A Mandibular Proprioceptor in the Lobster, *Homarus vulgaris*

There have been numerous studies of arthropod proprioceptive sense organs in recent years[1]. The decapod crustacea have provided many of the examples, and analyses of reflex activities involving these organs have been of prime importance in an understanding of certain aspects of behaviour[2,3]. Fundamental physiological features have also, of course, been well investigated[4].

In decapoda proprioceptors are known to occur in several situations, e.g. the walking legs[5], the antennules[6], the antennae[7], the abdomen (MRO)[8], the dorsal part of the thorax[9] and ventral abdominal soft cuticle[10]. Surprisingly nothing is known of the proprioceptive input from the appendages that provide a classical zoological study, the mouthparts. As the function of these appendages differs from that of the appendages for which proprioceptors are known it may be anticipated that some variation in receptor structure exists. We are making a survey of these receptors and report here on one system that is probably involved in monitoring movements of the mandible.

The structure of the floor of the thorax and the internal surface of the mandible in *Homarus* is basically similar to that of *Astacus* as described by SCHMIDT[11]. The mandible is hinged at 2 points and is moved by 2 sets of antagonistic muscles. The bilaterally symmetrical receptor organs arise as small branches from each inferior oesophageal nerve (Figure 1). The inferior oesophageal nerves originate at the commissural ganglion on each side of the oesophagus and run to the medial oesophageal ganglion[12]. Soon after leaving the commissural ganglion each inferior oesophageal nerve gives off a small nerve trunk that courses forward to innervate the labrum (anterior border of the mouth). A much larger nerve trunk which also runs anteriorly arises somewhat closer to the mid-line of the animal. The small outer labral nerves in turn give off a branch that progresses laterally and runs to the anterior corner of the mandible. This branch contains a small group (4 or 5) of nerve cells which innervate part of a discrete strand of tissue (Figure 2A).

The main strand extends from the posterior region of the oesophagus to the carapace at a position anterior to

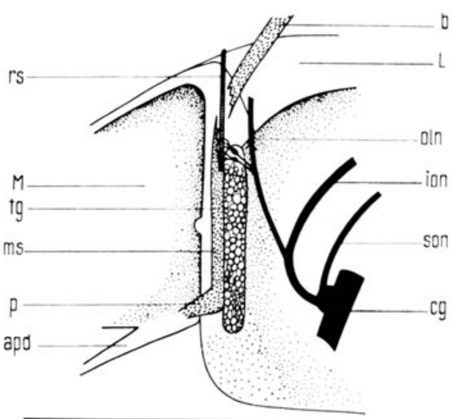

Fig. 1. A diagram of the interior of the left oesophageal-mandibular region of *Homarus vulgaris*. The main strand (ms) is attached posteriorly (p) to the apodeme of the posterior adductor muscle of the mandible (apd). It runs forward to the base of the ventral strand of the basal ocular muscles (b). Near the anterior of the tegumental gland (tg) this strand has been cut away to show the receptor strand (rs) which runs from the main strand to the carapace just above the inner anterior corner of the mandible. This receptor strand is innervated by cells which lie in the outer labral branch (oln) of the inferior oesophageal nerve (ion). This nerve and the superior oesophageal nerve (son) run to the commissural ganglion (cg) from which the connective has been cut away. All these nerves lie on the side wall of the deflected oesophagus. M, mandible; L, labrum; scale mark is 1 cm.

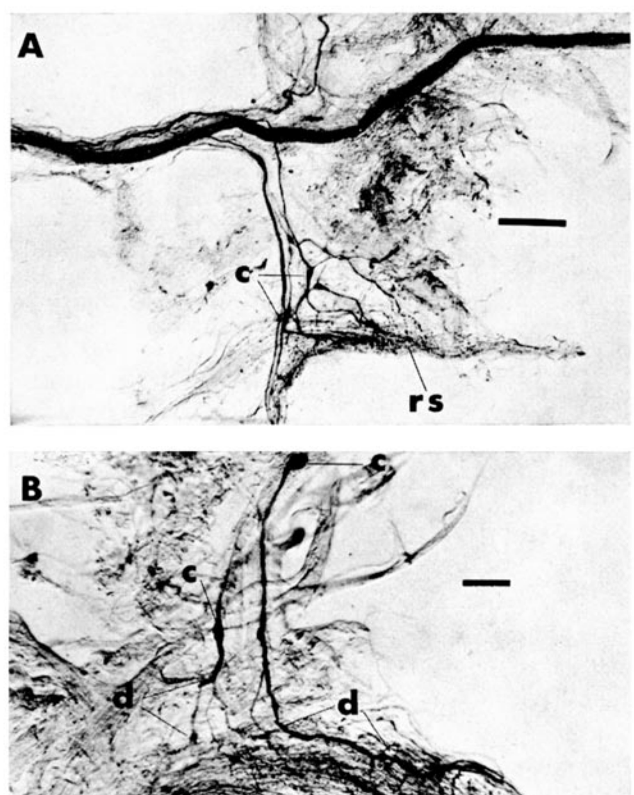

Fig. 2. Preparations of MPRI from *Homarus vulgaris* stained with methylene blue. (A) The right MPRI. The small branch from the inferior oesophageal nerve runs towards the labrum (to the right). It gives off a small branch laterally which contains a group of nerve cells (c). These cells innervate the receptor strand (rs) Scale mark is 250 μ. (B) The dendritic processes (d) of cells (c) innervating a receptor strand (rs). Scale mark is 100 μ.

