A RADIAL COMPONENT OF CENTRAL MYELIN SHEATHS

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Gray (see Robertson (9, Fig. 25)) has observed the presence of a radial structure in the myelin sheaths of peripheral nerves, but so far this appears to be the only record of such a component. The purpose of the present article is to describe the occurrence and characteristics of a similar radial component in myelin sheaths from the optic nerves of rats, mice, and toads (*Xenopus laevis*). These nerves, which were fixed in osmium (1), were embedded in Araldite (2) and, after sectioning, stained with either potassium permanganate (4) or lead acetate (10).

In low-power electron micrographs of transverse sections of central sheaths, thin dense lines can be observed arranged radially across the thickness of some of the sheaths, at right angles to the lamellae. These lines (Fig. 1, arrows) tend to occur in groups and while most of the lines extend throughout the thickness of the sheaths, others extend for only part of the distance (Fig. 1). Within each group the lines show a fairly regular spacing, the distance between adjacent lines usually being 300 to 400 A.

At higher resolution, it is apparent that the lines are not continuous, but are composed of a series of thickenings of the intraperiod line (Fig. 2, arrows). At the site of thickening the width of the intraperiod line (Fig. 2, *I*) increases from 20 to 30 A to 40 to 50 A, the extent of the thickening along the intraperiod line being about 60 to 90 A. A somewhat similar appearance has also been observed in longitudinal sections of sheaths, which indicates that the thickenings have a disc- or plaque-like structure. It should be noted however (Fig. 2) that the lamellar spacing of the sheath does not increase at the site of the thickenings which encroach upon the light layers of the sheath, between the intraperiod (Fig. 2, *I*) and major dense (Fig. 2, *D*) lines.

In the present observations on myelin sheaths in optic nerves, and those of Gray (3) on sheaths in the cerebral cortex, the most common site for these radial thickenings of the intraperiod line is in that part of the sheath lying under the cytoplasm of the tongue process (Figs. 1 and 2, *T*) on the outside of the sheath (5–7). Radial thickenings are not confined to this situation, however, but also occur quite commonly in the following sites:—

(*a*) In regions where cytoplasm, other than that of the tongue process, is present in the outer turn of the sheath.

(*b*) In regions where the outsides of adjacent sheaths either come into contact or lie side by side (Fig. 1 at 1).

(*c*) In relation to the internal mesaxon. In the majority of sheaths, the tongue process and the internal mesaxon are found in the same quadrant of the sheath (8), in which case the radial thickenings are related to both (Figs. 1 and 2) but when the internal mesaxon and tongue process are in different quadrants of the sheath, radial thickenings may be related to either one or both of them.

Radial thickenings have been observed elsewhere than in the situations cited above, but their occurrence in other places is much less common.

It should be emphasized that although these radial thickenings of the intraperiod line are not present in every sheath, they occur quite regularly in sheaths from the optic nerves of adult rats and mice, although they are found less frequently in the optic nerves of adult toads. The radial component has also been observed in developing sheaths from 7- and 14-day postnatal rats.

It is clear from Fig. 1 that the radial thickenings are not present on the same side of each sheath, so that they are not cutting artifacts. Further, the sheaths showing the radial component are distributed throughout a block of tissue and, as pointed out above, the sites of thickening of the intraperiod line are most commonly confined to certain regions of the sheaths. If, on the other hand, the thickenings are produced by a deposition of fixative into gaps where the surfaces of the membranes forming the intraperiod line have separated from each other, it would be expected that the lamellae would be further apart at these sites, to give an increased lamellar spacing; this is not the case (Fig. 2).

It appears therefore that the radial thickenings of the intraperiod line are a true reflection of the composition and structure of the sheaths in these regions, but their significance is not known.

Received for publication, September 4, 1961.

