

HYPOPHYSIO-PORTAL VESSELS AND THEIR COLLOID ACCOMPANIMENT

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AT the meeting of the Anatomical Society of Great Britain and Ireland held at University College, London, on 30 June, 1930, we called attention to the presence of a peculiar (and until then unrecorded) system of vessels in the stalk of the pituitary (Proceedings of the Anatomical Society, *J. Anat.* vol. LXV, p. 178). Subsequently a short note was published in *The Lancet* (2 August, 1930, p. 238) and another in *The Journal of Anatomy* (October, 1930, pp. 88–91). In these preliminary communications we gave only the bare facts concerning these vessels without microphotographs, the slides having been shown at the Anatomical Meeting on 20 June.

We wish now to make a third communication for two reasons:

(1) To clear up some misunderstandings by giving microphotographs of the hypophysio-portal vessels to demonstrate the presence of colloid in the lumen and to show the course of these vessels as seen in serial sections, and

(2) To draw attention to the statements of previous observers concerning these vessels and in particular to the memoir of Karl Pietsch (of the Pathological Institute of the University of Jena), "Aufbau und Entwicklung der Pars tuberalis des menschlichen Hirnanhangs in ihren Beziehungen zu den übrigen Hypophysenteilen" (*Zeitschrift für mikrosk.-anat. Forschung*, 1930, Bd. XXII, S. 227–56).

The manuscript of his paper was sent to the *Zeitschrift* on 4 June, 1930, 16 days before we, in ignorance of his work, reported to the Anatomical Society the results of the work upon which we had then been engaged for about a year. It was not until June, 1932, that Pietsch's paper was brought to our notice. He had observed the vessels which we call hypophysio-portal, but he did not pursue them into the secondary net. He says (*op. cit.* p. 232): "Die Struktur der Pars tuberalis wird wesentlich bestimmt durch auffallend reichliche und weite Blutgefäße sowie durch ein kräftig entwickeltes Bindegewebsgerüst. Stellenweise nehmen die meist strotzend gefüllten Blutgefäße fast die ganz Dicke der Pars tuberalis ein, . . . die Gefäße zum grossen Teil für die Pars tuberalis keine funktionelle Bedeutung haben, sondern nur ihren Weg durch sie hindurchnehmen," p. 233. "Die Venen und die Kapillaren der Pars tuberalis stammen aus dem Vorderlappen. . . zum Teil sollen sie in den Sinus

circularis münden, zu einem grossen Teil sehe ich sie aber auf meinen Schnitten in das Innere des Stiels übertreten und diesem tubwärts ziehen." Italics ours.

These are the hypophysio-portal vessels of our account. Pietsch also observed colloid in these vessels. He says (*loc. cit.* p. 233): "Da es morphologische (Kolloid in den Gefässen) und pharmakologische (Hypophysingehalt des Venenblutes) Anhaltspunkte dafür gibt dass das Vorderlappensekret zum Teil durch die Gefässe abgeführt wird, könnte man aus den Eindringen der Venen in den Stiel und in das Tuber cinereum vermuten dass nicht bloss die Saftspalten des gliösen Stiels für den Sekretstrom von Vorderlappen zu den hypothalamischen Zentren in Betracht kommen, sondern auch der Gefässweg."

What was for Pietsch an interesting subsidiary observation has been for us the basis of the histological work we have already communicated and of a considerable amount of experimental work not yet published.

We regard Pietsch's work and our own as being clearly confirmatory the one of the other in this matter of a venous drainage from the hypophysis to the hypothalamic region, the observations individually recorded being entirely independent the one of the other.

In our short notes published in 1930, we stated the fact that there is a system of veins taking origin from the sinusoids of the buccal portion of the hypophysis and from the capillaries of the neural portion, which ascend through the stalk to the region of the floor of the infundibular recess of the 3rd ventricle where they break up into a secondary capillary net. As they ascend, these run first in the substance of the pars tuberalis, mostly in front of the stalk, and then at various levels penetrate into the neural portion of the stalk and ascend within "glial sleeves" towards the floor of the infundibular recess, where they lose their glial wrapping and break up into the secondary net.

That the blood flows in these vessels in the direction stated is evident from their colloid accompaniment. As colloid—whatever it may be—is formed in the pituitary and not in the brain, its association with the vessels may be taken as indicating that the direction of the flow is certainly hypophysio-hypothalamic. Sometimes colloid globules occur within the lumina of these vessels, sometimes in the intervascular tissue of the neural portion of the stalk, and sometimes in the vicinity of the secondary net.

