



# CRYSTALLINE ENZYMES

BY JOHN H. NORTHROP, MOSES KUNITZ  
AND ROGER M. HERRIOTT

*SECOND EDITION, REVISED  
AND ENLARGED*



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## PREFACE TO THE SECOND EDITION

WHEN the Jesup Lectures were delivered in 1938 ten enzymes had been isolated, crystallized, and found to be proteins. Nevertheless, the protein nature of these compounds was still a very controversial subject. Those workers who had themselves isolated enzyme proteins were convinced that the crystalline proteins obtained actually represented the enzymes in pure form, but most other workers were somewhat skeptical. At the present time about thirty-five enzymes have been obtained as crystalline proteins and the identity of the enzyme and the crystalline protein has been widely accepted. The chemical structure responsible for the activity and the question as to whether or not prosthetic groups are necessary is, however, still under discussion.

The protein nature of some viruses at least has also been pretty well demonstrated. As a result three hitherto apparently independent problems, the formation of proteins, of enzymes, and of viruses, which are of the first importance for the comprehension of the mechanics of living matter, have been reduced to a single problem—the mechanism of the synthesis of proteins in general.

The subject matter has been restricted, as in the first edition, to work carried out at the Laboratory of General Physiology of The Rockefeller Institute for Medical Research at Princeton, New Jersey, or to closely related subjects.

General reviews may be found in Sumner and Somers, *Chemistry and Methods of Enzymes*, in Nord and Weidenhagen's *Handbuch der Enzymologie*, and in the various volumes of *Ergebnisse der Enzymforschung* and *Advances in Enzymology*.

The authors are indebted to Miss Jocelyn Farr for valuable assistance in the preparation of this manuscript.

Laboratories of The Rockefeller  
Institute for Medical Research  
Princeton, New Jersey  
November, 1946

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## PREFACE TO THE FIRST EDITION

THE present monograph is based on the Jesup Lectures given at Columbia University in the spring of 1938. It contains the results of a series of investigations on the isolation and chemistry of bacteriophage and the proteolytic enzymes carried out in the writer's laboratory. Bacteriophage has not been crystallized and may not be an enzyme, but the results of the experiments with bacteriophage are essentially similar to those obtained with the enzymes and are, therefore, included in the present volume.

The problems presented formidable technical difficulties, owing partly to the unstable nature of the enzymes and partly to the large quantities of material which it is necessary to handle. The results are in large part due to the ability and perseverance of my collaborators, Dr. M. Kunitz, Dr. M. L. Anson, Dr. Roger M. Herriott, and Dr. A. P. Krueger. The work has entailed also a very great amount of analytical and preparative procedure for which acknowledgment is due to faithful technical assistants, especially to the late Mr. Nicholas Wuest, to Miss Margaret MacDonald, and to Miss Elizabeth Shears, who has also been most helpful in the preparation of the manuscript.

I am indebted to the *Journal of General Physiology* for permission to reproduce the figures and photographs used.

References to the older literature will be found in the original papers.

JOHN H. NORTROP

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Princeton, New Jersey  
September, 1938*

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