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Key to Lettering

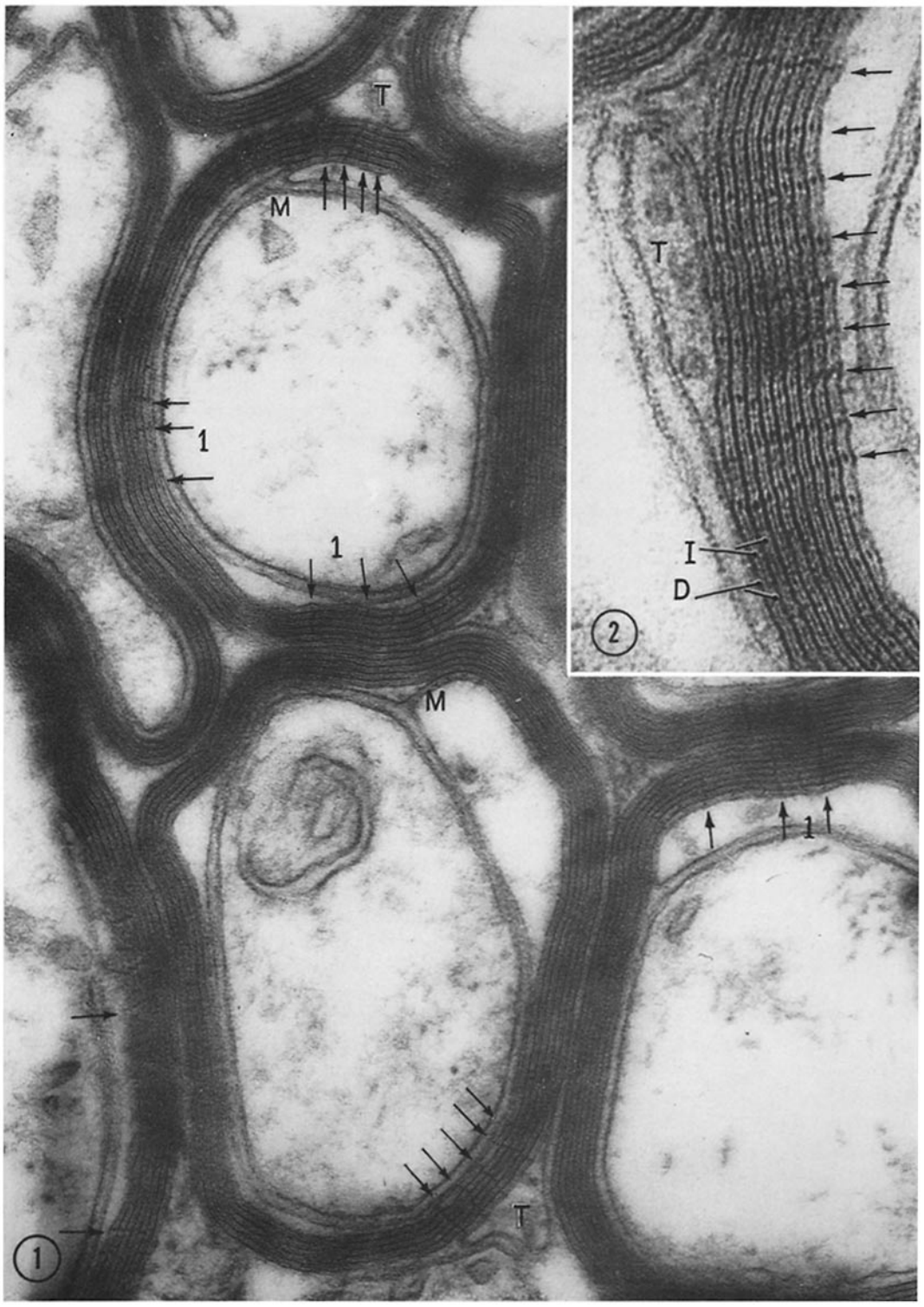
arrows, radial component of sheaths	*M*, mesaxon
D, major dense line	*T*, tongue of cytoplasm outside of sheath
I, intraperiod line	1, region of contact of adjacent sheaths

FIGURE 1

Transverse section of part of the optic nerve of a mouse to show the disposition of the radial component (arrows) of the sheath. For further explanation see text. × 90,000.

FIGURE 2

Part of a myelin sheath from the optic nerve of a mouse to show the radial thickenings (arrows) of the intraperiod line (*I*) in association with the tongue process (*T*) on the outside of the sheath. × 170,000.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