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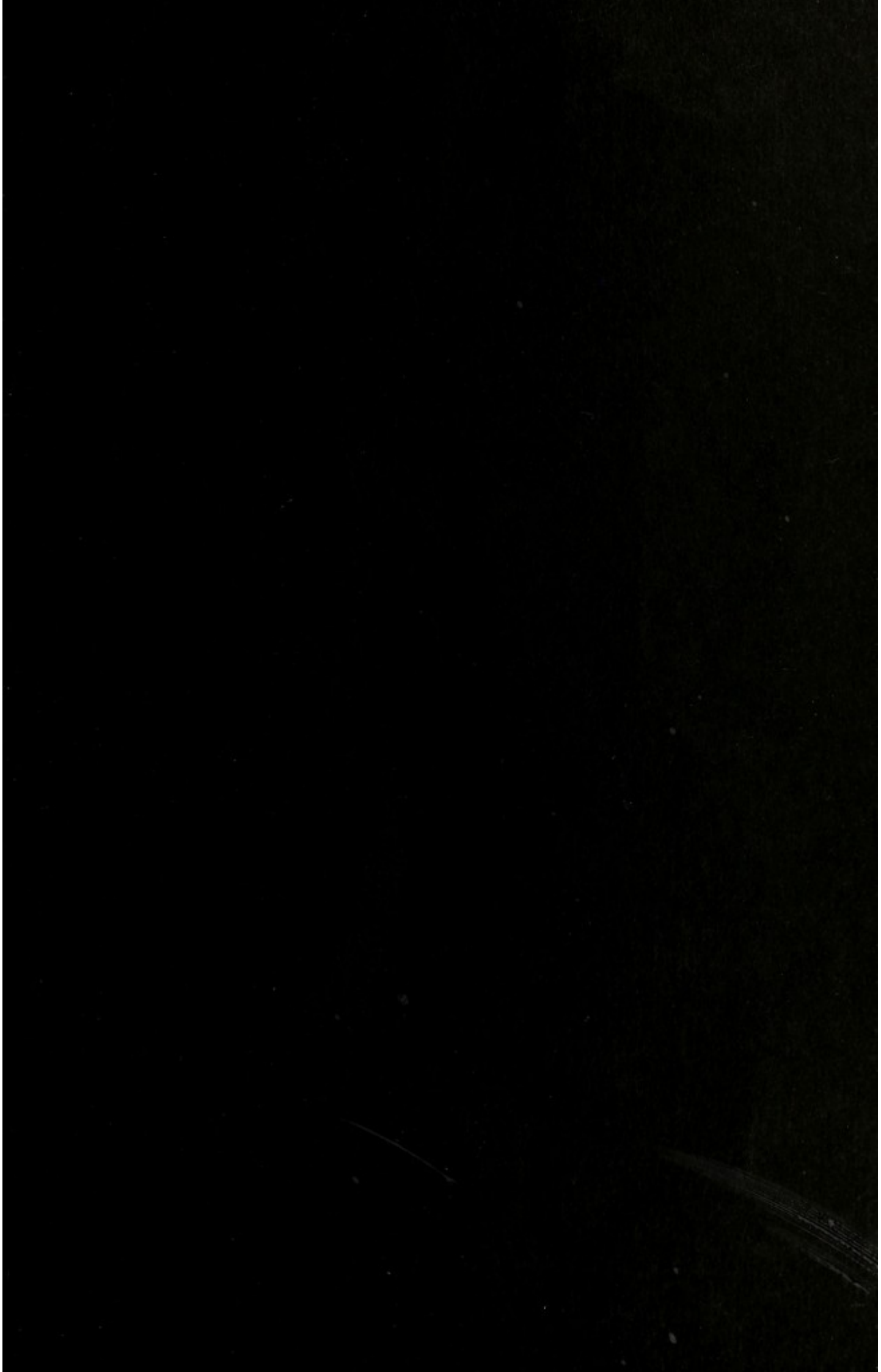

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ON THE CONNECTIONS OF THE INFERIOR OLIVARY BODY.

BY

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On the Connections of the Inferior Olivary Body.

By Alexander Bruce, M.A., M.D., F.R.C.P.Ed., F.R.S.E.

