THE VENOUS SYSTEM OF THE BLADDER AND ITS SURROUNDINGS.

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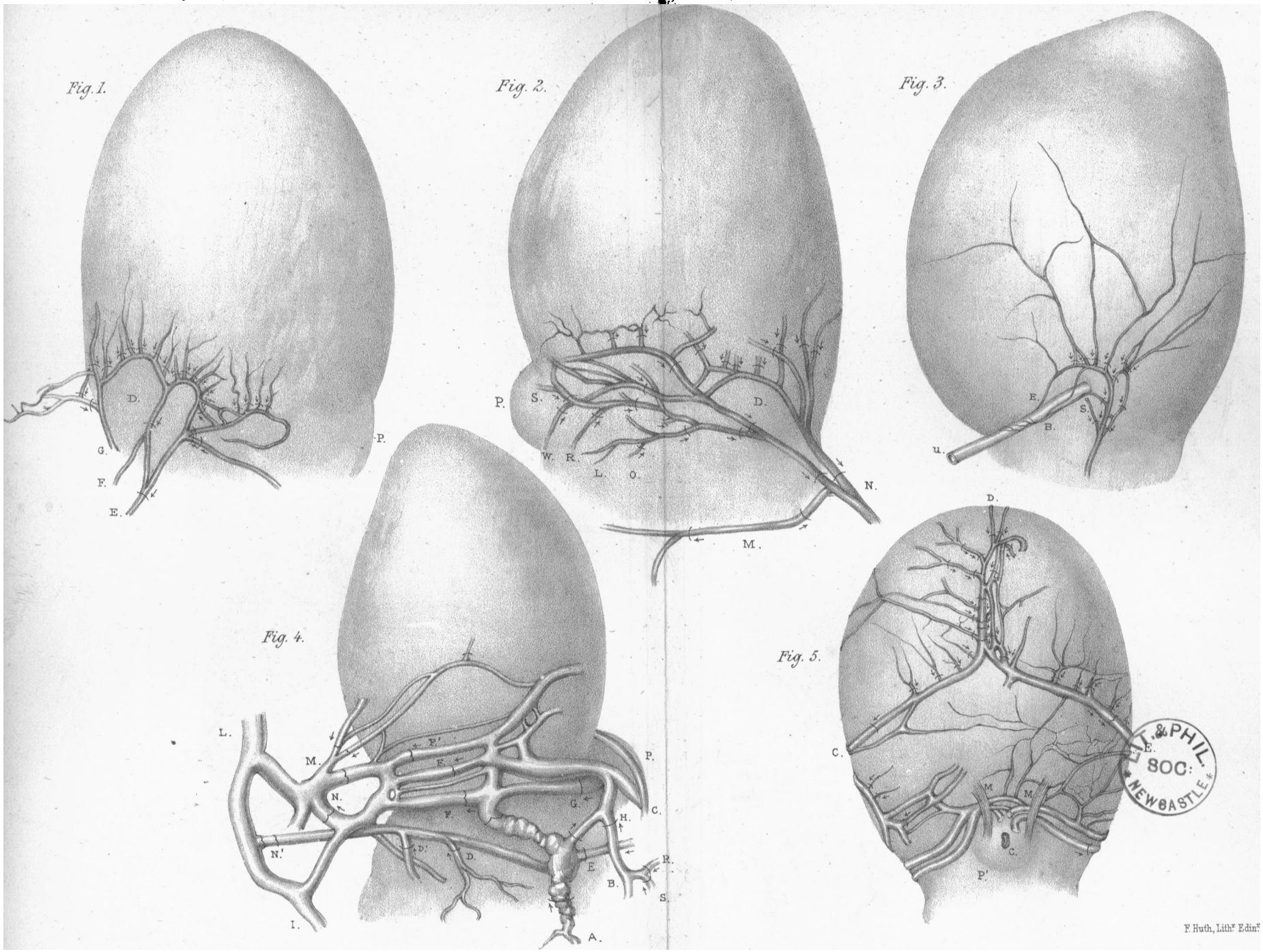
It is generally admitted that our knowledge of the venous system is neither so accurate nor so complete as that of the arterial.

