

## ILLUSTRATIONS OF CENTRAL ATROPHY AFTER EYE INJURIES.

*With Plate I.*

C. L. HERRICK.

In the present paper it is not hoped to add anything new to the vast and daily augmenting literature of the visual connections but simply to place in accessible form some data accumulated, with the hope of ultimately making a careful study of the peripheral connections and particularly the central mechanism of accommodation. The difficulty of finding figures illustrating the actual results of the atrophies due to the destruction of the eye has disposed us to print our own diagrams with a running commentary. The material consists of serial sections of the brain of two rabbits whose eyes were operated on shortly after birth and before the eyes had opened. Series 292 is from a rabbit operated on August 25th, the right eye being removed. Killed November 1st, when nearly full grown. Series 297 is from a rabbit from which the left eye was removed September 19th, being then one day old. It was killed December 19th. As these brains were intended to compare with control series of normal brains and were to be used primarily in the study of the cells, etc., they were stained with sublimate hematoxylin and fuchsin. In both cases the loss of vision was complete and the wound closed by first intention without suppuration, though in one the globe of the eye and the muscular attachments were less completely destroyed than in the other. Unfortunately there was no opportunity for careful post-mortem examination of these conditions which can be inferred from the state of atrophy found in the sections. It will be seen that the atrophy in the optic tracts was much more complete in No. 297, that is in the one operated upon within 24 hours after birth, than in the other which was operated upon a few days later. We begin with No. 292, commencing behind the chiasm. The optic tract on the right

side<sup>1</sup> is intact except that the innermost band of fibres is filled with granules to such an extent as to be decidedly darker than the ectal portions. The degenerate portion does not embrace more than a sixth of the whole. On the left side (that corresponding to the injured eye) the conditions are exactly reversed. The outer five-sixths is degenerate and filled with irregularly disposed granules, while the ental layer appears normal or nearly so. Under a moderate power (1.5 in. obj.) the difference between the degenerate and normal tracts is conspicuous. The unaltered portions have the nutritive granules arranged in regular files of 6-8 between the fibres and these rows are disposed at approximately equal distances. In the degenerate portions the granules are not only relatively more numerous but they are dispersed with absolute irregularity. The fibres are no longer approximately parallel but are irregularly meshed. The sheaths are partly dissolved and the myelin completely absorbed. (Cf. Fig. 11.) The tectum in this series is somewhat larger on the right side but there are no demonstrable histological differences.

Passing caudad to the level of the exit of the oculo-motor, we find the right root entirely absent while its fellow is normal. The right nidulus of origin is also absent while the interpeduncular niduli, which some writers persist, in spite of abundant evidence, in regarding as accessory third niduli, are intact on both sides. It is not possible to identify positively any of the elements of the missing nidulus though shrunken adendritic elements occur in the site. (Fig. 3.)

At the level where the interpeduncular nidulus ends caudad, the cells of the fourth nidulus appear in the sections and are more numerous on the right than on the left side. Still there is no conspicuous difference in this subject between the two sides. The dorsal longitudinal fasciculus becomes more concentrated at this point and the nidulus lies directly dorsad of it in a stroma of deeply staining material. There are about the

---

<sup>1</sup>In discussing the sections it may be premised that the cephalic aspect of the section is presented so that the right side of the section is the left side of the figures.

same number of fibres in the root of the fourth nerve on either side. (See Fig. 4.) The external portion of the fourth nerve of the right side is apparently wholly degenerate while its fellow of the opposite side is intact. For some reason, then, the degenerative process has destroyed the central tract and nidulus of the third nerve but not those of the fourth, though the external part of the latter has disappeared. We find no central tracts degenerate between the fourth and sixth nerve niduli, but the latter has as completely disappeared as in the case of the oculo-motor. Nothing is left of root, tract or nidulus. The nidulus of the left side lies, as usual, just laterad of the genu of VII and its root tract turns sharply mesad beneath the VII fibres and then passes directly ventrad to the root. Some traces of the sheath may be found by careful search in the course of the root of the other side.

The result of the operation, then, has been as follows: (1) degeneration of the lateral three fourths to five sixths of the left optic tract and of the mesal one fourth to one sixth of the right tract, (2) proportional atrophy of the optic tecta, most marked on the left side, (3) obliteration of the nidulus, root tracts and roots of III and of the external part and roots of IV on the right side, (4) the obliteration of VI on the left side as completely as III. Negatively, the central portions of IV are unaltered and the interpeduncular niduli are intact.

The rabbit of series 297 was operated on earlier and the results are rather of the nature of atrophies than of degenerations. The diameter of the left optic nerve is somewhat more than one fourth that of the right. At the chiasm, as seen in Fig. 7, the proportions are about the same. The degenerated portions are almost completely absorbed leaving only atrophic phenomena. Sections further caudad show very distinctly the atrophy in the tract. (Fig. 8.)

At the proper level the corpus geniculatum of the left side appears with its tracts, but on the other side it seems quite absent. There are no degenerative changes to enable us to trace the tracts cephalad to the cortex but there seems no reason to doubt that they are atrophic throughout. The reduction in the

tectum has gone on and perhaps nearly reached its limit. The left tectum is fully four times the size of the right but the intimate structure is not obviously different.

Passing to the oculo-motor apparatus, the third nerve roots are both present and it requires close examination to discover anything unusual in them but the fibres are atrophied to some extent. The niduli, on the other hand, are nearly completely atrophied. The cells are nearly all shrunken and shrivelled and lie in large perilymph spaces. The contrast between these cells and the unaltered cells of the interpeduncular niduli is instructive. (See Fig. 10.) In this case the fourth nerve has shared the fate of the third. While the atrophy has been more marked on the right side than on the left both are affected. The series unfortunately does not extend to include the sixth, but it is probable that the same condition existed in it. Our material is inadequate to illustrate the changes in the tracts and niduli of the second order.

In attempting to analyse the various alterations with which we here have to do it is necessary to distinguish degeneration from atrophy and aplasy, the latter being a failure to develop as a result of operative interference. See Singer and Munzer, *Denksch. Kaiserl. Akad. z. Wien.* 1890.

#### DESCRIPTION OF FIGURES.

*Fig. 1.* Transection of rabbit brain (No. 292) immediately cephalad of the optic tecta, showing the atrophy of the tracts of the left side. The section is not exactly transverse.

*Fig. 2.* Section through the tecta showing the atrophy of the left side and in the nidulus numbered "3."

*Fig. 3.* Section at the roots of the third nerves showing the absence of the right nidulus and root.

*Fig. 4.* Portion of a section through the fourth nidulus showing that it is not affected by the atrophy.

*Fig. 5.* Section at the exit of the sixth showing the absence of the fibres of the right side.

*Fig. 6.* Part of a section further caudad showing the complete atrophy of the right nidulus.

*Fig. 7.* Part of a transection of a rabbit brain (No. 297) from which the left eye was removed at birth, showing the degeneration of the right tract.

*Fig. 8.* A section further caudad.

*Fig. 9.* Section at the habenæ showing atrophy in tract of second order on the right as well as in the optic tract.

*Fig. 10.* Cells from the nidulus of the third (A) and from the interpeduncular nidulus (B) to demonstrate the atrophic changes in the former.

*Fig. 11.* Normal and degenerate portions of optic tract from 292, 8.