Plate I, fig. 1 is a microphotograph of a frontal section through the hypophysis and its stalk, stained with haematoxylin and eosin.

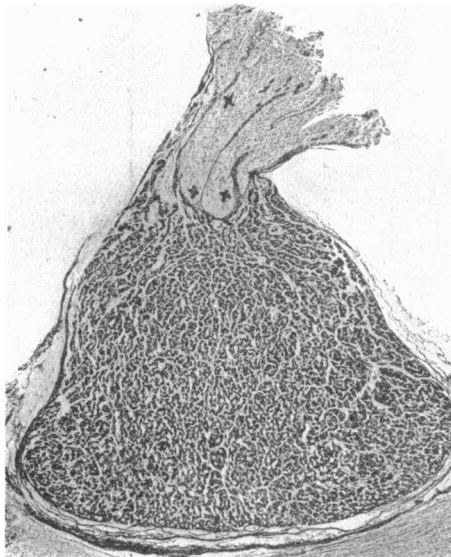
From the anterior lobe of the hypophysis one can see a large sinusoid being continued into a portal vessel (*h.p.v.*) in the pars tuberalis: the subsequent fate of such a vessel is as follows. It passes upwards in the pars tuberalis and then enters the neural portion of the stalk and becomes ensheathed for a certain distance in a neuroglia sleeve where its course is tortuous, and finally it breaks up to take part in the formation of the secondary capillary network.

In the lower part of this vessel four round globules of colloid are shown in Plate I, fig. 1, lying in single file in the channel. Looked at under the microscope, these globules are homogeneous and refractile. A little lower at the site

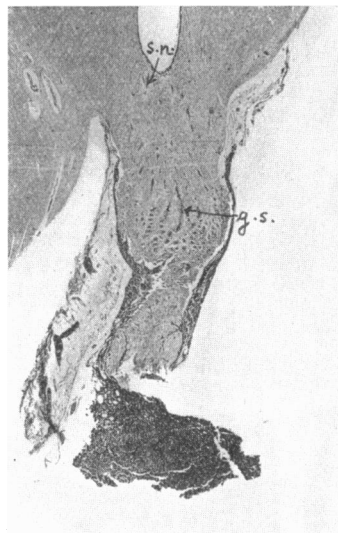
marked *X* there is a sinusoid of the anterior lobe cut almost transversely, which contains three rounded globules of colloid, smaller than those in the hypophysio-portal vessel.

Plate I, fig. 2 is taken from a section in the same series as fig. 1; here another hypophysio-portal vessel (*h.p.v.*) happens to be cut for a long distance [*XX*] in the section as it is passing upwards. This also contains a number of colloid globules of various sizes lying within the lumen like a string of beads. In figs. 1 and 2 the hypophysio-portal vessels shown have not yet plunged into the neural portion of the stalk.

Text-fig. 3 is a microphotograph of a coronal section of the pituitary of a full-term foetus. This section is stained with haematoxylin and eosin. It



Text-fig. 3.



Text-fig. 4.

shows hypophysio-portal vessels in the process of leaving the pars tuberalis and entering the neural portion of the stalk [*XXX*].

Text-fig. 4 shows a frontal section through the stalk, both the neural portion and the pars tuberalis can be seen—and a number of the hypophysio-portal vessels are visible as they are passing, surrounded by glia sleeves (*g.s.*), towards the region of the secondary net. The site of the secondary net (*s.n.*) beneath the epndymal floor of the infundibular recess of the 3rd ventricle can also be seen.

