

RESEARCHES ON THE CHANNELS BY WHICH THE
CEREBRO-SPINAL FLUID ESCAPES FROM THE
INTRACRANIAL CAVITY, BY THE LATE DR.
GEORGE ELDER.

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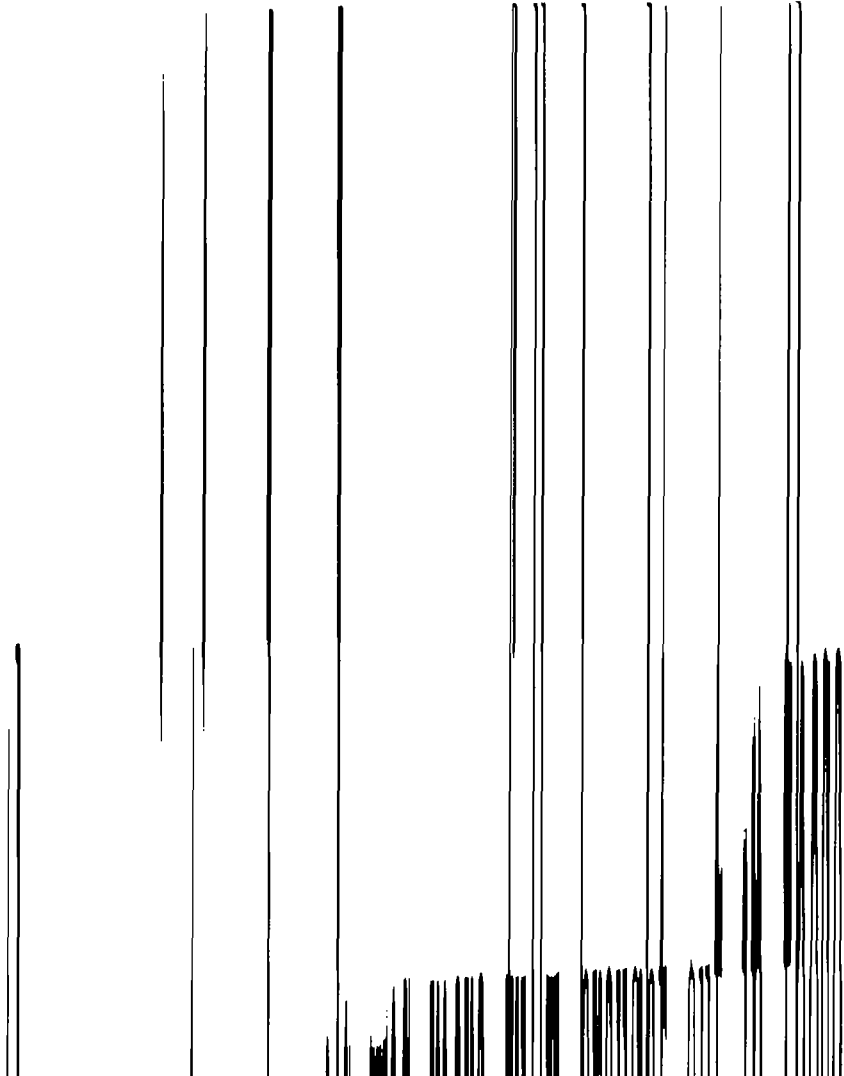
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IN the course of the summer and the autumn of 1899, the late Dr. George Elder carried out a series of experiments, with the view of determining more exactly the paths by which the cerebro-spinal fluid is normally conveyed away from the cranial and spinal cavities. Whilst the investigations were in progress, Dr. Elder from time to time showed us the results he had obtained, and discussed their significance; and since his research, although not completed, served to establish at least one fact of considerable importance, it seems desirable that some account of it should be published.

We do not propose to give details of the experiments, although careful records of many of them are available. The end that we have in view will be amply served if we merely indicate the general nature of the work and its results.

The observations were made upon dogs, cats, and rabbits. Small quantities of a Prussian blue (or, occasionally, lead chromate) injection fluid were introduced into the subdural space. In some instances the injections were made immediately after the animal had been killed, in others while it was under the influence of an anæsthetic. In the latter case, the animals were allowed to live for periods varying from half an hour to three weeks. In the neighbourhood of the point of injection the dura mater was generally more or less diffusely stained by the coloured fluid. On microscopic examination of the tissues of some of the animals which had been killed immediately before the injection was made, coloured particles were observed in the lymph channels throughout the whole depth of the dura, and also in the dural and cranial veins. In some of the animals killed shortly after the injection had been made, the pigment was found in the same situations, and in one instance also in a large vein in the neck. These results clearly proved the existence of very free communications between any portion

of the subdural space and the dural and cranial veins. The nature of



the communicating channels was more fully brought out in those animals which had been allowed to survive for several days after the injection. In them the protoplasm of the endothelial cells lining the perivascular and other lymph spaces of the membrane contained numerous granules of Prussian blue, which must have been taken up by the cells from the fluid in which they are bathed (see Fig. 1). On account of the staining of their walls, it was possible to trace these lymph channels from the perivascular canals of the capillary network at the inner surface, obliquely through the substance of the dura, and

fluids through the dura. He concludes from his observations that "the pathway of the filtration of the fluid from the cranial cavity may be through the Pacchionian bodies, through the dura, or through the veins in the pia mater." He attributes chief importance to the direct passage of the fluid into these veins and through the walls of the dural sinuses. Obersteiner¹ maintains that the perivascular canals of the dura mater "open into the real blood vascular system." We do not know whether this conclusion is based on experimental observation or not. Dr. Elder was, of course, fully cognisant of the views of these and other previous writers. The particular point which he wished to determine was whether the cerebro-spinal fluid escapes by the whole general surface of the dura, or whether the walls of the pial veins and dural sinuses contain specially important conducting channels. His observations seem to prove that the former is what actually occurs. Apparently the whole of the intracranial dura mater takes part in the conveyance of the cerebro-spinal fluid to the general circulation, and no special importance can be ascribed to direct passage through the walls of the pial veins and dural sinuses, except that which takes place through the latter where they are penetrated by the Pacchionian granulations.

¹ "The Anatomy of the Central Nervous Organs," translated by Alexander Hill, London, 1890.