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ADENOMA VAGINÆ DIFFUSUM (ADENOMATOSIS VAGINÆ), WITH A CRITICAL DISCUSSION OF PRESENT VIEWS OF VAGINAL AND HYMENEAL DEVELOPMENT.

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THIS exceedingly rare condition has been recently described for the first time by Bowley and Bryden Glendinning.[1] Bowley and Glendinning describe the clinical features as follows[2]:—A red granular honeycombed appearance of the vaginal walls, small cysts, and a continuous secretion of a mucous fluid like white of egg.

Pieces of the vaginal lining, when removed and submitted to microscopical examination, gave the following condition:—Epithelium poorly stratified, reduced to a single layer at many places; fibro-muscular stroma, with the muscular element predominant but ill-formed; tissue permeated with numerous gland-spaces lined by a single layer of columnar epithelium, which was traced in continuity with the superficial layer; no elastic tissue immediately under the epithelium, but its presence round the vessels.

In Dr. Haultain's case, malignant disease developed later.

I now take up in explanation of this condition the question of the development of the vaginal tract in the human female, and also in marsupials. This involves the consideration both of vaginal development and also of the nature of the hymen. The first has special bearings on diffuse adenoma of the vagina, but I purpose at the end of the paper also taking up critically the development of the hymen.

If we look at a transverse section of the genital cord[3] in a human embryo about the sixth-seventh week we see in it three lumina; the two outer are the Wolffian ducts, separate, the mesial one the two Müllerian ducts coalesced. It is important to notice

[1] Bowley and Glendinning, "Adenomatosis Vaginæ, a Hitherto Undescribed Condition," *Proc. Roy. Soc. Med.*, iv.; *Obstet. and Gynec.*, I. Trans. p. 18.

[2] A case has also been recorded by Dr. Haultain, in whose practice it occurred some time ago.

[3] The genital cord is practically the part where the ducts of Müller, Wolffian ducts, and urinogenital sinus are imbedded in connective tissue, and not free at any part of their periphery.

that at this early stage—sixth-seventh week—the septum between the Müllerian ducts has disappeared. The Müllerian duct is lined at this time with a low columnar epithelium. At a certain level of the urinogenital sinus corresponding to a point in the adult vagina an inch or so above the hymen there is a distinct projection on the posterior wall of the duct—the eminence of Müller. Here the Müllerian ducts end blindly. Below the eminence of Müller the Wolffian ducts open one on each side (Fig. 1). The urinogenital sinus is relatively long at this period, and indeed has been described erroneously as the future vagina. At this stage, then, the Müllerian duct, which will form part of the future vagina, has a single lumen, is lined with columnar epithelium, has no lower aperture, and no hymen is present. In earlier sections the ducts are double.

The next distinct stage of development known to me is at the fourteenth week, and this is an important period, as it is at this period of fœtal development that the hymen develops. I have examined two specimens at this time, and, so far as I know, no other similar specimens have been described, even by observers who have strong views opposed to mine on the nature of the development of the hymen. Specimens at this period are best cut in the form of a central mesial slab in sagittal central section, as the paraffin blocks are somewhat large, and this direction gives a useful view of the whole tract.

In such a section one can see from above down—(1) The uterus with a lumen and beginning formation of glands; (2) the lower end of the cervical canal blocked with epithelium; (3) the vagina solid with cells, and with a line of clear space between them and the connective-tissue wall of the duct; (4) at the lower end, a remarkable condition, viz. a development of two bulbs of epithelium with cells exactly like the squamous epithelium of the adult vagina, and into one of these I traced the Wolffian duct. From these bulbs —the Wolffian bulbs—the squamous epithelium spreads up into the Müllerian duct, blocks it, absorbs its epithelium, maps out the future fornices, solid also, and passes a short distance into the cervical canal. Outside the bulbs, and higher up, the epithelial streams from each bulb communicate before entering the Müllerian ducts, and one can still see the Wolffian duct lying by the side of the vagina as would be expected (Figs. 2, 3, 4, 5).

Thus, at or about the fourteenth week of fœtal life two lateral bulbs develop at the lower ends of the Wolffian ducts at a level a little below the eminence of Müller, where these open into the

FIG. 1.—T. S. genital cord, 6-7 weeks' fœtus; in front, urinogenital sinus; between sinus and pouch of Douglas, Müllerian and Wolffian ducts; behind pouch of Douglas, rectum.

