events may be regarded as a further argument for spatial and functional differences in their origin[4,6].

For a given stimulus interval the minimal amplitude of generator potential at which firing of propagated potentials occurs (firing height) is fairly constant. The firing height increases progressively as the interval is shortened during the relative refractory period. The increase in firing height and the reduction in amplitude of the refractory generator potential determine the threshold rise during the corpuscle's relative refractory period.

The generator potential set up in response to a single mechanical stimulus decays to zero in 4–8 msec. The decay time is constant for a given receptor and is independent of duration of stimulus. However, the spontaneous decay of generator potential is not due to the receptor's incapacity for sustaining a generator potential, since with repetitive mechanical stimulation of the corpuscle at, for example, the rate of 900 stimuli per second a generator potential is built up which shows no decline over 100 msec. of observation. A mechanical component in adaptation[7] may account for the spontaneous decline in generator response.

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Variations in Axonal Diameters of Myelinated Nerve Fibres: Apparent or Real?

IN a paper read to the Anatomical Society of Great Britain and Ireland on November 29, Miss B. Higgs, of the Royal Free Hospital School of Medicine, put forward clear evidence that fixatives may affect the relative diameters of a nerve fibre in the nodal and internodal regions. Although readily accepting her findings, which provide at least a partial explanation for the differences in axonal diameters seen in fixed material, it is obvious that such a fixation artefact cannot explain the apparent diameter variations recorded as existing in living nerve fibres by de Renyi (1929).

It had occurred to me that the highly refractile myelin sheath might act as a lens and magnify the internodal portions of axon, making them seem abnormally wide in comparison with the uncovered axon in the nodal regions. To illustrate this point, on the same day I showed to the Society a lantern slide depicting a simple piece of apparatus which I had made. This consisted of a black rod (axon) partially enclosed in a water-filled glass tube (myelin sheath). The enclosed portion of rod presented a diameter some 30 per cent greater than the un-enclosed portions (Fig. 1). It may well be that a myelin sheath would indeed act in this way in living tissue,

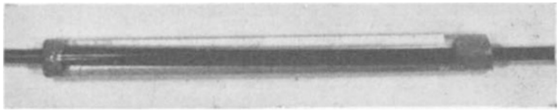

Fig. 1

and it is possible that 'fixed' myelin may have an even higher refractive index and produce even greater magnification of the internodal portions of the axon.

Since nerves are extensile structures then they must possess the ability to recoil. This property may be invested, in part at least, in the myelin sheath; and, in teased preparations, the myelin sheaths, by virtue of this recoil mechanism, may cause actual shortening and broadening of the internodal axoplasm without exerting a similar effect on the nodal axoplasm.

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QUANTITATIVE histological methods are employed in the study of the myelinated fibre population of peripheral nerve and frequently a histogram is constructed to demonstrate the myelinated fibre diameter size frequency distribution. For this purpose fibres are grouped according to calibre, based upon measurements of diameter of the whole fibre, including the myelin sheath. Within any fibre group the relation of the axonal diameter to that of the total fibre is thought to be relatively constant. Thus, for fibres of 10–12μ, the proportion of axonal to external diameter is usually considered to be 0·7 : 1. This ratio was obtained by Donaldson and Hoke[1], and later workers[2,3], using stained transverse sections of fixed nerve, and by de Rényi[4] using intact, unfixed fibres. The results of both these techniques need correction, the former for distortion inherent in the fixation and subsequent processing, and the latter for optical effects.

When fresh teased preparations of peripheral nerve are examined microscopically, measurements of axon diameter are affected by the optical properties of the highly refractile myelin sheath and of the immersion medium. At the mid-internodal region the basic problem is that of an axon within a cylindrical convex lens of myelin surrounded by immersion fluid. The interfaces to be considered are: (i) myelin – immersion medium; and (ii) immersion medium – air.

Experiments were conducted using normal saline as the immersion fluid and lecithin as the lens matrix, the optical properties of lecithin being comparable to those of the myelin sheath[5]. Determinations of the individual refractive indices of these media gave the following values for the effective indices operative at the interfaces when considering an emergent beam: interface i, 0·89; interface ii, 0·75.

Sample measurements made on a preparation of mammalian nerve teased in normal saline: external diameter, 11μ; apparent axon diameter, 8μ. The receiving angle of the objective used, under the conditions of the experiment, was 45°. Theoretical consideration of the myelin lens system and the appropriate refractive indices, involving the construction of scale diagrams, showed that the virtual images produced by the axonal margin lie on a curve. If the most lateral point on this curve is considered, the magnification of the system is 20 per cent. Thus