THE NEURONS IN THE LABELLAR NERVE OF THE BLOW FLY*

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Introduction

Sensory neurons of insects are, with few exceptions, partly enclosed by the integument from which they originate. Their dendrites grow centrifugally toward the site of stimulus reception while their axons develop centripetally and form nerve branches and finally the nerve (HENKE and RÖNSCH, 1951; WIGGLESWORTH, 1953). Unlike the interneural connection of some sensory neurons of vertebrates, the existence of internuncials in insects has not been proved outside the central nervous system. Here, the sense cells are connected directly with one or several neurons of the ganglia (SNODGRASS, 1935; WEBB, 1933, 1954). Afferent nerves of insects, therefore, should contain the same number of fibers as the sensory neurons connected with the nerve.

Studies with the light microscope indicated that the labial nerve of two blow flies [Calliphora vicina ROBINEAU-DESVOLDY (= Calliphora erythrocephala MEIGÉN) and Phormia regina (MEIGÉN)] appeared to consist of only one fourth as many fibers as the sensory neurons connected with it (STÜRCKOW, 1962). In addition, PETERS (1961 a, 1965; PETERS and RICHTER, 1963) found that each labellum of Calliphora vicina was provided with up to 30 multipolar neurons. WIESMANN (1964) confirmed these multipolar neurons for the labellum of the house fly, Musca domestica L. Thus the existence of integrating internuncials each connected with

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several sensory neurons was probable. A reduction in the number of nerve fibers compared with the number of sensory neurons was also mentioned for the antenna of *Rhodnius prolizus Stål* (Hemiptera) by Wiglesworth (1959) and of *Phormia regina* by Dethier, Larsen, and Adams (1963).

An investigation of the neural connections in the blow fly labellum was therefore approached *morphologically* by counting the axons of the nervus labialis from electronmicrographs and comparing this number with the number of sensory neurons and *physiologically* by recording the impulse patterns from the nervus labialis during stimulation of a single taste hair and comparing these with alternately recorded impulse patterns from the tip of the taste hair. Additional points of interest developed during the work.

### Material and Methods

**I. Electronmicroscopic**

Cross sections of the labial nerve of two-day-old specimens of *Phormia regina* and *Calliphora vicina* were made from a portion of the probosces free from efferent nerve fibers (indicated in Fig. 1 by the collar at the common base of the labella and the distal part of the haustellum). Portions of the probosces slightly larger than this area were fixed in either 2% osmium tetroxide in veronal buffer (Caulfield, 1957) or 2.5% glutaraldehyde in sodium cacodylate buffer (Smith, 1965) and post-fixed in 1% osmium tetroxide in cacodylate buffer. The tissues were dehydrated in an ethanol series, embedded in either pure butyl methacrylate or a 90:10 mixture of butyl: methyl methacrylate, and polymerized with ultraviolet light at 4°C or at room temperature. Sections were prepared with an LKB1 ultramicrotome, stained in aqueous uranyl acetate and lead citrate or in lead citrate alone (Venable and Coggeshall, 1965), and examined in a Hitachi HU-11 electron microscope. The number of nerve fibers was counted from composite electronmicrographs at a magnification of 9,000 (3,300 microscopic magnification) after subdividing the nerve cross section into 8 to 10 compartments. Each of four nerves was counted 8 to 10 times by marking off the axons counted on transparent sheets or on the photographs. The counting error averaged ± 2.7 axons per nerve.

**II. Lightmicroscopic**

The sense organs of the labellum were counted after transfer into 2,2,2-trichloro-1-phenoxyethanol for bleaching (Peters, 1961b, 1965) and spreading beneath the cover glass at a magnification of 200. Counting was facilitated by subdividing the labellum (Peters, 1965) into four compartments. Bleaching of the cuticle and subdivision of the labellum resulted in more dependable results than counting without these aids (compare Stürckow, 1962; and Adams, Holbert and Forgash, 1965).

The sense organs were counted on 20 labella of 20 two-day-old specimens of *Phormia regina* and on five labella of four two-day-old specimens of *Calliphora vicina*; two labella of *Calliphora* were severed from a proboscis that was studied electronmicroscopically.

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