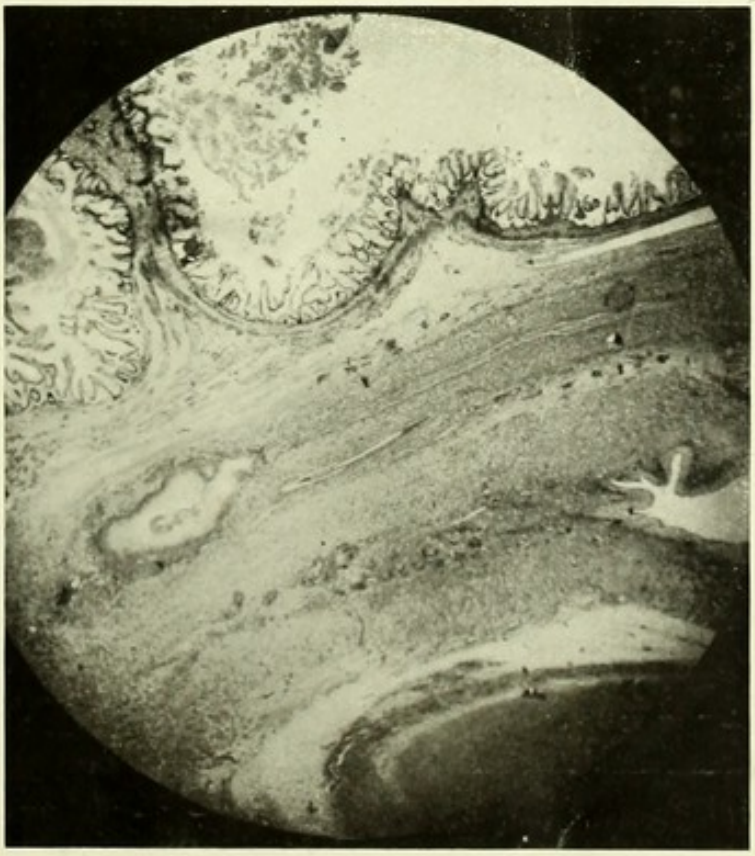

FIG. 2.—Shows sagittal mesial section of 6-7 weeks' fœtus; at left side coalesced Wolffian bulbs passing into Müllerian solid duct; below, Wolffian duct.

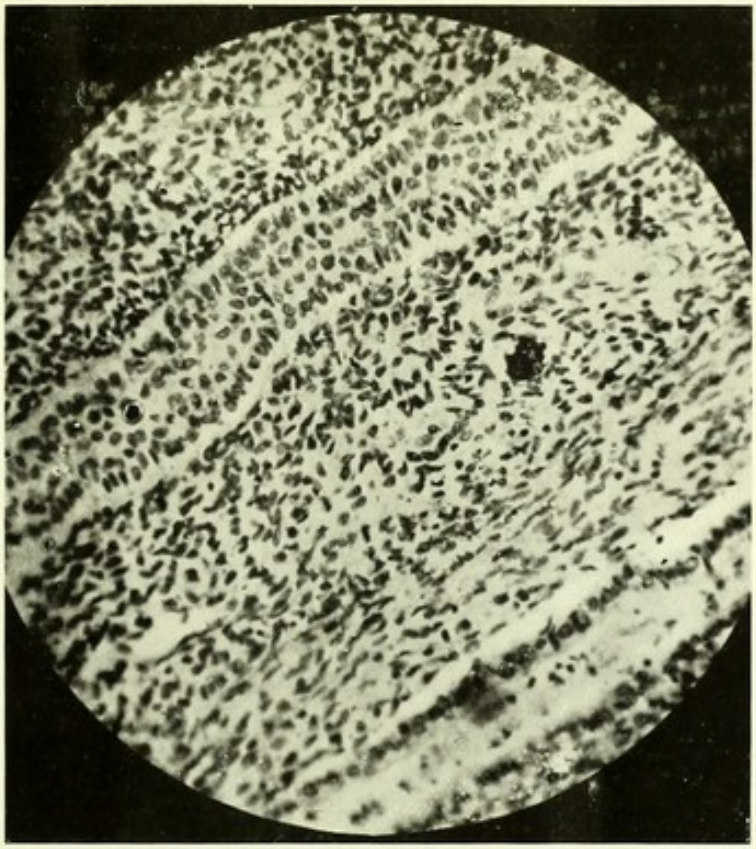

Fig. 3.—Shows solid Müllerian duct above and Wolffian duct below (14th week).

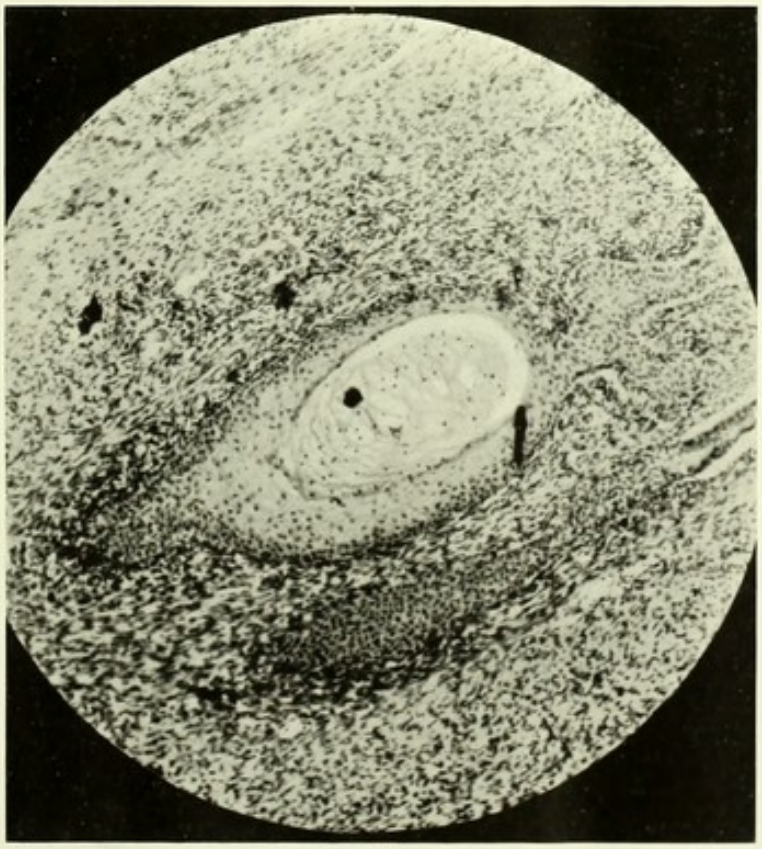

Fig. 4.—Shows large Wolffian bulb above, with epithelium passing into Müllerian duct; below is second Wolffian bulb with Wolffian duct continuous (14th week).

