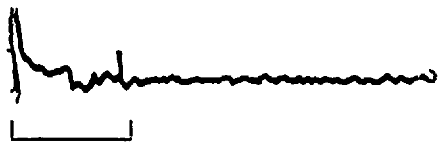
lier investigations have given contradictory results both with regard to the presence of muscle spindles and the route by which a proprioceptive innervation from the tongue should reach the central nervous system. Some authors[1–3] deny the existence of muscle spindles in the tongue muscles of the species they examined. COOPER[4] on the other hand has found spindles in man and monkey, but not in kitten or lamb. LAW[5] has presented a new type of sensory ending which she believes to be proprioceptive in nature. With regard to the route for the afferent fibres to the central nervous system the hypoglossal[2] and the lingual[6], as well as the upper cervical nerves[1], have been suggested.

Our morphological findings in the cat deny the presence of muscle spindles in the intrinsic tongue muscles and this observation, in combination with our electrophysiological experiments, rules out the hypoglossal nerve as the afferent pathway from at least the intrinsic tongue muscles. On the other hand a reflex between the lingual and the hypoglossal nerves has been found which, for the intrinsic musculature of the tongue, may to some extent substitute the proprioceptive reflex mechanism found in all other striated musculature.

Adult cats were used, either decerebrated under ether or anesthetized with chloralose (60 mg/kg body weight intraperitoneally) and some animals curarized only. The lingual and hypoglossal nerves were dissected free and cut near their entrance to the tongue. In this preparation the physiological studies were made. In some cats the tongue and the nerves mentioned were removed and prepared for morphological studies.

As stated above, it has not been possible by our morphological methods to show any muscle spindles in the intrinsic tongue musculature. This is in accordance with the calibre spectrum of the hypoglossal nerve which does not contain as many big fibres as in the muscle nerves of the extremities. Thus these few big fibres cannot account for an innervation of the rather large intrinsic musculature with ordinary muscle spindles. When stimulating and recording from the whole hypoglossal nerve no monosynaptic reflex is found with the method used. These findings indicate that the afferent pathway from the tongue receptors in the intrinsic musculature, whatever type they belong to, must be sought in some other nerve than the hypoglossal. The taste fibres and the general afferent fibres from the anterior two thirds of the tongue are known to pass in the lingual nerve. This nerve is also the afferent pathway for the linguo-mandibular reflex, first described by SHERRINGTON[7] as the jaw opening reflex and later by CARDOT and LAUGIER[8]. This reflex is considered to be nociceptive. On stimulating the lingual and recording from the hypoglossal nerve a reflex is found here called the linguo-hypoglossal.

The shortest latency of this reflex is 7 ms. It is crossed, i.e. the stimulation of the contralateral lingual nerve gives the reflex with practically no further latency. When recording is made from the whole hypoglossal nerve the reflex has two components, the first of which has a lower threshold and a bigger amplitude than the second. The fibres in the afferent path, giving the reflex, are among the fastest in the lingual nerve. To avoid possible artefacts due to simultaneous muscle twitch, the reflex has also been recorded from a single fibre preparation of the hypoglossal nerve in curarized animals (see Figure).



Curarized cat. Linguo-hypoglossalreflex, recorded in isolated filament of the hypoglossal nerve on stimulation of the ipsilateral lingual nerve.

This linguo-hypoglossal reflex, in combination with the morphological findings, indicates that the 'proprioceptive' innervation of the intrinsic tongue musculature is not arranged in the same manner as in ordinary striated musculature. A study of this reflex pathway is going on and a fuller report on its properties and relation to the extrinsic tongue muscles and their organization as well as the morphological findings will be reported elsewhere.

S. BLOM and S. SKOGLUND

Department of Anatomy, University of Uppsala (Sweden), August 2, 1958.

Zusammenfassung

Es wird gezeigt, dass der Nervus hypoglossus die afferenten propriozeptiven Impulse der inneren Zungenmuskulatur der Katze nicht leiten kann. Ein bisher nicht beschriebener Reflex zwischen N. lingualis und N. hypoglossus wird erwähnt und seine eventuelle Bedeutung für die Propriozeption der Zunge wird besprochen.

[1] J. D. BOYD, J. Anat. *72*, 147 (1937).
[2] G. WEDDELL, J. A. HARPMAN, D. G. LAMBLEY, and L. YOUNG, J. Anat. *74*, 255 (1940).
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[5] M. E. LAW, Nature *174*, 1107 (1954).
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[7] C. S. SHERRINGTON, J. Physiol. *51*, 404 (1917).
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Light Sensitive Nerve in an Echinoid

Clear instances of direct excitation of untreated nerve by visible light are rare[1–3]. In *Diadema antillarum* Philippi, evidence has been presented, to show that the radial nerves are sensitive to decreases in light intensity[4].

The evidence was not conclusive, because the nerve cord was stimulated *in situ* by a relatively large light spot (some 1·5 mm in diameter) and therefore, despite the precautions taken, there remained a possibility (though a slight one) of light spreading, to affect other structures in the preparations.

We have now overcome this by a different technique (Fig. 1). Pieces of test (*T*), bearing spines and radial nerve were prepared so that a short length of the oral region of the nerve (*N*) lifted from the test, could be fixed on to a platform of cork painted mat black, which formed part of the clamping device (*C*). This portion of a preparation is shown in Figure 2.

Minute light spots (*S*) projected on to the radial nerve, were obtained by passing a beam from a tungsten filament lamp through the objective lens (*O*) carried on a microscope barrel, to the other end of which was fixed a photo-

[1] C. L. PROSSER, J. cell. comp. Physiol. *4*, 363 (1934).
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micrographic plate camera. By replacing the camera back with an opaque sheet bearing apertures of different sizes, light spots varying in diameter from 10–100 μ could be focussed sharply on to the radial nerve. These could be positioned accurately by observing the illuminated region of the nerve with a lens system (*M*). The experiments were performed in a dark room and no significant light spread could be detected from such small spots.

