Chapter 4

Demonstration of Neurosecretory Cells in the Insect Central Nervous System

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The neurosecretory cells (NSC) of insects were first described more than 40 years ago as *drüsenartige Nervenzellen* in the pars intercerebralis of the honey bee *Apis mellifera* (Weyer, 1935). However, the study of insect neurosecretion progressed slowly during the years 1930–1950. Only after the introduction of Gomori's methods in the 1950s [first Gomori’s chrome hematoxylin by Bargmann (1949) and then paraaldehyde-fuchsin by Gabe (1953, 1955)] was the study of the insect neurosecretory system (NSS) intensified. Extensive studies of this period, which were later summarized in Gabe’s (1966) monograph, led to the concept of the universal occurrence of the NSC in insect nervous systems and allowed the establishment of a generalized scheme of their distribution in the brain and, to a lesser extent, in the thoracic and abdominal ganglia.

In the 1960s and 1970s, several histochemical, electron-microscopic, radioautographic, immunohistochemical, and other experimental methods were introduced specifically for the study of insect neurosecretion. The characteristic investigations of this period are, for example, those by Highnam (1961) and by Girardie and Girardie (1967) on locusts, by Schooneveld (1970) on the Colorado beetle, by Kind (1964, 1968) on several Lepidoptera, as well as by Raabe (1965) on thoracic and abdominal neurosecretion in several insects.
However, detailed studies of the NSS in specimens of a single species were somewhat negative in their contribution to the idea of an essential peculiarity of the NSC composition in each of the species studied. Thus, the concept of the insect NSS was in contrast to that of other organ systems of insects, which were characterized by a certain degree of generality in their organization within a given class.

At present, extensive comparative studies of the NSS of differently related species appear to be necessary to solve this problem. This comparative method of investigation is of great value because it not only allows the investigator to establish common characters of the NSS of a given insect group; it also permits a more objective study of the composition of the NSC in each species, sharply distinguishing age, sex, physiologic, and other species-specific characters.

A significant discrepancy often occurring in the data of different authors on the composition of the NSS (not only between related species but also within one and the same) seems to a great extent to be determined by differences in their staining methods. That is why the main task of this chapter is to report the known staining methods, to compare them, and to recommend those that allow the investigator to reveal the maximum diversity of NSC composition in secretory products so that they may be a basis for comparing the data obtained by different authors.

Methods for NSC Detection

In Vivo Observations

Neurosecretory elements can be revealed as bluish-white or yellowish-white opalescent spots when the NSC or neurohemal organs contain large amounts of the neurosecretory material (NSM) and when the ganglion sheath is thin and weakly pigmented.

The first in vivo observations on the perikarya of NSC were made by Thomsen (1948) on the imago blowfly (Calliphoridae) and by Bounhiol (1955) on Bombyx. The white-blue opalescence of the cardiac bodies was first discovered in the cockroach Blatta by Scharrer and Scharrer (1954).

The NSC become more distinct under oblique or dark-field illumination (Thomsen and Thomsen, 1954). In some instances, in vivo observations allow the apparent distinction between particular NSC types. In each half of the pars intercerebralis of Calliphora females, for example, between 7 and 8 NSC were found to have a bluish-white opalescence, and 4 NSC, a yellowish-white opalescence (Thomsen and Lea, 1968). According to their number and position, the first 7–8 NSC seem to correspond to A2 cells, and the second quartet to A1 cells, as described in stained preparations (Panov, 1976).