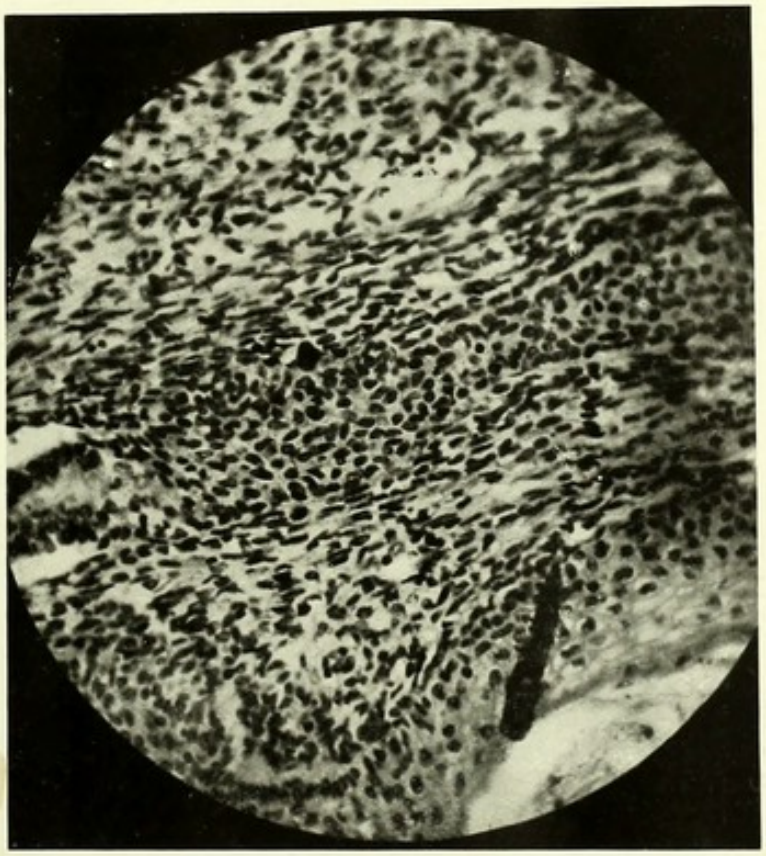

Fig. 5.—Shows Wolffian duct ending in small bulb and part of larger bulb in front at lower right corner.

urinogenital sinus, and thus a little below the site where the Müllerian duct forming part of the vagina ends blindly. These bulbs proliferate in two united columns, pass up into the Müllerian vagina, absorbing its epithelium, and then this solid ingrowth breaks down centrally and gives once more a vaginal lumen. This, however, is now of a stratified squamous nature, able to stand the friction of labour. It is analogous to skin in its structure, and differs from it in not possessing hair or glands.[1]

We get a very striking illustration of this method of development of the vaginal tract if we consider the structure, naked-eye and microscopic, of the vagina in marsupials.

The Vaginal Tract in Marsupials.—The vaginal tract in the marsupials is very remarkable, as it is made up of three canals known as the lateral canals and the central canal. The two lateral canals communicate with the upper part of the central one, and open into the urinogenital sinus below. The central canal is a closed pouch usually, but in some, for instance in Bennett's kangaroo, the central pouch communicates directly with the urinogenital sinus. When it does not, it is said that in parturition the embryo passes from the central pouch into the urinogenital sinus, thus breaking down the separating tissue. This is a very extraordinary fact, and it may be that the other view, viz. that the fœtus passes down the lateral canals, is correct.

In 1907 I examined microscopically the entire genital tract (one lateral half) of the rat kangaroo, and found a very remarkable condition present.

The lateral canals are lined with a multiple-layered epithelium like that of the adult human vagina, while the central portion has a glandular epithelium. There is thus preserved in the central canal the temporary condition of the Müllerian ducts in the human embryo, and in the lateral canals, epithelium the same as the permanent epithelium which removes and displaces the Müllerian epithelium in the human embryo. The lateral canals are therefore Wolffian ducts in whole or in part (v. d. Broek), the central canal the Müllerian ducts combined, or cervix according to v. d. Broek.

In considering this point again, in view of v. d. Broek's criticism that the whole lateral canals are not a vaginal element, it occurred to me to look over Owen's specimens again. In one of them there is present what looks like an os externum, at or about

[1] Von Preusschen long ago described occasional glands in the adult vagina a fact explained by its development given above.

the lower third of the lateral canal. If this be right, then below the os externum is vaginal; above it, up to the top of the central point, uterine. As it is lined with squamous epithelium in many layers, it corresponds to the part of cervical canal in the human fœtus temporarily lined with squamous cells like the vagina.

Diffuse adenoma of the vagina in the human female is thus a persistence of a fœtal condition owing to the epithelium of the Müllerian ducts remaining permanent, probably from its not having been absorbed and replaced completely by the ectodermic cells of the Wolffian bulbs.

I wish now to discuss the various views of the nature and development of the hymen.

