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Evidence of perpetual proximo-distal growth of nerve fibers.[1)]

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G.H. Parker has postulated a proximo-distal shift of substance in nerve fibers. That some such process really occurs is demonstrated by the following experiments. When a mammalian nerve is chronically constricted by a cuff of artery, the axis cylinders proximal to the constriction assume characteristic shapes, ranging from simple "beading" to ballooning, telescoping, and coiling. These changes (noted in over 50,000 fibers) are most marked immediately at the "bottleneck" and grade off proximally. They appear within a week, and are still present eight months later. They do not perceptibly interfere with nerve function.

The observed configurations resemble closely the damming up of a column of viscous substance driven forward against elastic resistance. One is thus led to the following concept: The neuron, as a living cell, is in a state of constant reconstitution. The synthesis of its protoplasm would be confined to the territory near the nucleus (perikaryon). New substance would constantly be added to the nerve processes from their base. The normal fiber caliber permits unimpeded advance of this mass, with central synthesis and peripheral destruction in balance. Any reduction of caliber impedes proximo-distal progress of the column and thus leads to its damming up, coiling, etc.

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This concept is supported by two facts. Firstly, the spacing of the beads (4000 measurements) increases in linear proportion to their distance from the constriction, which is precisely the form to be expected from models. Secondly, release of the constriction after several months is followed by a gradual centrifugal spreading of the dammed up substance with straightening and equalisation of caliber of the affected fibers.

Rate of growth and final caliber of a regenerating nerve fiber vary with the rate of supply from the central cell body. Nerve fibers which have grown through a constricted zone remain small and poorly myelinated in the parts lying distal to the constriction (Weiss and Taylor, Proc. Soc. Exp. Biol. and Med., 55; 1944).

Our experiments suggest that reproduction of the basic neural protoplasm occurs only near the nucleus. If all cells behave in this manner, this would mean that cytoplasmic reproduction does not occur throughout the cytoplasm, but only in the vicinity of the nucleus, a fact which would have far-reaching implications for our concept of growth.