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The inferior olivary body or nucleus forms the ovoid projection which extends almost the whole length of the medulla oblongata, from the lower margin of the pons Varolii to within a short distance of the level of the decussation of the anterior pyramids. It is separated from the latter by a groove through which emerge the roots of the hypoglossal nerve. On its outer margin it is separated from the line of the roots of the glossopharyngeal and pneumogastric nerves by a shallow depression. Transverse vertical and longitudinal sections of the medulla show the olive to be a highly convoluted sac of grey matter open, at its hilum, towards the mesial plane. (It has two accessory nuclei of smaller size, an internal and a posterior accessory olive, which, as they are really parts of the larger nucleus, do not call for special consideration here.) The fibres of the hypoglossal nerve pass through its substance, but do not become, as was at one time supposed, and as has been recently again affirmed by Vincenzi, connected with the olive. On its median aspect lies the *interolivary stratum* or *fillet*. Anteriorly lies the anterior pyramid, posteriorly the formatio reticularis.

According to the experiments of Bechterew, the inferior olive is concerned in co-ordinating movements necessary for the maintenance of the equilibrium of the body.[1] One would naturally from this

[1] Bechterew (*Neurologisches Centralblatt*, Dec. 1, 1882) states the results of section of the inferior olivary bodies to be as follows:—(*a*) Deep section of the olives produce forced movements, mostly rolling round the long axis of the body towards the injured side, and nystagmus with one eye directed upwards and outwards, and the other downwards and inwards. (*b*) Slighter lesions produced movements in a circular or in a forward direction, or caused the animal to throw itself backwards. (*c*) Sometimes forced positions, with strong lateral

fact (as well as from its large size) expect that it should possess an extensive system of fibres connecting it with other parts of the central nervous system, more especially with such parts as have a similar function; but it is a striking illustration of the difficulty of the histological investigation of this region, that until quite recently only one of these connecting systems had been definitely established.

It has long been known that when one half of the cerebellum is congenitally defective, the restiform body of the same side, and the inferior olive of the opposite side, are also absent, the development of the olive being evidently dependent on the opposite hemisphere of the cerebellum. With regard to the other relations of the olive, opinions have been very divergent.

The most generally accepted view is that of Deiters, viz., that the olive is a nodal point or ganglion of interruption, between the posterior columns of the spinal cord (or their nuclei) of one side and the restiform body of the opposite side. Deiters thought that the internal arcuate fibres which originate in the nuclei of the posterior columns (*i.e.*, the clavate nucleus, or nucleus of the column of Gall, and the cuneate nucleus, or nucleus of the column of Burdach) terminate on the convex surface of the olive of the same side; while other fibres, arising from the interior of the same olive, leave it at its hilum, and after crossing the raphé, and then passing partly anterior, partly through and partly posterior to the opposite olive, enter the restiform body. Deiters considered that the fact that the restiform

curvature of the body, were produced. (*d*) There was generally, also, a tendency to fall towards the injured side, or in lesions of both olives unsteadiness of gait, or actual inability to stand or walk.

In estimating the results of these experiments, it must be remembered that it is impossible to divide the olivary bodies without at the same time injuring some of the following structures, viz., the direct cerebellar tract, the arciform fibres of Solly (or the anterior external arcuate fibres of Edinger), the ascending tract of Gowers, or those fibres which pass from the lateral columns of the spinal cord to the superior olive, and the posterior corpus quadrigeminum. The lesions produced in these various strands may therefore be, at least in part, responsible for the phenomena attributed to the section of the olivary bodies. Ferrier concludes (*Functions of the Brain*, 2nd edit., p. 207) that the views of Deiters and Meynert, with regard to the connection of the olive and the posterior columns, are established by Bechterew's experiments. In view of the possible fallacies in these experiments, and the certain results of embryological investigations, that connection can no longer, in my opinion, be maintained.

body gradually increases in volume in proportion as the posterior columns diminishes is an evidence of the intimate association of these two structures.

Meynert, while espousing the opinion of Deiters, pointed out that many of the internal arcuate fibres arising from the cuneate and clavate nuclei pass behind the olive of the same side, and reach the restiform body of the opposite side without entering either olive.

Ross (*Diseases of Nervous System*) and Ferrier (*Functions of the Brain*, 2nd edition) adopt the views of Deiters and Meynert.