Within the past few years the question of the development of the vagina and hymen has been a good deal investigated, but observers are still at variance in their opinions, and as I am mainly responsible for one of these, viz. that the vagina is Müllerian in its upper two-thirds and urinogenital sinus in its lowest third, and that the hymen originates from the lower ends of the Wolffian ducts and is a development in the urinogenital sinus, I purpose reopening the subject and considering critically its main points.

In the adult virgin female the relations and naked-eye anatomy of the hymen can be observed in an operative case when the patient is under chloroform and in the lithotomy posture. If the labia minora are drawn not too far apart, it will be found to be a double pouting sagittal mesial ridge with the edges of the slit-like opening in apposition (Cullingworth), the upper coalesced ends often overlapping the urethral orifice. The alleged various forms of normal hymen, where the aperture is described as oval, crescentic round, and so on, are due to lateral traction on the edges of the hymen, causing disturbance in their normal apposition. Even when the hymen has a double slit the above applies.

On naked-eye examination of the hymen in anatomical virgin specimens, one can see on its inner aspect rugæ continuous with those of the vagina, as Budin pointed out. Its covering is more analogous to skin, a fact often rightly emphasised as regards the vagina. The microscopical structure of the hymen has been well described by Gellhorn among others. It is covered with a many-layered epithelium on papillæ of connective tissue, with elastic and sometimes unstriped muscle in its substance; special nerve endings have been observed. In the hymen in some atresic cases it has been noted that the inner surface is covered with single-layered epithelium, the outer with multiple-layered epithelium.

Nagel, in a sagittal section of a 4 cm. fœtus, describes the eminence of Müller as made up of special protoplasmic cells, and considers the cells at the level of that part of the Müllerian ducts forming the future vagina to be of a different nature from those at a higher level. Any change in the epithelium afterwards he considers as a local development and not an invasion from any other source.

It is very generally held that the hymen is the thinned-out lower end of the vaginal walls. Budin, who stated this view very clearly and fairly, studied it from the point of view of naked-eye anatomy, and pointed out that the vaginal rugæ could be traced on the inner surface of the hymen. In this he is quite correct, but in a conversation that I had with him on the subject he stated that this was not conclusive evidence that the hymen had not an origin from the Wolffian ducts.

Pozzi and others have associated the hymen with the vulva, and Matthews Duncan drew attention to the fact that in ordinary atresia hymenealis leading to the retention of menstrual blood the edge of the hymen was present. This I have verified in some cases and found that the hymeneal edge fringed the occluding membrane.

The view that the hymen is vulvar[1] in its nature is quite untenable. The hymen lies, in the adult virgin, in the lower part of the former urinogenital sinus. It is separated from the labia minora, has the vestibule above it and the vaginal aspect of the fossa navicularis between it and the fourchette. Those who hold the view argue by imperfect exclusion, and conclude that if the hymen is not Müllerian it must belong to the external genitals, thus leaving the urinogenital sinus quite out of consideration.

An important contribution to the development of the vagina was made by Tourneux and Legay, and by Nagel, and confirmed by myself and others, when it was pointed out that at one stage of its development the Müllerian lumen became blocked by epithelial cells and was therefore solid for a time.

Klein and Nagel state that at about the fourth and a half month the lower end of the vagina is thus blocked by a mass of epithelial cells, and Klein considered that it was by this breaking down and by an involution from below that the hymeneal aperture was made.

According to Nagel, "the Müllerian ducts are originally composed of large protoplasmic cells of an epithelial character. Around

[1] This view does not include the urinogenital sinus in the vulva.

this mass of cells, which gradually becomes a tube, the mesodermal formative cells are grouped in a circular arrangement, thus forming the first Anlage of the connective tissue and muscular layer of the Müllerian ducts; in other words, the connective tissue appears after the ducts are established, and grows in proportion to and together with the downward growth of the ducts. Thus when the ends of the ducts protrude into the sinus in the form of an epithelial protuberance, their connective tissue comes down with them, grows into the terminal conus, and forms the inner or central layer of the protuberance."

If this be the true mode of origin, "the hymen" (Gellhorn urges) "is a product of the Müllerian ducts exclusively. The epithelium of the sinus urinogenitalis does not play any active part but only covers the outer layers of the epithelium of the Müllerian ducts in the form of a very thin cuticle. Thus it is readily understood why the epithelium of the vulva can be dissected from the hymen as recorded above in connection with the theories of Pozzi and Schaffer" (Gellhorn, *op. cit.* p. 495). Nagel objects to my view that the Wolffian ducts I described may be Bartholinian or a low implanted ureter. The Bartholinian duct, however, has not developed at this period, but does so about the fourth and a half month, and its axis is different, seeing that it runs transversely in to end on the outer aspect of the hymen. A low implanted ureter is exceedingly rare in the adult, and only a few cases have been recorded. I have described such, and shown that the so-called implantation of the ureter is due to a persistent communication of Wolffian duct and ureter; and when the normal development of the ureter and part of the kidney is considered, viz. that it is due to a budding upwards from the Wolffian duct to meet the part developed above from mesoblast, the cause of the anomaly is at once evident.

J. C. Webster of Chicago, in a probationary essay on the "Early Wolffian and Müllerian Ducts" for the Fellowship of the American Gynæcological Society, opposes my views and agrees with those of Nagel. The most noteworthy feature of Webster's paper is that he describes no specimens bearing on the development of the hymen. His paper is thus a purely literary one and not of scientific importance. He is not consistent in his criticism, as at page 457 he states—"After the careful researches of Nagel and Hart regarding the origin of the hymen, which I have recently corroborated . . . "—but from the fact that he describes or figures no specimens and had previously disagreed with me, the position he there takes up is a puzzling one.

