IV. Lantern Demonstrations

1. *Drs Bruce and Muir* gave a lantern demonstration of a DESCENDING TRACT in the posterior columns of the spinal cord in the lumbo-sacral region, and also of sections of the cord from a case of AMYOTROPHIC LATERAL SCLEROSIS, of which Dr Alexander Bruce has given the following description :—

In his classical work on the "Leitungsbahnen im Gehirn und Rückenmark des Menschen," Flechsig divided the lateral columns of the cord into the crossed pyramidal tract, the direct ascending cerebellar tract, the lateral ground bundles (Seitenstrangreste), and the lateral limiting layer (Seitliche Grenzschicht). Of these the crossed pyramidal and direct cerebellar tracts occupy perfectly defined positions; but the other two, which form the remainder of the lateral columns, are very imperfectly differentiated from each other. Consequently there is much vagueness of statement with regard to their boundaries, and such statements as are made appear to be in a large measure arbitrary. The lateral limiting layer is stated by Flechsig to vary in its position with different levels of the cord. In the upper cervical region it lies on the outer side of the anterior cornu, extending from the anterior group of the ganglion cells to the posterior margin of the cornu. In the cervical enlargement it occupies the angle between the anterior and posterior cornua. In the dorsal region its anterior part again passes forwards and forms a layer on the outer side of the anterior cornu rather thinner than that in the upper cervical region. In the lumbar region its relations are not so clear.

FIG. 1.

While a further subdivision of the lateral ground-bundles (Seitenstrangreste) has since been made by the discovery of the ascending antero-lateral tract by Gowers, and the descending lateral-fillet-tract by Ferrier and Turner (not to mention the still problematical descending cerebellar tract of Löwenthal), no such differentiation has hitherto been attempted in the case

of the lateral limiting layer. It is true that Flechsig states that this layer does not form a single system, and that, in the cervical enlargement, in the dorsal and the upper lumbar regions, certain bundles of fibres are found in the angle between the anterior and posterior cornua and along the outer side of the latter. These fibres are in part continuations of the posterior roots, and in part are derived from the column of Clarke. They lie partly between the grey substance and the lateral limiting layer proper, and partly intermingled with the fibres of the latter. The lateral limiting layer otherwise was supposed to be formed by fibres of short course.

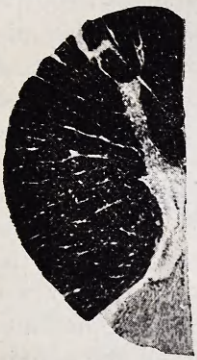

FIG. 2.

Although Edinger (in his "Zwölf Vorlesungen," 4th edition, p. 137) supports this view, it is, however, probable that fibres from the posterior roots do not enter into the lateral limiting layer. Careful examination of sections of cords from advanced tabes affecting the lumbar and dorsal regions (Figs. 3 and 2), and also others in which the cervical region is involved (Fig. 1), shows that although the posterior root fibres are degenerated, there is no change whatever in any part of the lateral limiting layer, as would undoubtedly have been the case had there been any continuation of posterior roots into the latter. Further, in sections made at a level immediately above a transverse crush of the cord in the lower dorsal region, in which the posterior roots and the postero-external columns of the cord were degenerated, no indication of degeneration was found in the lateral limiting layer. It is well known, also, that fibres belonging to the direct cerebellar tract are found in the lateral limiting layer only in the dorsal and not in the lower lumbar or in the cervical regions. Further, the evidence furnished by the recent researches of Cajal (see his diagrams, Figs. 1 and 2, "Atlas der Pathologischen Histologie des Nervensystems," part iv.) as to the constitution of this tract, goes to show that it is composed of fibres which arise from

FIG. 3.

ganglion cells in the anterior and posterior cornua, and which, after a short course (either upward or downward) return again to the grey matter. It has not, however, hitherto been shown how much of the tract is in connection with the anterior, and how much with the posterior cornu. This could manifestly only be done if the cells in the one cornu disappeared or were destroyed, while those in the other remained intact. It is impossible to produce such a condition experimentally, without at the same time injuring the lateral limiting layer. The only method at present available is to examine cords from cases of degeneration of the anterior cornual cells (no known disease, except syringomyelia, ever affects specially the cells in the posterior cornua).