The recent researches of Edinger,[1] Flechsig, Bechterew (with which I fully agree, on the ground of my own observations in my Thesis for the degree of M.D.), show the view of Deiters, with regard to the termination in the olive of those internal arcuate fibres which originate in the nuclei of the posterior columns, to be untenable.

If one examines transverse sections of the medulla oblongata of a human embryo between the ages of six and eight months which have been stained with hæmatoxylin after the method of Weigert, one finds that the fibres from the olive to the restiform body are not yet invested with myeline, while those internal arcuate fibres which form the cuneate and clavate nuclei are fully medullated. An uncomplicated view of their course can thus be obtained ; and it is beyond any doubt that none of these fibres terminate in the olive of the same side, that all the fibres of this system which enter the olive merely pass through its substance, and terminate in the interolivary stratum or fillet of the opposite side.

Flechsig (*Plan des menschlichen Gehirns*) was at one time of opinion that the larger part, or two-thirds of the interolivary stratum or fillet, entered the olive; but it would appear that he no longer maintains this view, and though there seems to be some pathological evidence in its favour (see the case of Meyer, *Arch. f. Psych.*, vol. xiii.), the examination of embryonic brains, especially in longitudinal sections, points to the absence of any such connection.

There is as yet no evidence that any part of the fibres of the

[1] Edinger, *Neurol. Centralblatt*, 1885, p. 73. See also Spitzka's paper, *Medical Record*, 1884, vol. xxvi., Nos. 15–18.

spinal cord terminate in the olive, though that may well be the case.

In 1885 Bechterew (*Neurol. Centralbl.*, 1885, p. 194) discovered in the brains of infants of the age of one month a tract passing from the olive in a direction upwards towards the brain, which had been regarded erroneously by Stilling as a continuation of the posterior columns of the spinal cord, and by Wernicke as a downward continuation of the posterior commissure. This strand (Plate XLII. fig. 1, *Bt.*), which he calls the "centrale Haubenbahn," appears on the posterior and external aspect of the olive. It gradually increases in size from the middle of the olive upwards. At the lower part of the pons (Plate XLIII. *Bt.*) it lies between the superior olive and the fillet and dorsal to the fibres of the corpus trapezoideum. In the upper part of the pons it lies in the middle of the formatio reticularis. At the level of the anterior corpora quadrigemina it lies immediately external to the posterior longitudinal fasciculus. It then passes behind the red nucleus, and enters the lenticular-nucleus loop, to terminate, according to Flechsig, in the lenticular nucleus.

About nine months ago, while making oblique sections of the medulla and cerebellum of a nine months' embryo, in order to demonstrate the course of the restiform body (the posterior aspect of the section being thus at a higher level than the anterior), I found another tract (Plate XLII. fig. 2, *a.o.t.*), apparently previously undescribed. (It is possible that this tract is referred to by Bechterew in the paper quoted above.) The strand, which is only indistinctly seen in the ordinary vertical transverse sections, begins, like Bechterew's tract, on the external aspect of the olive. It then bends gradually inwards, backwards, and in an upward direction, forming a compact bundle, till it reaches the inner side of the nucleus of the vii or facial nerve (vii nucl.). Then it turns outwards and slightly backwards, crossing the roots of the facial nerve (vii rad.). As it does so the fibres spread out from each other in a fan-shaped manner, and become less easy to trace. They apparently, however, bend somewhat downwards and enter the external (Deiters' nucleus) of the vestibular root of the auditory nerve.

This connection of the olive with the auditory nerve may serve to throw some light on the special function assigned to the inferior olivary body in maintaining the equilibrium of the body.

Explanation of Plates.

Plate XLII. fig. 1.—*a.p.*, anterior pyramid; *i.o.*, inferior olive; *B.t.*, Bechterew's tract; *V.Asc.*, ascending root of fifth nerve; *c.r.*, corpus restiforme.

Plate XLII. fig. 2.—*a.p.*, anterior pyramid; *inf. olive*, inferior olivary body; *v.Asc.*, ascending root of fifth nerve; *vii nucl.*, nucleus of facial nerve; *vii rad.*, root of facial nerve; *a.o.t.*, acustico-olivary tract; *viii B. nucl.*, Bechterew's nucleus of auditory nerve; *s.p.c.*, superior cerebellar peduncle.