This deficiency is doubtless due to the greater difficulty experienced in the injection and dissection of the veins, and the much greater diversity observed in their form, arrangement, and course. No part of the venous system, however, can vie with the pelvic plexuses in the many obstacles which have to be overcome before a complete injection is attained, for the anastomoses of their constituent veins are manifold, the gas produced in them is difficult to contend with, and the valvular impediments found in them are great. These same plexuses are also unrivalled for real difficulty of venous dissection. This fact is readily appreciated, if we consider the extreme delicacy of their walls, the lack of a firm support, the minute calibre of their smallest veins, and the fineness and intricacy of their mesh.

Of the vesico-prostatic plexus, the celebrated anatomist J. Hyrtl has said—"Preparations of the venous plexuses of Santorini belong to the curiosities of an anatomical museum" (J. Hyrtl, *Handbuch der prak Zergliederungskunst*, p. 734).

It is upon this plexus—the vesico-prostatic—that the writer has more especially concentrated his attention, for the mere anatomical knowledge of the other pelvic plexuses is accurate—here only is it fallacious. The inexactness of our knowledge, as exemplified in the differences which may be observed in the various pictures of this plexus, can be accounted for, and will be reverted to immediately. A more important point than the normal course of the veins has, however, to be introduced.

The laws of the directions of the venous currents through this and the other pelvic plexuses, as established by due consideration of the direction and position of the innumerable valves found therein, have never been laid down. As far as the writer



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can ascertain, the subject has been entirely overlooked, and the real value and influence which these current-regulators necessarily exert upon a part, through which large quantities of blood are momentarily passing, from which masses of blood are being frequently and suddenly displaced by the action of the viscera, has neither been justly estimated nor rightly appreciated. It is in the expectation of giving wider publicity to the subject, and thereby of gaining greater criticism, that the writer has ventured to publish briefly the results of a careful dissection of over fifty subjects only the normal anatomy being embodied in this paper.

In the investigation of the valves three points are to be insisted on.

1. No solid injection can be used.
2. Subjects should not be chosen above twenty-five years of age.
3. The veins must be slit up, to prove beyond doubt the existence and position of the valves.

1. It is absolutely impossible to ascertain the existence of valves in the veins, if any solid injection is thrown into them. To dissect uninjected veins necessarily increases the difficulty of investigation, but it is the only course adaptable.

2. Only young bodies can be used. This is a point of paramount importance. The advice given by Lenhossek is not good. He says—"To exhibit the venous system of the pelvis take a very *old* corpse because in it the veins are varicosed"[1] (they are easier to inject).

It is to the fact that for greater ease in preparation, bodies with such varicosity of the veins have been selected, injected, and depicted, that we owe our mistaken belief in the normality of that marked diversity thus observed in the form and arrangement of the vesico-prostatic plexus.

It will be found, however, that in subjects from the seventh month of intra-uterine life to the age of twenty-five, one broad type is clearly marked. Divergencies therefrom are few and trifling. After the latter age pathological changes may set in, greater stress may be thrown upon one or more particular points in the plexuses, involving enlargement of pre-existing venules

[1] Lenhossek, *Das Venöse Convolut der Beckenhöhle beim Manne*, 1871.

or even the formation of new venous channels, and the resulting venous plexus differs greatly from the normal arrangement.

3. A slight change of contour in the vein often simulates a valve; it is necessary, therefore, when valves are apparently found, to slit up the vein and confirm its presence. This is a rule reflecting some criticism upon the work of M. Houzé de l'Aulnoit (*Recherches anatomiques—sur les valvules des veines*, Paris 1854), the author who pointed out that valves exist in the veins at the base of the bladder. He describes his method of ascertaining the presence of a valve thus:—"If I could not see the valves I could always throw them into bold relief by a little pressure of the finger along the vein" (*i.e.*, by driving the contained blood against the valve). This method is not only crude, but extremely misleading, for often small blood clots will so block the finer veins as to simulate valves most markedly.

Method of Dissection.

My earlier dissections were all made after the venous plexuses had been inflated, the knife cleaning the tense veins with certainty and ease. Coloured fluids were then thrown in, in a direction, which, in the living subject would be opposed to the normal venous current. The valves were easily seen through the thin-walled veins pouched by the force of the fluid. Their situation was then marked upon a plan previously taken of the dissection. Much labour was thus expended, each vesico-prostatic plexus and its connection often demanding more than a week's continuous work. I soon found it to be a quicker method to dissect out a small tract of a vein at a time, to clamp each end of the exposed piece, to make a diagram of it, and to inject it with fluid coloured with Berlin blue. If the injection was suddenly arrested, and a corresponding swelling at the site of the obstruction was observed, the vein was incised over the obstruction, and generally a valve exposed. It was then depicted.