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the front corner of the mandible and it also is continuous with the ventral strand of the basal ocular muscles (Figure 1). Along its length it is closely associated with the oesophagus and is also involved in the location of several other receptor systems, details of which will be described elsewhere. The receptor described here (called by us MPR 1, mouth-part receptor 1) is inserted on the ventral side of the main strand on a separate portion which lies below the main strip (nearer the anterior hinge of the mandible). This receptor strand does not appear to be muscular (having no striations) and is presumably elastic since it is stretchable.

The sensory cell bodies lie close to the strand. The axons proceed undivided to the circumoesophageal connective at the commissural ganglion. Peripherally the dendritic region is complex (Figure 2B). Each cell gives rise to a multiplicate dendritic tree which ramifies on the lower strand. The arrangement of dendritic branches is variable; some cells being classically bipolar with only distant dendrite branching; others being multipolar with one branch as axon and a variable number of other twigs innervating the receptor strand. This organization differs considerably from that of the familiar dendritic organization of the abdominal MRO[13], of leg receptors[5] and of coxo-thoracic organs[14]. Similar sensory cells are, however, well known in insects[15] and crustaceae[9].

The operative stimulus for this presumed mechanoreceptor is probably a movement of the mandible rather than of the adjacent oesophagus. Physiological investigations are in hand to determine the properties of the receptor neurones.

Zusammenfassung. Nachweis und Beschreibung eines propriozeptiven Sinnesorgans an den Mandibeln des Hummers (*Homarus vulgaris*).

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On the Brain of the Amazon Dolphin *Inia geoffrensis* de Blainville 1817 (Cetacea, Susuidae)[1]

The brain of the Amazon dolphin (Figure 1) has not yet been investigated. The central nervous system of 4 *Inia geoffrensis* (Table I) were prepared during an expedition in the tropical rain forest of Bolivia (Beni district).

Seen dorsally (Figure 2), the brain is trapezoid with rounded corners. It is widest in the posterior third of the cerebral hemisphere. The fissura sagittalis gapes at the caudal end allowing part of the dorsal cerebellum to be seen. Seen rostrally, the brain is dorso-laterally regularly rounded. The base of the fore-brain with the olfactory tubercle lies quite low towards the basal plane. The fissure of Sylvius forms an angle of 40–45° with the basal plane. Seen from the front, the temporal lobe is quite small and leaves most of the medial formations (amygdala, archicortex) uncovered. Seen caudally, the basal contours of the occipital brain form an angle of approximately 120° with the fissura sagittalis. The cerebellum extends horizontally. It is not as broad as the cerebrum and is flattened on the lower surface. The vermis cerebelli is separated

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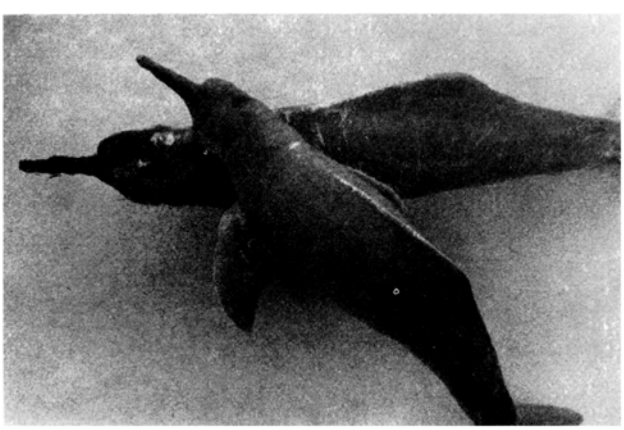

Fig. 1. *I. geoffrensis*, Photo G. PILLERI II. 1968.

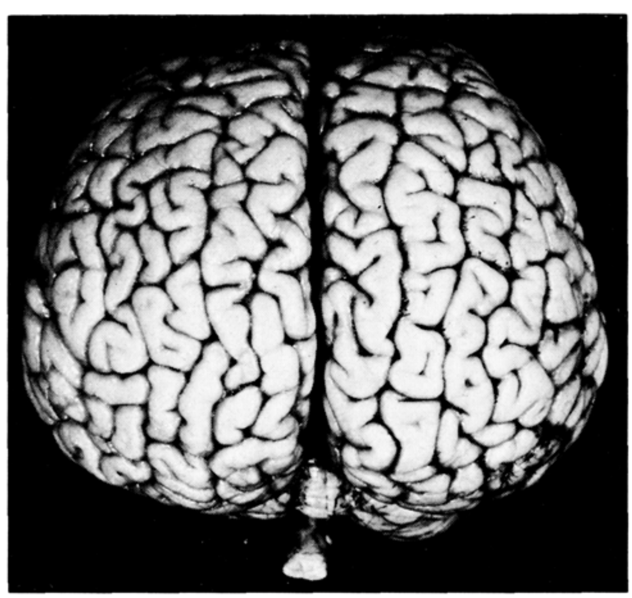

Fig. 2. Dorsal view of the brain (T 417, Collection of the Brain Anatomy Institute Waldau/Berne).