Gellhorn in his paper urges against my view that "systematic researches of other investigators result in an altogether different conception of the course of the Wolffian ducts. Until recently the majority of observers believed that the Wolffian ducts terminated at or near the cervix uteri in the upper part of the vagina. This view can no longer be held. Beigel, Dohrn, v. Ackeren and others first described *rests* of the Wolffian ducts along the entire length of the vagina, and Klein, in 1897, demonstrated in serial sections the course of the Wolffian ducts within the hymen. It must be noted that v. Ackeren, Klein, and Groschuff, Seitz, Hengge, the last three working with Klein, found the Wolffian ducts within the hymen" (Gellhorn, *op. cit.* pp. 428, 429). These facts, however, are not only not against my view but are directly confirmatory of it. Had the Wolffian ducts normally ended above the level of the hymen that might have been fatal to it. What Gellhorn finds in the quotation given against my view I fail entirely to see; in fact it is totally irrelevant, and I see no point in the quotation hostile to my view at all.

Kempe has shown that in the white rat the hymen develops from a bridge of tissue below the ends of the Müllerian ducts (see Quain's *Embryology*, T. H. Bryce).

Dr. Wood Jones, in a valuable paper, has been the first observer to confirm the existence of the double bulbs I have described, and he considers them to be derived from the Müllerian ducts, but the details are not given and there is thus no opportunity of discussing his views. He believes the hymen to be "the tissue these bulbs do not penetrate." He also confirms my statement as to the urethra becoming occluded by the bulbs and re-tunnelled, a process analogous to what happens at the vaginal orifice. Indeed some observers have described what they term a urethral hymen, which is probably due to this urethral perforation.

One difficulty in accepting Dr. Wood Jones's view is that even at the sixth week the Müllerian duct in the genital cord has a lumen and is single. Dr. Jones's view, apart from other points, would require the Müllerian ducts to re-acquire a double lumen.

The view that the hymen is Müllerian has at first sight much to recommend it, but it fails to account for several facts. In Nagel's account he figures, as I have already noted, in a 4 cm. fœtus the urinogenital sinus with the Müllerian eminence made up of well-marked protoplasmic cells, the Anlage of the hymen and vagina, and considers the cells higher up where the uterus and tubes form to be different. The ultimate vaginal lining he con-

siders to be due to a local proliferation, and he figures this as blocking the vagina in a three months' fœtus. Those who accept Nagel's view are omitting the consideration of the all-important stage of the double bulbs I was the first to note. All other observers who figure the epithelium blocking the vagina figure it as a single and local epithelial plug. Of course it is a very evident deduction from their facts that this proliferation and distension open up the lower end of the vagina and form the hymen. These two far apart stages of Nagel from a 4 cm. fœtus to one at the third and a half month are not the only ones, and to criticise my view on them alone must lead to an erroneous conclusion. Gellhorn, indeed, takes this one stage of Nagel's in the 4 cm. embryo, and writes as follows:—"From this eminence the hymen is formed. The fine details may to my mind be conceived as follows:—When the united Müllerian ducts reach the sinus urinogenitalis they push the thin layer of epithelium lining the sinus forward, and by so doing they make this epithelium even thinner than before. This condition is clearly seen in Nagel's picture. In this stage the lower ends of the Müllerian ducts represent a somewhat cone-shaped solid epithelial cord. The formation of a lumen proceeds from above downwards, and this canalisation corresponds with the course of the ducts themselves, with its concavity anterior. Therefore the point where the lumen of the duct breaks through the solid end is as a rule nearer the upper border of the conus and so is responsible for the production of the semilunar form of the hymen, which is by far the most common. The concave course of the Müllerian ducts is due to the curved abdomen of the embryo. The extremity of the conus (Müllerian eminence), with a more or less eccentric lumen projecting into the sinus, consists at first only of the epithelium, covered on the outer surface with a very thin layer of sinus epithelium. Only secondarily is this mass of epithelium invaded by connective tissue" (Gellhorn, pp. 434, 435).

Gellhorn admits that this account of his as to the origin is almost entirely hypothetical, and it is indeed remarkable as a piece of induction. He describes the development as occurring in the stage of the 4 cm. fœtus of Nagel, and does not figure any subsequent stage or indeed describe any such until the fourth month of Nagel's specimens. The hymen is not formed at this early stage but at a much later one—three to four months—so that he rejects my views on insufficient grounds and brings forward a purely hypothetical and wildly improbable theory.

Taussig agrees with Webster and states (in a footnote) that "Webster has fully pointed out the fallacies of his (Hart's) conclusions." He further states that he has assumed that the vagina is entirely formed by the coalesced Müllerian ducts and not to any extent by the urinogenital sinus (p. 99), *i.e.* he assumes what he should prove or disprove and rejects actual specimens in favour of a mistaken preconception.