Such an opportunity has been recently afforded me in the study of a case of amyotrophic lateral sclerosis. In this disease it is not merely, as was first described by Charcot, the pyramidal tracts, the motor nerve cells in the anterior cornua, and the anterior nerve roots that are degenerated, but also the greater part of the antero-lateral columns, with the exception of the ascending tracts, namely the direct cerebellar tract and the ascending antero-lateral tract of Gowers. This degeneration can be distinctly shown by Marchi's or Weigert-Pal's method, and by means of carmine or aniline blue-black (English) it is easy to demonstrate a certain increase of neuroglia, although to a less marked extent than in the crossed pyramidal tract, owing, no doubt, to the fact that there is a relatively smaller number of degenerated fibres in the former system. The degeneration of fibres in the antero-lateral tract can only be explained as the result of atrophy of the motor "Strangzellen" in the anterior cornua. It is, however, not limited to the antero-lateral ground bundles, but affects also part of the lateral limiting layer. In sections stained by Weigert-Pal's or Wolters' method the anterior part of the

FIG. 4.

lateral limiting layer shows a degeneration equally advanced with that in the antero-lateral ground bundles, while the posterior part of the layer remains deeply stained and contrasts sharply with the anterior portion. The relative areas covered by the degenerated and the undegenerated fibres will be best seen by studying Figures 4, 5 and 6. They are most clearly seen in the cervical and dorsal regions, less so in the lumbar region, owing to the fact that the atrophy in the anterior cornual cells, and consequently the degeneration in the antero-lateral ground bundles and lateral limiting layer, is less marked. The contrast, therefore, between the degenerated and undegenerated parts of the lateral limiting layer, although it can still be made out, is not so distinct as in the cervical and dorsal regions. The undegenerated area lies immediately external to the posterior horn, extending from its base to almost as far as the posterior extremity of the horn. It is bounded externally in the cervical and dorsal regions by the crossed pyramidal tract. Its form is that of a club, the head of which lies most anteriorly, in the angle between the anterior and posterior cornua, while the handle passes backwards along the side of the posterior horn. The position of the head of this club varies with different levels of the cord. It may be said in general to occupy a more anterior position the lower the level of the cord at which it is examined. Thus in the cervical enlargement (Fig. 4) it is situated behind the innermost point of the angle between the anterior and posterior cornu, and quite behind the posterior commissure. In the

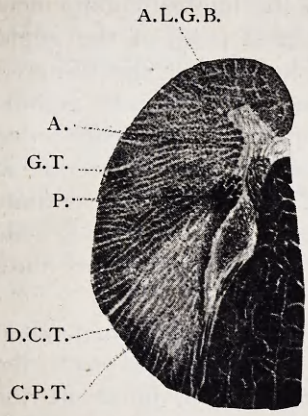

FIG. 5.

FIG. 6.

dorsal region (Fig. 5) it occupies the innermost point of the angle, even touching the anterior cornu, but still lying slightly behind the posterior commissure. In the lumbar enlargement it extends as far forwards as the innermost point of the angle, but this latter is itself now at a level in front of the posterior commissure (Fig. 6). Sections stained with Marchi's method show that the undegenerated area contains a few degenerated fibres, so that it cannot be said to be perfectly differentiated from the anterior part of the limiting layers; but whereas there is an increase of neuroglia in the anterior portion there is none detectable in the coarser reticulum which separate the fibres in the posterior part.

As already stated, it seems probable that the degenerated fibres in the lateral limiting layer are connected with the anterior cornua, and that the undegenerated fibres in the posterior part are derived mainly from the posterior cornua. If this is so, then the lateral limiting layer must be regarded as consisting of two almost completely independent systems which merely agree in this, that they arise in cells in the grey matter, and are fibres of short course. If it is thought under such circumstances desirable to retain the term lateral limiting layer, its constituent parts might be termed respectively *ventro-lateral* and *dorso-lateral limiting layer.*

EXPLANATION OF THE PLATES.

Figs. 1, 2, 3. Hemi-sections of cervical, dorsal, and lumbar regions of the cord from three different cases of locomotor ataxia. Stained by Pal's method to show the degeneration of posterior roots and posterior columns, with complete integrity of the lateral limiting layer.

Fig. 4. Transverse hemi-section of the cord. The cervical enlargement. Stained by the Weigert-Pal method.

A. Anterior or ventral part of the lateral limiting layer, degenerated.
P. Posterior or dorsal part of the lateral limiting layer, undegenerated.
A.L.G.B. Antero-lateral ground bundles.
T.G. Tract of Gowers.
D.C.T. Direct Cerebellar Tract.
C.P.T. Crossed Pyramidal Tract.

Fig. 5. Similar section from dorsal region.
Fig. 6. Similar section from lumbar region.

2. *Drs Byrom Bramwell, Muir and Leith* showed a number of lantern slides illustrative of the clinical and microscopic appearances of the muscles, spinal cord and peripheral nerves