Ultrastructure of Bacterial Viruses

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Анна Сергеевна Тихоненко
УЛЬТРАСТРУКТУРА ВИРУСОВ БАКТЕРИЙ
UL'TRASTRUKTURA VIRUSOV BAKTERII
ULTRASTRUCTURE OF BACTERIAL VIRUSES

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This book is
dedicated to my mother
Aleksandra Davydovna Sheinina

Introduction

After the discovery of the tobacco mosaic virus by D. I. Ivanovskii in 1892 [14], the new science of virology was born and began to develop rapidly.

The number of viruses now known is enormous and they can infect nearly all animal and plant organisms. Microorganisms themselves are no exception to this rule.

Despite intensive study of viruses, their origin and nature are still a subject for speculation and hypothesis.

The general concept of viruses embraces a wide group of biologically active structures occupying an intermediate position between living and nonliving matter. The dual character of viruses is determined by the fact that, while they do not possess an independent system of metabolism, which is a characteristic feature of every living being, they nevertheless carry within themselves all the necessary information for autoreproduction.

A striking feature of the virus is that it consists essentially of two components: a protein envelope and the nucleic acid contained within it.

In contrast to the elementary structural unit of the living organism, the cell, which contains two types of nucleic acid (DNA and RNA), the virus particle contains only one type of nucleic acid – either DNA or RNA. It is perhaps this which is responsible for the imperfection of the virus as a living organism.

Unlike living cells, viruses cannot reproduce by any way known for cellular organisms (by division or gemmation). For their reproduction they utilize the energy resources of another,

more highly organized, living system. After infecting the host cell, viruses lose their morphological individuality, and they do not persist as specific structures throughout their cycle of development. The formation of individual structural components of the virus takes place separately within the cell, and it is only at the final stage of intracellular development that they come together to form the mature virus particle.

An extremely characteristic feature of viruses is the strict consistency of their shape and size.

Early electron-microscopic investigations established that most viruses of animals and plants are either rod-shaped or spherical.

In 1941, Ruska [320] showed for the first time that the viruses of bacteria, or bacteriophages, as a rule, are particles of characteristic shape resembling spermatozoa.

The relatively simple organization of viruses, carrying their own genetic system providing for autoreproduction and variation, has attracted the attention of investigators seeking to solve fundamental biological problems.

Bacterial viruses, because of their comparative accessibility and the simplicity of working with them, have proved to be the most convenient viruses for analysis of major virological and general biological problems.

Bacteriophagy as a general biological problem has developed rapidly in the last 20-25 years and has attracted specialists in different fields of science. It should be pointed out that the progress made in many of the fundamental theoretical problems in modern biology is largely bound up with the study of phages. In recent years, phages have occupied the center of the stage as a model for the study of the basic problems in molecular biology. It was this model which was used for classical investigations to study the fine structure of the gene, to decipher the genetic code, to study the mechanism of transmission of information for protein synthesis and so on.

The study of the macromolecular structure of phages is accordingly of considerable interest. It forms the subject of this monograph, which is based largely on the results of investigations carried out by the author and her collaborators.

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