For injecting the larger veins an ordinary Pravaz syringe with a small nozzle was used, but in the smaller, especially those in the intra-uterine subjects and in those of early childhood, the finest capillary glass tubes were absolutely necessary. The

greater part of the dissection of the finer meshes on the bladder had to be performed in direct sunlight.

Results.

Consideration of the Valvular Arrangement of the Pelvic Venous System as a whole.—The venous bed in the pelvis, and the numerous tributary veins which enter it from below, may be roughly compared to a room with many approach-passages and with only one exit, the doors of these approach-passages opening inwards, permitting ingress, but preventing egress.

All the many veins which converge from the buttocks, genitals, and lower extremities to the pelvis, be it to the true or false divisions of that cavity, are valved at their entrance into it. These valves—some of the veins have two or even three sets—allow the venous blood to flow freely into the abdomen, but prevent its escape therefrom. Hence the abdomino-pelvic venous blood-pressure is entirely shut off from that of the lower extremities and genitals. The accuracy of closure and the constancy of position of these entrance-valves is most striking.

Prostatic System.

The large dorsal vein of the penis which runs in the median groove of that organ is valved, often trebly so, just in front of the sub-pubic ligament.

After passing backwards beneath this structure it splits into two parts which clothe the sides of the prostate. Here it forms, with veins from the prostate and other tributaries, the *labyrinthus venosus* of Santorini.[1] The veins from this plexus or labyrinth travel backwards, receiving in their course veins from the sides and base of the bladder, and peri-rectal cellular tissue, and finally empty themselves into the internal iliac veins.

Valves.

Valves are present in all parts of this labyrinth of Santorini, or, as we shall term it, the vesico-prostatic plexus, from its

[1] Santorini, *Observat.*, p. 194.

commencement at the pubic arch to its termination in the internal iliac vein. These valves are in three groups. One group is found just behind the pubes, *i.e.*, at the commencement of the tract; another, a very constant and strongly made set, is placed at the termination of the tract guarding reflux from the internal iliac vein; a third set, less constant and apt to degenerate, is placed about the middle of the tract.

I would here briefly describe a valvular arrangement adjuvant to the post-pubic set of valves, which varies in strength according to the muscular development of the bladder.

Passing from the anterior and inferior surface of the bladder over the upper and anterior surfaces of the prostate are two thin muscles, the bundles of which seem to be generally in direct continuity with the anterior longitudinal fibres of the bladder. After crossing the various veins found on the prostate, *i.e.*, the post-pubic part of the vesico-prostatic plexus, each slip goes partly to be inserted into the pubes, beneath and outside the pubo-prostatic ligaments, and partly to blend with the innermost fibres of the anterior margin of the levator ani muscle of the corresponding side.

On contraction of the bladder, each plexus is compressed by the simultaneous contraction of this cross muscle, and hence regurgitation of the blood from the anterior inferior zone of the bladder, which is valveless, and from the rest of the plexus, now over-distended with the blood expressed into it by the contracting vesical wall, is prevented. We have as yet found no record of these—"the tourniquet muscles," as we may call them.

Tributaries of the Vesico-Prostatic Plexus.

Numerous veins enter this plexus—coming from the bladder, vesiculæ seminales, ureter, prostate, pubes, peri-rectal tissue, and anus.

With few exceptions every vein is valved at its entrance—often doubly valved. The plexus then is a large venous highway—the many paths leading into which permit of no backward passage—the blood passing of necessity directly into the inferior vena cava without attempting a circuitous route.

(*a*) With the exception of the anterior inferior zone of the

bladder, to be referred to immediately, most of the veins at the sides and base of that viscus are valved at their entrance into the vesico-prostatic plexus.

(*b*) The branch from the pudic vein and those from the peri-rectal veins are all powerfully valved. This fact is in direct opposition to the view generally taught, that the rectum can normally serve as a venous diverticulum to the bladder and prostate.

(*c*) Veins from the prostate gland entering the vesico-prostatic plexus are either *valved* or enter so obliquely from before backwards that their orifices guard them to a great degree from backward pressure.

Vesical Plexus.

This is, of all others, the most interesting, as it is, of all others, the most complete. There are three venous meshes—the submucous net (quite unvalved), the muscular, and the subperitoneal, both most carefully and intricately valved.