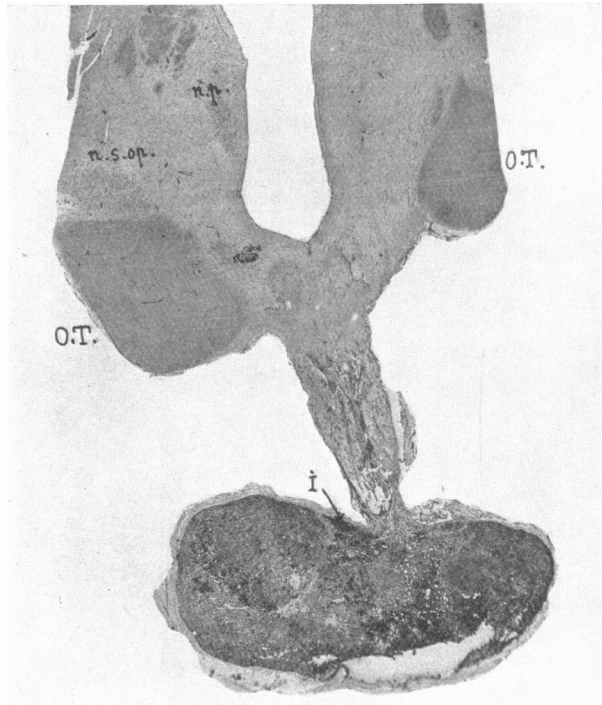
Plate I, fig. 5 is a high-power view of the region of the glia sleeves.

Plate I, fig. 6 is a high-power view of the region of the secondary net.

Text-fig. 7 shows a frontal section of a pituitary attached by its stalk to

the hypothalamic region: the optic tracts (*O.T.*) are seen laterally. Into the anterior lobe of this gland a puncture injection of Indian ink was made prior to fixation and the site of the puncture (*I*) corresponded to the place of the large sinusoid containing colloid globules shown in Plate I, fig. 1. From this spot the ink entered some of the portal vessels and can be seen plainly in them. It also penetrated to some extent into the secondary net in the hypothalamic region.

In this figure the position of the nucleus paraventricularis (*n.p.*) and of the nucleus supraopticus (*n.s.op.*) can be seen.



Text-fig. 7.

The ink, besides being present in the secondary net beneath the floor of the ventricle, has been seen in minute vessels rising close under the ependyma of the lateral walls of the ventricle towards the site of the nucleus paraventricularis. The ink particles have not been seen actually among the cells of the nucleus.

Also passing laterally from the secondary net beneath the floor of the infundibular recess, small particles of ink have been encountered. They have not been found amongst the cells of the nucleus supraopticus, but their position seems to us to indicate the possibility that the secondary net sends prolonga-

tions in this direction as well as dorsally in the direction of the nucleus paraventricularis. These nuclei, supraopticus and paraventricularis, have a good systemic arterial supply.

In studying the very voluminous literature on the minute structure of the pituitary we have found statements which indicate that many observers have seen the hypophysio-portal vessels of our account, but without (excepting Pietsch) attaching to them the significance which we have given.

Looking for an excretory path from the hypophysis, Lothringer observed in the "Umschlagteil" of the hypophysis (the place where the anterior lobe is continuous with the pars intermedia on the ventral aspect of the stalk, at its lower end) a peculiar intermingling of epithelial cells with large vessels and supposed that this might be the resorption place of the gland ((1), pp. 264 and 290).

Edinger had different ideas on the pathways of hypophysial excretion. He found that Indian ink puncture injections, forced into the tissue of the anterior lobe, resulted in the appearance of long strands of ink extending from the hypophysis to the hypothalamic region, *along the vessels*. This implies that the vessels were present in his preparations, but he was looking for perivascular spaces and so did not appreciate the significance of the vessels ((2), p. 502).

Herring seems also to have observed these vessels. He says ((3), p. 155): "Some of the veins from the anterior lobe appear to take a similar course, passing through the epithelial investment of the neck of the infundibulum to run into the nervous portion;"

Trautmann has also observed that at the "Umschlagteil" the pituitary has a distinctive appearance when seen under the microscope, being characterised by an unusual richness of vessels ("Reichtum an Gefässen") ((4), p. 341). He also noted that the tissue surrounding the stalk is greater in amount ventrally and laterally than it is dorsally, and that it ends in the nervous substance at different levels towards the tuber cinereum, varying according to age, species, etc. ((4), p. 341).

Berkeley says ((5), p. 517): "The anterior or glandular portion is attached loosely to the rounded base of the infundibulum by connective tissue, and a large number of vessels, both veins and arteries, that directly pass into it from the substance of the infundibulum and to the 'lobus infundibuli'"; but he did not consider these veins as being any other than ordinary systemic vessels.

Collin says ((6), p. 41): "Aussi, les vaisseaux de la pars tuberalis accompagnés de leur trame conjonctive sont-ils, en même temps, les vaisseaux de l'infundibulum, où ils pénètrent avec une partie de cette trame conjonctive."

