times to about 50 per cent of that seen in controls (Fig. 1).

Although the series is small, presence of lymphosarcoma in a third of the animals in group 2 and all animals in group 3 strongly indicates that surfen is oncogenic at these dose-levels. Based on a spontaneous incidence of one per cent for group 2, p is calculated as 0·000080 and for group 3 as 0·000001.

Absence of sarcomata in group 4 may be explained by the suppressing effect oncogenic substances exert on neoplasia in high doses[4], and by the resistance of malnourished and/or vitamin-deficient animals to tumour development[3]. The findings, in 2 animals of group 1, and 3 animals of group 2, suggest that a prolonged test-period would result in increased tumour induction even at the low dosage in group 1. The oncogenic property of surfen is supported by its hyperplastic effect on gastro-intestinal mucosa. Tumours have not been observed before in this colony of Swiss mice. Although we accepted the manufacturer's chemical description of surfen, we did subject the substance to fractionation in an attempt to disclose oncogenic impurities. The product was homogeneous. Environmental factors would have probably induced neoplasia with equal frequency in the control colony and in group 1. The quinolines have not previously been incriminated in oncogenesis, except in the styryl complex[2], and indeed have displayed oncolytic properties[5].

The other changes observed indicate that surfen interferes with food and/or vitamin utilization. Similar changes are seen in vitamin-deficient animals but not in starved animals[1]. Although the diet was not enriched with vitamins, food intake was sufficient in all groups to maintain health in untreated animals. The liver pathology was suggestive neither of starvation nor of hepato-toxic effect.

Coagulation work performed using heparinized rabbits pre-treated with surfen indicated moderate heparin-neutralizing effects. Surfen is apparently slowly and imperfectly absorbed in the digestive system, and shows activity only if given several hours in advance of heparinization. In this respect, it is inferior to protamine sulphate.

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NERVE ENDINGS IN THE MOLE'S SNOUT

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CONCENTRATED in a small area of hairless skin at the tip of the snout of the near-blind mole are numerous cutaneous nerve endings. In all probability they play an important part in facilitating path-finding and feeding while the animal is either on or below the surface of the ground.

During waking hours the snout is constantly used in a probing fashion (accompanied by head movements) to explore the immediate environment, although the general direction of the animal's movements towards food or away from danger is presumably plotted beforehand in response to olfactory and vibratory sensations. A memory system must also be involved as even when traversing unaccustomed territory the animal may only deviate momentarily from its set course in order to circumvent local obstacles. Observations during life confirm that the snout region is markedly pink in colour and that it is also freely mobile. They also suggest that it is semi-erectile in character since during periods of hyperactivity or stress it assumes a redder hue and becomes more prominent (for example, as during obligatory swimming, when the animal progresses at a great speed and holds its snout well above the water-level). After death, the snout becomes paler and diminishes in size. However, it is not known whether such local circulatory changes could affect the character of responses from nearby nerve endings sensitive to external physical stimuli[7].

At present light-microscope work using *Talpa europaea* has confirmed the classical work of Eimer[4] that there are, in the snout region, many profusely innervated epidermal papillæ passing into the dermis (the so-called 'Eimer's organs'). The presence of encapsulated nerve endings near the deep aspect of Eimer's organs has been recorded by Ranvier[10], Bielschowsky[1] and Boeke[2]. More recently Cauna and Alberti[3] have denied the presence of encapsulated

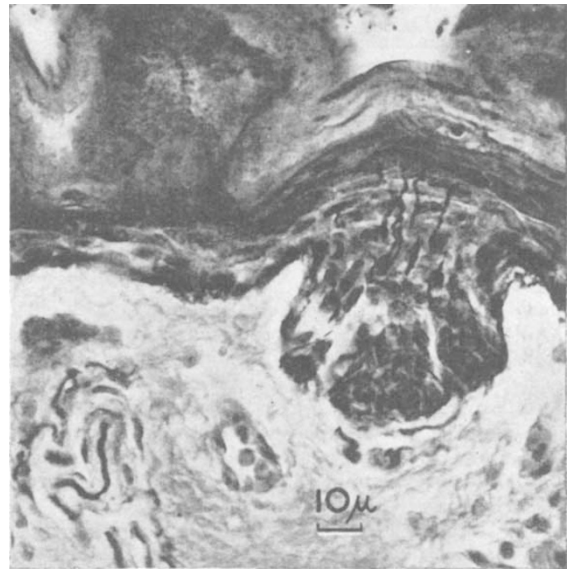

Fig. 1. Vertical section through the skin of the tip of the mole's snout. An Eimer's organ lies to the right. Part of the dermal plexus supplying it and some of the nerve 'terminals' within it can be seen. An encapsulated nerve ending of an unnamed variety lies to the left and intervening between these two structures is a blood sinus. (This material, together with that shown in Fig. 2, was stained by a modified Cajal method)