Bolk in a recent important paper gives the history well, and his conclusions are as follows:—

"Nach Dohrn entwickelt sich somit die Klappe sekundär, hat nichts mit der ursprünglichen Müller'schen Papille zu tun und ist die hymenale Offnung eine primäre Offnung, nämlich das nicht ganz verschlosene Lumen des Scheidenkanales. Doch bleibt immerhin der Hymen eine vaginale Bildung. Eine dritte Ansicht, die hier kurz erwähnt zu werden verdient, ist jene von Berry Hart. Die morphologische Deutung der Scheidenklappe, die dieser Autor gibt, hängt mit seiner Auffassung der Entstehung der Vagina zusammen. Es sollte nämlich der untere Dritteil der Scheide nicht von den Müller'schen, sondern von den Wolff'schen Gängen gebildet worden sein und demzufolge musz der Hymen als ein Produkt der terminalen Enden dieser Kanäle angeschen werden; so sagt der Autor (l. c. S. 342): 'thus the hymen is formed by a special bulbous development of the lower ends of the two Wolffian ducts, aided by an epithelial involution from below of the cells lining the urogenital sinus.' Schlieszlich musz die Auffassung von Pozzi erwähnt werden, der den Hymen als eine vulväre Formation deutet, entstanden aus zwei seitlichen Falten, die sich auf die Seitenwände des primitiven Sinus urogenitalis bilden, und einander entgegenwachsend in der Medianlinie sich verbinden.[1] Der Hymen würde somit paariger Herkunft sein und von dem Müller'schen Hügel ganz unabhängig sein.

"Der zweite Punkt betrifft die Herkunft der Vagina. Die älteren Autoren (Müller, Valentin, Rathke) meinten, dass die Scheide eine differenzierter Teil des Sinus urogenitalis war, eine Ansicht, die durch spätere Untersuchungen als nicht richtig erkannt worden ist. Weitaus die meisten Autoren erblicken jetzt in der Vagina ein Bildungsprodukt ausschlieszlich der Müller'schen Gänge. Nur einige wenige Autoren nehmen einen etwas anderen Standpunkt ein. Jener von Berry Hart geht schon aus dem Obengesagten hervor, und wird weiter deutlich durch die zwei

[1] Pozzi's view has been classed with those deriving from the external genitals, omitting the fact that he places the urinogenital sinus with them.

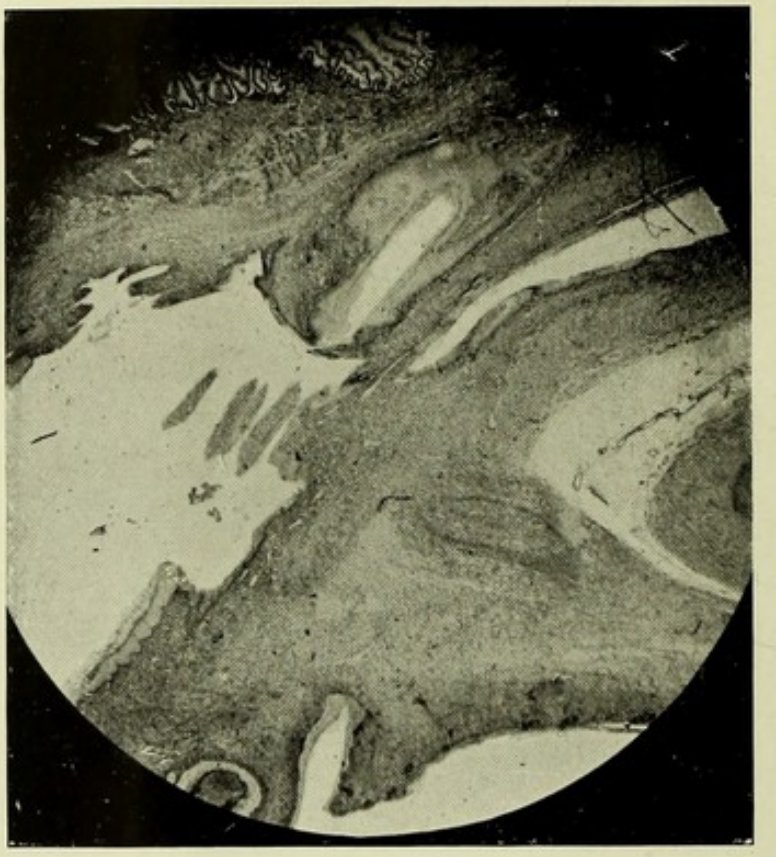

Fig. 6.—Formation of hymen. To left is urinogenital sinus (vestibule) and above Wolffian bulbs breaking down.

