Social insects, in particular the social Hymenoptera, have an almost inexhaustible behavioral repertoire. Many of their abilities, such as navigation using patterns of light polarization in the sky, communication using a language based on movement symbols, the perception of color, form and scent, the ability to learn rapidly and their capacity for long term memory, have continued to amaze and inspire scientists working in this field. If one considers that all these behavioral capacities are controlled by a tiny brain, seldom greater than 1 mm$^3$ in size and generally composed of less than $10^6$ neurones, one must assure that during the process of evolution, extraordinarily economical and effective mechanisms for the control of the many varied behaviors of these insects have been developed.

What are the neuronal mechanisms? In 1965, Bullock and Horridge in their 2 volume work on "Structure and Function of the Nervous System of Invertebrates" wrote "there is hardly any physiological data on the neurons mechanisms which make possible these varied responses". The situation has changed considerably over the last decade. Substantial progress has been made possible as a result of a concentration of interest by neuroanatomists, neurophysiologists and behavioralists on an animal initially used under great success by Karl von Frisch (1966), namely the honey bee Apis mellifera.

The structure and organization of many parts of the bee brain (retina, first optic ganglion, mushroom bodies) are already well understood, and with the help of the new neuroanatomical methods and intracellular marking techniques now available, the knowledge available concerning these and other regions of the brain continues to increase. A crucial contribution to this symposium is the presentation and discussion of the latest neuroanatomical findings, and the application of these findings to the derivation of models to explain brain function. For the first time, it is possible to formulate hypotheses
concerning the flow of information and the strategies of neuronal integration in the brain of the bee based on neuroanatomical data, and to compare them with results obtained using neurophysiological and behavioral methods.

Over the last 10 years, electrophysiological studies have provided considerable information about the brain of the insect. In the bee brain, research involved, above all with visual integration and multisensory assimilation of information in the brain, has been particularly successful. Mechanisms involved in color and movement coding, the modulatory effect of sensory inputs on one another, and the role played by particular neuropiles such as the mushroom bodies and the central body, have been investigated with the help of intracellular recording of neuronal responses in identified neurones. Although such analyses are still a long way from providing a full understanding of the mechanisms controlling behavior in insects, the combination of many such investigations does allow increasingly precise models to be constructed.

Learning and memory play a central role in the control of behavior in social Hymenoptera. Since the fundamental experiments of Forel (1910) and von Frisch (1914), conditioning techniques have not only been applied for many decades and with great success to studies of sensory physiology, but in the last decade, have led also to the accumulation of considerable information concerning the analysis of events involved in learning itself. There are incredible and unexpected parallels between the process of learning in bees and in mammals including man. The question of the neural basis of memory function represents another central point of presentations and discussions of the symposium. The particular suitability of the honey bee as an experimental animal, the combination of behavioral studies, electrophysiological and neuropharmacological methods have enabled initial insights into these questions.

Neurobiology is an exciting research area with rapid development of new concepts and methods. Neurobiologists working with social Hymenoptera contribute considerably to the excitement because their experimental animals provide both behavioral complexity and experimental accessibility to the neural circuitry. In the near future it is to be expected that studies particularly on the honey bee will become even of greater importance for neurobiology in general.