The Subperitoneal.—As regards their arrangement, it will be seen that the veins here have a very characteristic and purposeful course. On the anterior surface of the bladder a vertical vein commences at the summit, and after traversing the upper two-thirds, and draining it to that extent, it bifurcates. Each of the veins thus formed sweeps obliquely round the lateral surfaces of the bladder to empty itself more posteriorly into the vesico-prostatic plexus. We have named it the inverted Y-shaped vein. Thus, venous blood, from the entire upper two-thirds of the anterior surface, is forced on contraction—not into the plexus behind the pubes to arrest there the inrushing blood from the penis—but posteriorly and obliquely towards the termination of the plexus. The anterior inferior one-third of the bladder is drained by minute valveless veins into the post-pubic part of the plexus.

The veins from the lateral, posterior, and inferior parts of the bladder all open towards the posterior inferior angle of that viscus into the termination of the plexus, and all the veins here are stoutly guarded.

The veins on the posterior surface consist in two laterally

vertical veins, which are united by a cross branch. Their form thus resembles the capital letter H.

In describing the many valves found in the subperitoneal and muscular meshes, the bladder may be conveniently divided into three zones—a superior, middle, and inferior. These zones are again subdivided into anterior, lateral, and posterior divisions.

It will be found that in the normal bladder each of these zones (with the exception of the lower part of the anterior inferior zone) contains many valves, the constancy and strength of which is remarkable.

So evident is the design of directing the blood towards the posterior inferior angle—so carefully has venous pressure been minimised by the valves—that even the veins of the fat and cellular tissue which commonly surround and accompany the urachus to the umbilicus, are doubly, often trebly, valved—though here most minute—and the valves are so placed that they direct the blood from the region of the umbilicus into the valved H or inverted Y veins just described, and thence into the internal iliac vein.

The veins from the base include those from the third lobe of the prostate,—the vesiculæ seminales, the ampullæ of the vasa deferentia,—and pass for the greater part into the termination of the vesico-prostatic plexus, just before it empties itself into the internal iliac vein. They all are strongly valved.

The veins from the lower third of the ureter enter with the above, and are similarly strongly valved.

The Pudic Vein.

This has exactly the same valvular disposition which the writer proved as existing in the deep epigastric, and in every intercostal vein (Braune and Fenwick, *Die Venen der vorderen Rumpfwand des Menschen*, 1884).

There are three divisions—an internal iliac, a perineal, and a prostatic division. The middle or the perineal division receives tributaries, but, being valveless, allows the blood flowing into it to pass either into the vesico-prostatic plexus or into the internal iliac vein. Both the prostatic and internal iliac sections are valved at their terminations so as to prevent blood regurgitating into the pudic tract.

The internal iliac veins are formed by the fusion of several veins—gluteal, sacral, sciatic, obturator veins, and the vesico-prostatic plexus—all of which, except the tributary from the sacral plexus, are accurately valved.

A full account of the work will shortly be published; but from the above superficial description it will easily be appreciated how designedly and carefully the veins of the pelvis have been valved, and in such a manner as to reduce, in so far as is possible, the liability to congestion to which this, "the venous province par excellence," as Luschka calls it, must necessarily be exposed.

EXPLANATION OF PLATE XVI.

Fig. 1. Male, æt. 8. Right lateral aspect of bladder to show right postero-lateral angle. P, prostate; D, spot where water is found; E, F, G, veins to enter last part of vesico-prostate plexus.

Fig. 2. Same bladder. P, prostate: N, vesico-prostatic plexus; M, venous branch displaced somewhat downwards, receiving blood from peri-rectal tissue, and anastomosing with hæmorrhoidal vein; R, L, O mark similar branches; W, branch from internal pudic.

Fig. 3. Right postero-lateral angle of bladder of male, æt. 29. U, ureter; E, F, G, S, circumuretral ring of veins; E, vein from base of bladder; B, uretral vein.

Fig. 4. Right lateral aspect of bladder of male, æt. 38 (many valves atrophied). P, prostate; A, veins from perianal ring, extending from A upwards to vesico-prostatic plexus, is a pouched, valved vein; B, termination of internal pudic; R, S, inferior hæmorrhoidal branches; E, branch from bulb; D, D′, peri-rectal veins; F, F′, mid-plexial valves, G, isolated post-pubic valve; M, N, N′, terminal valves; I, L, internal iliac.

Fig. 5. Bladder of male, æt. 75. P, prostate, with contracted orifice of urethra, *c*; M, the tourniquet muscles cleaned as they cross the plexus; C, D, E, the inverted Y vein.

The diagram shows the antero-inferior zone valveless.