De Beer ((7), p. 98) speaks of the probability that products of the pituitary (other than those of the anterior lobe proper) may be blood borne.

Dostoiewsky's attention was also attracted by large vessels rising from the central part of the glandular lobe and taking a course dorsally towards the stalk ((8), p. 596).

Tello ((9), p. 156) gives a clear description of the distal part of our

hypophysio-portal vessels. He saw them at the lower end of the stalk going on the surface of it and having a tortuous course after they penetrate into the stalk, and he says that they branch and become more complicated as they approach the infundibulum. He says: "Los vasos de este trozo del tallo pituitario... caminan de preferencia por la periferia, siguiendo ensortijadas trayectorias y en manojos, pero emiten numerosas ramas que penetren en el espesor del tallo... Estos pelotones son tanta más frecuentes y complicados cuanto más nos acercamos al infundibulo."

Unfortunately Tello worked with material which did not include a portion of the brain attached to the hypophysis and so he could not follow the entire course of these vessels and see their relation to a secondary net in the hypothalamic region. So Tello concluded that these vessels passed from above, down to the hypophysis and also (because of a resemblance of these vessels to some vessels of the cerebral cortex in atrophía senilis) came to regard them as being of a pathological nature.

It will be clear, from this short review, that the literature contains many references to the vessels which we have named hypophysio-portal, but so far as we have ascertained no one suspected that they were placed between two nets of distribution, i.e. the sinusoids of the buccal hypophysis and the capillaries of the neural hypophysis on the one hand and the secondary net in the hypothalamus on the other.

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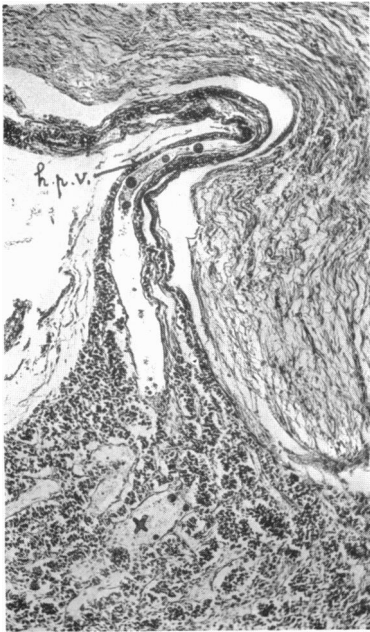


Fig. 1.



Fig. 2.

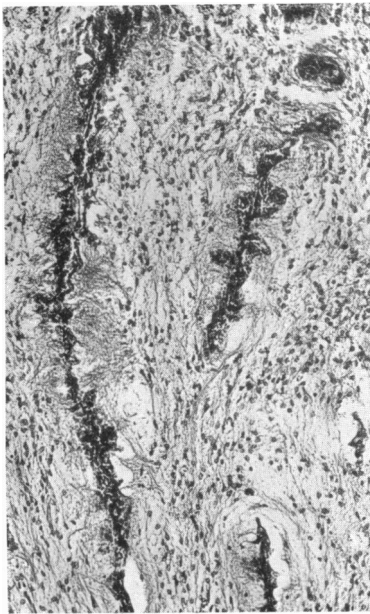


Fig. 5.

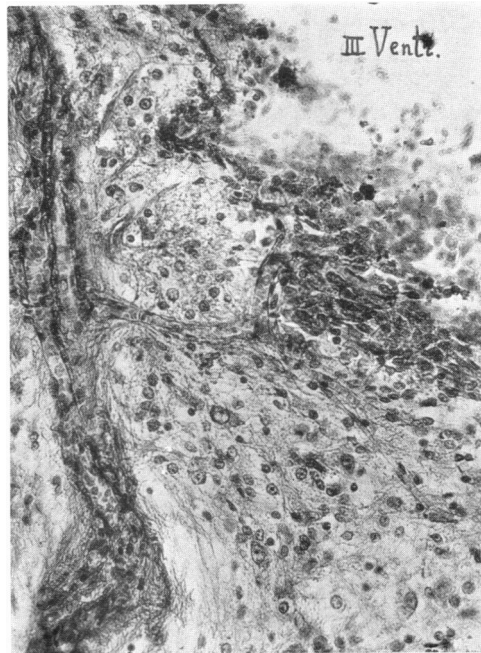


Fig. 6.