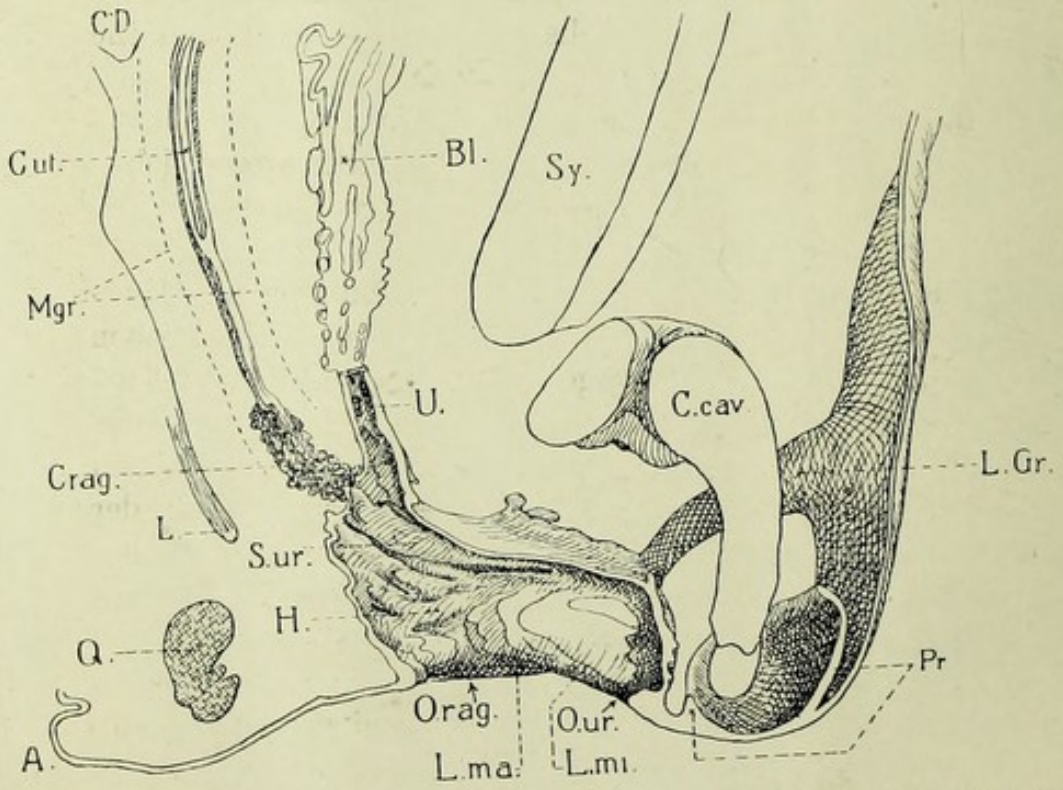

Fig. 7.—Mesial sections through the urinogenital sinus of a 13·5 mm. (head-breech length) female embryo, viewed from within. A. Anterior end of anus; Q. M. Sphincter ani; L. Longitudinal muscle of rectum; C.D. Lower end of pouch of Douglas, posterior; C. ut. Cavum uteri; M. gr. Boundary of uterine mesenchyme; C. rag. (instead of vag.). Conus vaginalis; Bl. Bladder; U. Urethra; S. ur. (instead of uv.). Plica septi uro-vaginalis; O. ur. Anlage of the ostium urethræ; Sy. Symphysis; C. cav. Corpus cavernosum clitoridis; Pr. Prepuce fold; L. gr. Boundary opposite labium majus; L. ma. Labium majus; L. mi. Anlage of the labium minus (Spuler, *op. cit.*, fig. 35, p. 628).

My own views, confirmed by Bolk, as stated in 1901, are as follows (*Edin. Obstet. Trans.*, 1900-1, xxvi. 273):—

1. The upper two-thirds of the vagina are derived from the ducts of Müller.

2. The lower third is due to the coalescence of the upper portion of the urinogenital sinus and the lower ends of the Wolffian ducts.

3. The epithelial lining of the vagina is derived from the Wolffian bulbs, which again are epithelial proliferations of the lower ends of the Wolffian ducts. The vaginal mucous membrane is thus ectodermic.

The hymen forms at the Wolffian-ducts-opening and not at the eminence of Müller as usually stated. I think it probable that the Wolffian bulbs block the urinogenital sinus, and that the lumen is re-established as a double one, urethral and vaginal, by an epithelial central resolution and by involutions from the sinus below. Thus in the adult female the vestibule, lower third of the vagina, and lower end of the urethra are derived from the sinus urinogenitalis (pp. 273, 289) (Figs. 6 and 7).

In the new edition of Veit's *Handbuch der Gynäkologie*, Spuler in a comprehensive article emphasises the above views (Bolk's and my own), and gives also his own researches on the comparative anatomy of this region in cavia—felis, ovis, sus—specially on the cavy.

The following are his conclusions (1908):—

"Bei meinen Untersuchungen kam ich in einem wesentlichen Punkt zu einem von den Bolkschen abweichenden Resultat. Im November 1907 habe ich in der Erlanger Societas physico-medica mitgeteilt: Die Vagina entsteht nach Untersuchungen an Cavia, Felis, Ovis, Sus, speziell an Cavia, und auch an menschlichen Embryonen, aus zweierlei Bildungen; aus einem in den Müllerschen Hügel einwachsenden, dem Epithel des Sinus urogenitalis enstammenden 'Conus vaginalis,' der sich später beim Menschen auszerordentlich stark entwickelt und den gröszten Teil der Scheide liefert, und durch Aufteilung des gröszeren Teiles des Sinus urogenitalis durch zwei ungefähr frontal gestellte Falten in einen vorderen Kanal die sekundäre weibliche Harnröhre, und einen hinteren, den unteren Teil der Scheide; nur der kleine ungetellt bleibende Bezirk des Sinus urogenitalis wird zum Vestibulum vaginæ" (Spuler, Veit, v. pp. 620-621).

We may thus consider the view of the entire Müllerian origin of the vagina and hymen as overturned and its origin in part

(upper two-thirds) from Müller's ducts, in part from the upper portion of the urinogenital sinus, as established. Thus the hymen is not an organ of the Müllerian ducts nor of the vulva but of the urinogenital sinus.

