

# I

## Architecture and Operation of the Nervous System

It is essential that all investigators of the nervous system understand the principles of operation of the neural machinery that they are investigating. Usually this research is being carried out on some small component that is isolated for study by highly sophisticated techniques, for example, in neurochemistry, neuroimmunology, or electron microscopy. The study may even be at a more elemental level with such techniques as homogenization of some brain constituents such as cerebral nuclei and the isolation from fractions of the homogenates of interesting molecules such as, for example, enzymes or other proteins and putative transmitters or related molecules. The aim of this kind of investigation is to construct metabolic systems that are vitally concerned in chemical synaptic transmission. This important field of inquiry will be dealt with extensively in Part II of this book. In order to achieve neurobiological meaning, however, the detailed accounts of neurochemical and neuropharmacological studies must be related to the structure and operation of the neural machinery of the brain.

In Part I this information is presented in four chapters. It will not be a bare factual treatment. Rather, the attempt is made to outline the important historical events and to show the growth of understanding that occurs with a progressively changing problem situation. Too often it is erroneously believed that science consists of the discovery and presentation of facts. On the contrary, it is concerned with the attempt to understand the phenomena of nature by the development of hypotheses and their rigorous testing by experiments. We hope that this book is an exemplar of this philosophy of science, which makes science an exciting adventure both in creative imagination and in experimental investigation, two aspects of science in vital interaction.

The first chapter gives an account of the structure of the components of the nervous system: neurons, synapses, nerve fibers, glia. Special treatment will be given to organelles, both in the perinuclear region and in the presynap-

tic terminals, because of their significance in relation to the theme of Part II. The second chapter concentrates on the beautiful and efficient signaling system of nerve impulses. In the third chapter, synaptic transmission is studied in two locations of peripheral nervous systems because at these favorable sites the principles of operation have been investigated with great precision. When established in this way, it was possible to show that similar principles obtained with transmission at some synapses of the central nervous system that were amenable to comparable investigations. For example, the quantal composition demonstrated for the end-plate potential could be recognized with central synapses (cf. Figure 4.3, Section 4.2). The fourth chapter comprises a wide range of investigations on excitatory and inhibitory synapses, and finishes with a description of some simpler neuronal pathways. This will serve as an introduction to the much more complex situations in Part III.