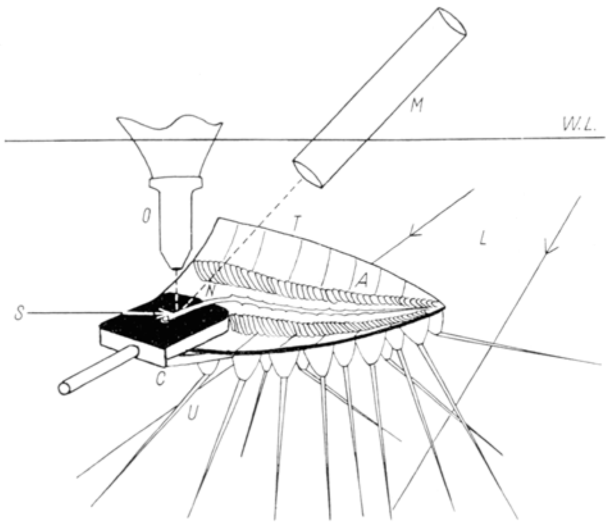

Fig. 1.—Type of preparation used. *A* ampullae; *C* clamp; *L* light beam passing below preparation and casting shadow of spines shown in Fig. 3; *M* microscope for viewing light spot; *N* radial nerve; *O* objective lens of compound microscope; *S* position of light spot; *T* piece of test; *WL* water level.

The nerve was illuminated for 5–10 min and then stimulated by interrupting the light beam with a camera shutter. The resulting response of the spines, moving in another light beam (*L*) was recorded photographically.

Preparations were immersed in aerated sea water which covered the objective (*O*) so as to avoid stray light from surface reflexion; the experimental tank and photographic procedure were as previously described[5].

Responses such as those shown in Figure 3*A* were given after illumination of either the centre or the margins of the radial nerve, but if the light spot was focussed on a point just outside the margin (in the region of the ampullae), no response was obtained (Fig. 3*B*).

Not all preparations responded and their sensitivity varied considerably, which is scarcely surprising in view of the drastic procedure necessary to obtain such preparations; but clear responses could be obtained even after 5 min illumination with the smallest light spot.

Since the response folowed rapidly after stimulation and appeared in widely separated spines, nervous excitation is clearly involved. No receptors other than nerve elements can be envisaged in the area stimulated, so that the conclusion is obvious.

We do not regard changes in temperature occurring in the radial nerve when the light spot is obliterated as significant. Experiments in which the radial nerve was replaced by a thermo-couple showed that the change in temperature which occurred during the 15 s following interruption of the light beam was less than 0·03°C.

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M. YOSHIDA and N. MILLOTT

Department of Zoology, Bedford College, University of London, July 15, 1958.

Résumé

Grâce à une méthode perfectionnée de stimulation, nous avons pu démontrer l'existence, prévue par des indications antérieures, du nerf photosensible chez l'oursin *Diadema*.

Nous avons enregistré des mouvements piquants d'après des observations au cours desquelles le nerf radial, partiellement isolé, était stimulé par des diminutions de l'intensité lumineuse, qui affectaient des parties de 10–100 μ de diamètre.

[5] N. MILLOTT and M. YOSHIDA, J. exp. Biol. *34*, 394 (1957).

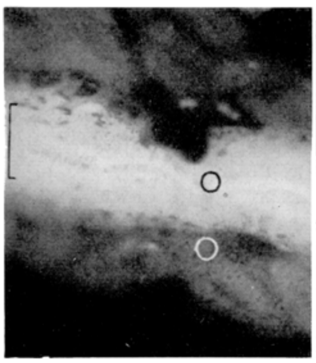

Fig. 2

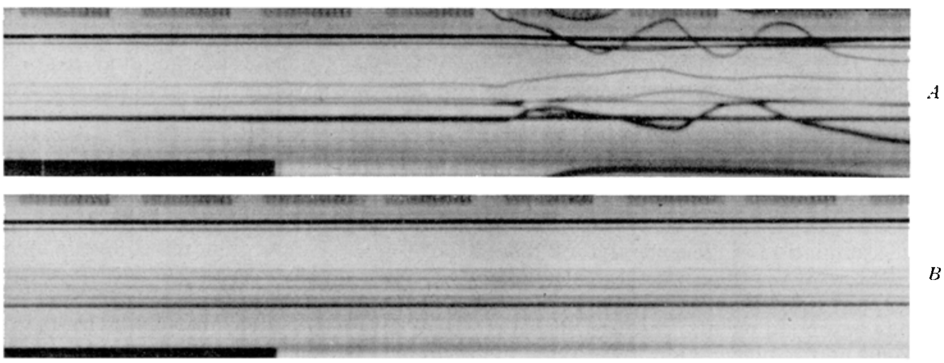

Fig. 3

Fig. 2.—Photograph showing the position of the radial nerve and associated structures that were freed from the test, in position for stimulation on the blackened platform. The radial nerve appears white. The dark areas overlying it are due to pigment. The grey areas on either side are the ampullae. The scale represents 0·5 mm.

Fig. 3.—Photograph of the shadows cast by the spines. *A* shows the effect of interrupting a light beam focussed on to the radial nerve for 10 min in the position marked by the black circle in Fig. 2. – *B* is a control experiment in which the light spot was focussed to a position just outside the edge of the radial nerve as shown by the white circle in Fig. 2.

Time scale in s. The interruption of the beam is marked by the disappearance of the black band below the tracing.