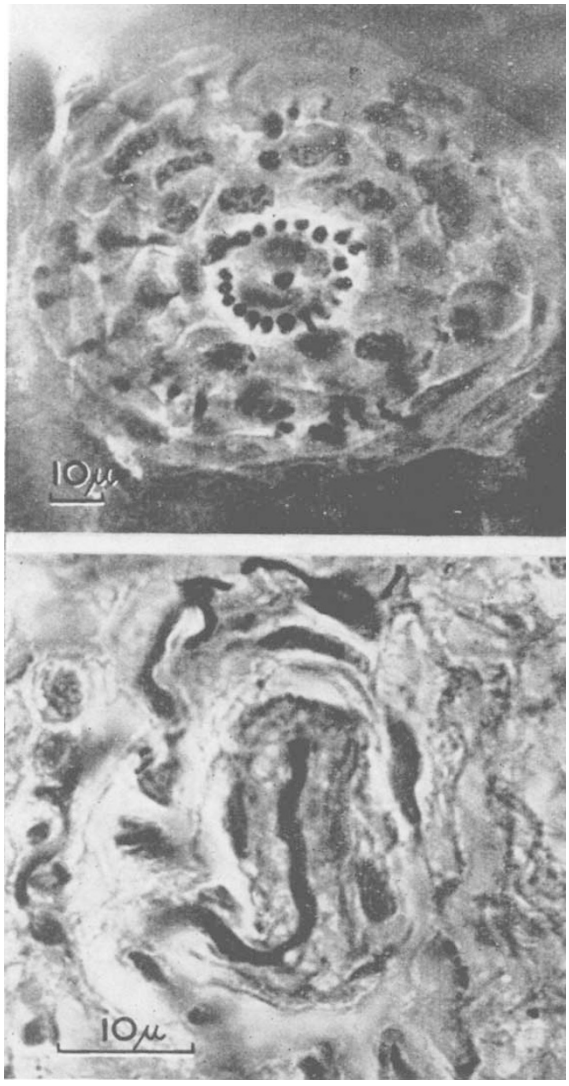

Fig. 2. Above, transverse section through an 'Eimer's organ' showing the axial nerve terminal closely related to paired cells of an inner core. Satellite nerve terminals are arranged circumferentially in a clear annular space. Lying peripherally are the epidermal cells that constitute the bulk of Eimer's organ.

Below, longitudinal section (high power) through an encapsulated nerve ending of an unnamed variety showing a single central axon surrounded by a comparatively simple core and an ill-defined capsule

nerve endings in this region, and have suggested, by implication, that the Eimer's organs are themselves multi-purpose transducers. The present work, together with unpublished electronmicroscopic findings (Quilliam), clearly demonstrate the presence of encapsulated nerve endings of an unnamed variety in the dermis and have considerably amplified the original descriptions and hand-drawn illustrations of them published 35–90 years ago[1,2,10].

The importance of the present findings lies in the fact that it is now no longer necessary to attach an extraordinary functional significance to the Eimer's organs, and in particular, to ascribe to them the unique ability of subserving a comprehensive spectrum of cutaneous sensory modalities.

Fig. 1 shows a vertical section through the skin of the tip of the mole's snout.

Above can be seen the undulating profile of the epidermal surface and towards the right is an Eimer's organ in longitudinal section. A few of the fibres of a dermal nerve plexus supplying it from below are visible and a number of ascending nerve 'terminals' (or possibly 'pre-terminals') can be seen traversing it vertically on their way towards the more superficial layers of the epidermis. Located below and to the extreme left is an encapsulated nerve ending the long axis of which in the photomicrograph illustrated happens to be orientated vertically. It is separated from the Eimer's organ previously identified on the right by a blood sinus.

Fig. 2 (above) depicts a typical Eimer's organ in transverse section. A single nerve terminal, axially, is clearly seen to be surrounded by an array of circumferentially disposed satellite nerve terminals. The latter are situated in a clear annular zone that separates the outer core of epithelial cells from the paired cells of the central core which themselves closely invest the axial terminal. The unusually orderly pattern of these grouped nerve terminals may well form a satisfactory structural basis for the fine tactile discrimination that the mole practises during normal activity. Unfortunately, it has not yet proved possible to differentiate histologically between axial and satellite nerve terminals except in respect of diameter measurements and of their relative positions within an Eimer's organ. Consequently, it is not known whether any of the satellite terminals are collaterals of the dermal fibre which is in continuity with the axial terminal. In view of the many bundles of myelinated fibres present in the dermis it would appear likely that every Eimer's organ is innervated by several myelinated fibres. The relatively large number of satellite terminals in an Eimer's organ further suggests that at least some of the dermal fibres supplying it must branch prior to entry into its deep surface—presumably in a subjacent nerve plexus.

Fig. 2 (below) is an enlargement of the encapsulated nerve ending shown in Fig. 1. The capsule is rather poorly differentiated, and the core tissue surrounding the nerve terminal is somewhat scanty. However, nuclei can be made out in the latter on either side of the terminal (at 4.o'clock and 9 o'clock) and several small granules can also be distinguished (at 12 o'clock). The single nerve terminal is almost straight once it has entered the core and ends without visible structural modification. Since some of its morphological features suggest that it belongs to an unnamed type of ending not adequately described hitherto its fine structure will be described elsewhere (Quilliam).

The cellular organization of these encapsulated endings exhibits both certain similarities to and a number of divergences from the pattern typical of the Pacinian corpuscle in the cat. However, it may be tentatively assumed that, functionally, the former behaves like the latter in responding to high-frequency pressure changes[5,6,8].

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