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Dorsal Root Fibers Which Contribute to the Tract of Lissauer.

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Recent physiological evidence shows that the small, thinly myelinated fibers of peripheral nerves are concerned with the conduction of pain (Heinbecker, Bishop and O'Leary[1]). Evidence for the participation of fiber elements in the tract of Lissauer of the spinal cord in the transmission of pain seems adequate (Ranson and Billingsley[2]). It is necessary, therefore, to determine how large is the number of small, thinly myelinated fibers which enter the tract of Lissauer from the dorsal roots.

To examine this tract, the seventh lumbar segment of the spinal cord of the cat with attached dorsal roots was isolated and divided into lateral halves. One half was fixed in ammoniated alcohol for the pyridine silver technique, the other in 2% osmic acid by immersion. The osmic acid cross-sections revealed that Lissauer's tract contains closely packed, small, thinly myelinated fibers. The silver pyridine preparations showed from 1½ to 2 times more fine axons than could be accounted for by the number of fibers apparent in the osmic acid sections. The additional axons were those of non-myelinated fibers.

Evidence secured by Ranson[3] through degeneration of the dorsal roots indicates that in the lumbosacral cord (cat) the tract has medial and lateral divisions; the lateral is primarily endogenous to the cord, the medial contains fibers which have entered from the dorsal roots.[4] Accordingly, in 7 cats, under ether anesthesia, the dorsal roots (levels L. 5 through S. 3) were ligated and cut (3) or crushed (4) between the spinal ganglia and the cord. The cats were killed after 20 to 100 days and the material prepared by the silver pyridine, 2% osmic acid and Marchi methods. The results show that a majority of the small, thinly myelinated fibers in the medial half of the tract of Lissauer degenerate (cord levels L. 6 and L. 7). Likewise, a similar proportion of the non-myelinated fibers are

[1] Heinbecker, P., Bishop, G. H., and O'Leary, J., PROC. SOC. EXP. BIOL. AND MED., 1932, **29**, 928.

[2] Ranson, S. W., and Billingsley, P. R., *Am. J. Physiol.*, 1916, **40**, 571.

[3] Ranson, S. W., *J. Comp. Neurol.*, 1914, **24**, 531.

[4] Ranson, S. W., *J. Comp. Neurol.*, 1913, **23**, 259.

eliminated. Both fine, myelinated and non-myelinated (endogenous) fibers remain.

In osmic acid preparations secured after 20 to 25 days there was no evidence of intact myelinated fibers in the central stumps of such divided dorsal roots. In silver pyridine preparations, however, occasional intact fibers were observed. These had the appearance of regenerating fibers but to remove doubt completely, 3 spinal ganglia were removed in each of 8 cats. After an adequate time was allowed for degeneration, the material was prepared by the pyridine silver method and sections cut through the zone of entry of the degenerated dorsal roots. In more than 20 such roots, evidence of the occurrence of intact fibers, either myelinated or non-myelinated, was lacking; only 3 or 4 intact non-myelinated fibers being observed in the whole series. Thus, both the small, thinly myelinated fibers and non-myelinated fibers of the dorsal roots have their cells of origin in the dorsal root ganglia.

Our results show that a larger number of small, thinly myelinated fibers are contributed to the tract of Lissauer by the dorsal roots than would be inferred from the conclusions of Ranson.[3] The dorsal roots undoubtedly contribute more non-myelinated than small, thinly myelinated fibers, but the question of whether pain is mediated by one or the other group is not to be decided by an excess of numbers. For example, the large, thickly myelinated fibers, known to be responsible for the conduction of tactile impulses, are no more numerous in the dorsal roots than the small, thinly myelinated ones. The finding that a significant number of small, thinly myelinated fibers in the tract of Lissauer are derived from the dorsal roots removes one difficulty in inferring that pain is mediated by this group.