Plate XLIII.—*a.p.*, anterior pyramid; *f.*, fillet; *c.t.*, corpus trapezoideum; *B.t.*, Bechterew's tract; *sup. olive*, superior olive; *vii nucl.*, nucleus of facial nerve; *v.Asc.*, ascending root of fifth; *c.r.*, corpus restiforme.

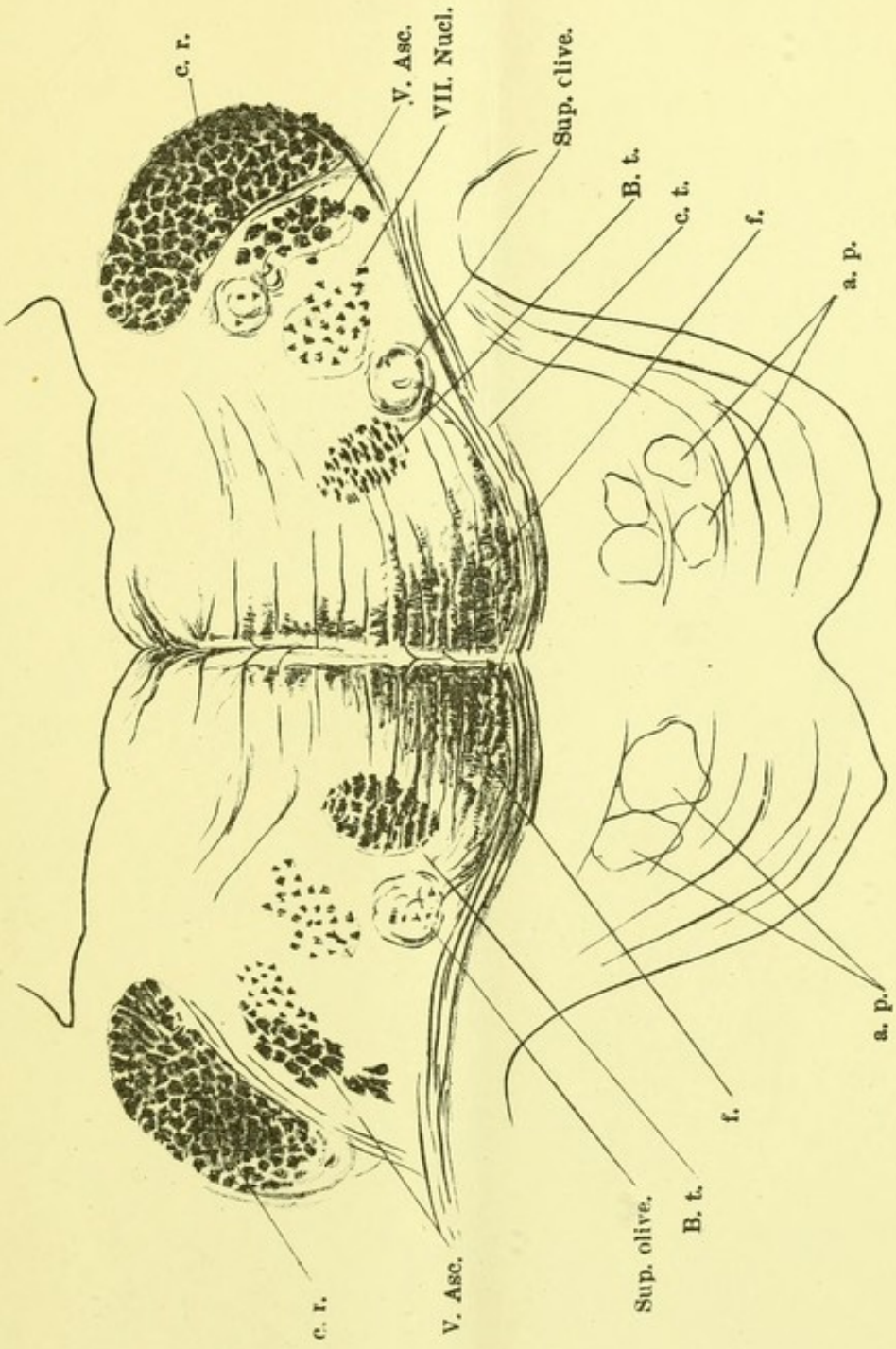

Diagram representing Bechterew's tract in the pons Varolii.