobenzoxy method for synthesizing peptides and the application of the X-ray method to the analysis of chemical structure. Information regarding the mode of combination

of the metallic elements with proteins, both from a qualitative and quantitative standpoint, needs to be expanded. Thermodynamic and physico-chemical constants for some of the amino acids and for many of the proteins are still to be determined. Many of the studies relating to the physico-chemical behavior of amino acids and proteins have been carried out on dilute solutions. Experimental work in which the concentrations of these substances simulate those found under natural conditions needs to be carried out. Nutritional studies on amino acids have, in large part, been limited to the requirements of the rat. The needs of other species of animals still await investigation. The precise chemical constitution of biologically important substances such as the toxins and antitoxins, certain of the hormones, and the enzymes, all of which are probably protein in nature, needs to be determined. An adequate knowledge of many of the problems in biology awaits a more thorough understanding of the behavior of the amino acids and proteins.

The literature appertaining to the various aspects of amino acids and proteins is so scattered that it has appeared worth while to collect the information and to present it to the reader in an integrated form. Whenever possible, fundamental and important data have been collected and presented in graphical or tabular form. The importance of data that have been obtained by sound procedures cannot be overemphasized. The presentation of available data will incidentally serve as a guide to the gaps which are still to be filled.

A discussion of the chemistry of the enzymes might properly have been included within the scope of this book. This would have necessitated expanding an already large volume. The subject has therefore been presented only so far as it may relate to the structure of certain peptides.

For purposes of convenience, most of the organic formulas given in the text have been presented in the orthodox manner. It is recognized, however, that in the future these formulas may have to be written in conformity with the views expressed by Lowry and Sugden and by Sidgwick.

The present treatise represents a cooperative effort on the part of a group of individuals whose scientific interests lie, in large part, in the field of the amino acids and proteins.

Our thanks are due to those who have so generously given of their time and efforts in contributing to this volume. Without their cooperation our task would not have come to fruition. We are in-

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CARL L. A. SCHMIDT

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SECTION IX. MAGNETIC AND DIAMAGNETIC PROPERTIES

SECTION X. THIXOTROPY

SECTION XI. MELTING AND DECOMPOSITION POINTS OF AMINO ACIDS

SECTION XII. ANISOTROPY

SECTION XIII. THE HOFMEISTER IONIC SERIES

SECTION XIV. ANTAGONISM OF IONS

SECTION XV. LIESEGANG RINGS