The question of vaginal atresia, and especially of atresia hymenealis, is intimately bound up with this whole question. One special point emerges, viz. that in atresia the initial defect is that the non-breaking down of the solid epithelial formation in the vagina and cervix is the central fact to be taken into account in the formation of many of them, and that when this gives a feasible explanation, as it does in most forms, hypothetical inflammatory changes need not be considered. In atresia hymenalis I have always seen the edges of the hymen and an unbroken diaphragm more or less thick between them. Some observers allege that in such the hymen may not be present. It has always seemed to me that the preponderating number of cases, at any rate in which the hymen edges are present, is due to the fact that the development of the hymen is intimately bound up with that of the ducts of such important early secreting organs as the Wolffian ones, organs essential to healthy development, and therefore structures whose absence or malformation entails serious nutritional defects. When the blocking epithelium in the vagina does not break down we get varieties of atresia, and these are easily understood in the light of the development given. Thus when the epithelial plug of the two Wolffian bulbs forming the hymen does not break down we get atresia hymenealis. Very rarely is there a transverse septum an inch from the septum hymen, but I have seen two such, and it is probably the lower end of the true Müllerian vagina, where the eminence of Müller was, that is imperforate. When all the solid epithelium in the vagina does not break down we get complete atresia of the vagina; when only that in the cervix, we get a retention of blood in the uterus hæmatometra.

In review, then, it will be seen that these two views of the origin of the hymen, viz. from the Wolffian ducts and sinus or from the Müllerian ducts, are sharply contrasted as to the origin of the hymeneal and vaginal lining; the one urges a local change from early protoplasmic cells to squamous multiple epithelium, the other an invasion of squamous cells from the Wolffian bulbs into the Müllerian duct as far as the lower third or so of the cervical canal.

The view I bring forward is an interpretation so far as possible

of what appears to take place during this development and an attempt to explain how the adult tract is formed. Development proceeds from the stage of the double Wolffian and Müllerian ducts and the urinogenital sinus with its single structure, from the blind ending of the Müllerian and patency of the Wolffian ducts, up to the formation of the adult tract, where we find the hymen present, the vagina provided with a skin-like multiple-layered lining, and uterus and tubes with a mucous membrane of a totally different nature. The Müllerian view states that the double Müllerian tubes (vaginal portions) coalesce, the epithelial lining of the hymeneal and vaginal Anlagen becomes converted into a multiple-layered epithelium which first occludes the vagina and then breaks down to form a lumen. A special increase of this epithelium at the lower end of the vagina by its bulging and pressure forms the hymen and hymeneal aperture.

How in the view of the Wolffian origin of the hymen does the vagina get its different lining as compared with the uterus and tubes? By the development of the Wolffian bulbs from an ectodermic source, viz. the lower ends of the Wolffian ducts, their coalescence to form the hymeneal ridges, and the passage of their epithelium into the vaginal tract rendering it solid up as far as the lower third of the cervical canal. If the vagina at this stage of occlusion is examined it will be seen to be, not a mere local proliferation of the epithelium lining its walls, but an actual solid plugging continuous with the epithelium of one of the bulbs. It may be urged that this description of the invasion of the vaginal lumen from the bulbs is an unusual phenomenon and therefore more likely to be an erroneous interpretation, but it is really quite analogous to what happens in the development of other organs; thus the glans penis is tunnelled in the same way, the open urethral canal in the male is closed in the same way, and, to take a simple instance, a sweat gland is first a solid epidermic plug with surface cells central and develops its lumen by these breaking down. In fact, the special value of an epidermic plug as a solid structure, or in the epidermic invasion of a lumen, is that it has in its centre surface-cells with a power of desquamation thus forming the lumen. In the bulbs one sees that the central cells are analogous to the superficial cells of epidermis or vagina, are desquamating to form the hymeneal opening. What happens there, occurs higher up in the vagina in the vaginal fornices, and in the cervical canal in its lowest third, so that the whole genital tract is ultimately pervious and provided in each segment with a lining appropriate to its functions.

From all this it follows, as already said, that adenoma vaginæ diffusum is a persistence of an embryological condition due to a practical absence of the epithelium relining the vagina at the third month. It is of great interest to note that malignant disease supervened in Haultain's case.

The question arises as to whether anything can be done for such cases. The only thing I can suggest is either entire excision or that flaps of skin be taken from the labia majora, and by them, after curetting, and in a way I need not detail, a skin covering provided for the vaginal walls.

LITERATURE.—Bolk, *Beiträge zur Affenanatomie*, vi., "Zur Entwicklung und vergleichenden Anatomie des Tractus urethro-vaginalis der Primaten," mit 33 Figuren; *Zeitsch. für Morph. und Anthropologie*, 1907, x. (p. 250). Gellhorn, G., "Anatomy, Pathology, and Development of the Hymen," *Amer. Gynæc. Trans.*, 1904, p. 405. Hart, D. Berry, "Morphology of the Human Urinogenital Tract," *Journ. of Anat. and Phys.*, xxxv. p. 330; also *Brit. Med. Journ.*, 13th September 1902. Klein, *Entstehung des Hymen*, Wien, 1897. Nagel, W., "Entdeckung und Entwickelungsfehler der Weiblichen genitalien," Veit's *Handbuch der Gynäk.*, 1897, Bd. i. Spuler, "Uber die normale Entwickelung des weiblichen Genitalapparates," Veit's *Handbuch der Gynäk.*, v. p. 576, Bergmann, Wiesbaden, 1910. Taussig, "The Development of the Hymen," *Amer. Journ. of Anat.*, 1908. Webster, "Early Wolffian and Müllerian Ducts," *Amer. Gynæc. Trans.*, 1898. Wood Jones, "The Nature of the Malformations of the Rectum and Urinogenital Sinus," *Brit. Med. Journ.*, 14th December 1904. For full literature see Spuler and Gellhorn.