*Pholidoptera griseoaptera*, and in wingless forms such as *Lentula callani*, as well as in alate species such as *Chorthippus brunneus*. They are well developed in nymphs as well as adults and it seems likely that they have a similar proprioceptive function throughout the order.

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## Function of certain Prothoracic Hair Receptors in the Desert Locust

THE behavioural experiments of Goodman (previous communication) suggest that registration of displacement of the head relative to the body—particularly rotational movement—in *Schistocerca gregaria* is carried out at least in part by external proprioceptors, consisting of hair sensillæ on the cervical hair plates and on the anterior edge of the pronotum. This view would be corroborated if the responses of the hairs were found to be those typical of other insect hair proprioceptors, such as those described by Pumphrey[1] and Pringle[2].

Attempts were therefore made to record the electrical discharges in the nerves supplying these hair receptors while the latter were stimulated with a mechanically controlled glass needle. The hairs are innervated by branches of the second nerve of the first thoracic ganglion; using fine platinum wire electrodes and a high-impedance input d.c. amplifier, it proved impossible to record discharges in the nerves supplying the cervical hair plates, which were so fine that the necessary dissection either broke them or caused them to dry out rapidly. It was possible, however, to record discharges in the nerve supplying the hair sensillæ distributed along the anterior edge of the pronotum. A constant maintained deflexion of a single hair with a fine glass needle then produced a relatively high initial discharge frequency (200–300 impulses/sec.) which became adapted rather rapidly to a steady level of 40–50 impulses/sec., which was maintained for a long period (Fig. 1). The response was obtained to deflexion of the hairs in any direction and the initial frequency of discharge appeared to depend both on the speed and magnitude of the original deflexion; the adapted frequency, however, bore no relation to the magnitude of the deflexion, as Pumphrey[1] found in certain cockroach proprioceptors, and indeed this level was very similar in all preparations (Fig. 1). The hairs could be stimulated by gross air movements and also by pure tones in the range 100–500 c./s., if these were of sufficient intensity; in the latter case the response was synchronous with the stimulus frequency.

The responses described above are very similar to those found by Pumphrey[1] and Pringle[2] in certain insect hair sensillæ now agreed to be proprioceptors, and certainly fit the receptors for the role suggested for them by Goodman. The pronotal receptors on one side, up to the dorsal median line, are innervated by the nerve of that side; thus, with the two cervical hair plates, there are in all four hair beds, disposed in such a way that information about the equilibrium position and direction of rotation of the head relative to the body can be registered. It seems likely that the cervical plates register the equilibrium position, while the prothoracic hairs register movement; this speculation is supported by Goodman's evidence that removal of the cervical plates makes the maintenance of an equilibrium position almost impossible, while removal of the prothoracic organs only partially reduced this ability.

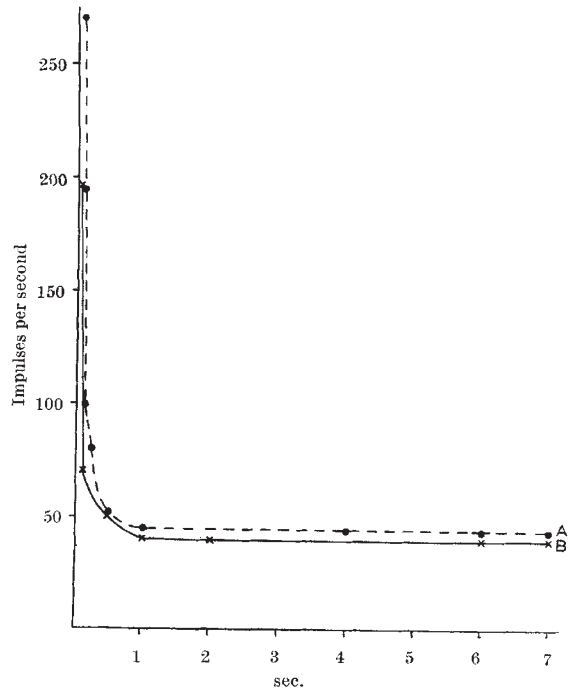


Fig. 1. Impulse frequency elicited by constant deflexion of single prothoracic hair receptor plotted against time after onset of stimulus; curve *A* resulted from a greater initial deflexion than for *B*

If the pronotal hair fringe is examined closely, it is found that it consists of a collar of upstanding, anteriorly sloped hairs which are only displaced by head movements in the dorso-ventral plane or by extreme angular rotations, and also a number of hairs on the underside of the edge of the pronotum which would appear to be displaced by any movement of the head relative to the body. Since the hairs in the collar-like fringe are deflected by wind when the locust is in flight, it would seem that proprioceptor functions in the air are carried out by the hairs under the edge of the pronotum. Histological preparations of the hairs (for which I am indebted to Miss K. M. Becker) show no apparent differentiation between the organs on the upper and under sides of the edge of the pronotum nor indeed from certain other, presumably tactile, hairs found elsewhere in the locust; the nerve fibre ending is apparently inserted at the centre of the hair, which accords with the fact that bending in any direction produces a response. This should be contrasted with the eccentric nerve insertion in campaniform sensillæ and in hairs responsive to bending only in one direction, noted by Pringle[3].

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Dec. 10.

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