

and showing, in multiparæ, the caruncule hymenales. The relation to the urethra borne by the anterior column of the vagina and the vaginal tubercle has been already mentioned. Since the hymen forms a membrane across the orifice of the vagina there is a slight groove formed between it and the nymphæ on either side, and this remains after the rupture of the structure. This is called the *nympho-hymeneal* or *nympho-caruncular sulcus*.

In this groove, opposite the lower and middle thirds of the introitus, are seen the openings of two ducts, one on either side, which belong to glands buried quite deeply in the fatty tissue between the vestibule and the ischium. These are the *greater vestibular glands* (*glandule vestibulares majores*, Fig. 4244), often called the glands of Bartholin, from Thomas Bartholin, who discovered them in the human subject in 1680. They had previously been seen in the cow by Duverney. Our most exact knowledge of them is due to Huguier (1849), who called them the vulvo-vaginal glands. He described them as situated, one on either side, about 1 cm. below the hymen, from 1 to 1.5 cm. from the ischium, 1 cm. from the bottom of the genito-crural fold of the integument. They are also about 3 cm. from the inferior edge of the labium. By compressing the posterior part of the labium between the thumb and forefinger, a gland can usually be felt. They are acinous glands, about as large as a pea or small bean, slightly oval in shape, and discharge by a duct 15-18 mm. long, and large enough to admit the cannula of an ordinary hypodermic syringe. They secrete a clear, viscid liquid that is discharged in considerable quantity during sexual excitement. This discharge was called by the older writers the female semen, and was long supposed to be the active generative product. It apparently serves as a lubricant to the passages during coitus. The glands attain their maximum development at puberty and atrophy during old age. They are homologous with the bulbo-urethral or Cowper's glands of the male. In normally developed virgins the nymphæ are united behind by a short transverse band, the *fourchette* or *frenulum labiorum*. This is ruptured at childbirth and sometimes by sexual approaches, and its relics may then be seen as a whitish scar. The shallow space between this band and the hymen, or the vaginal opening when the hymen is absent, is known as the *navicular fossa* (*fossa navicularis*). If the nymphæ are short the frenulum is absent. It should not be confounded with the artificial fold produced by widely separating the labia.

The Mons Pubis.—The genital cleft is bounded on either side by two pairs of tegumentary folds which unite in front below a rounded prominence situated directly over the symphysis pubis. This is the *mons pubis* or *mons veneris*. It is usually separated from the general surface of the abdomen by a shallow furrow, the *pubic sulcus*, and from the thighs by the *inguinal sulcus*. Smooth, or coated with a fine lanugo in the child, as puberty approaches it becomes covered with thick and somewhat stiff hairs that have a tendency to curl. The extent of this hairy covering varies very much in different individuals, being greatest in the races of Southern Europe. Usually it descends upon either side of the labia as far as the anus. Upward it may much exceed the limits of the mons pubis and extend upon the abdomen. The hairs usually agree in color with those of the armpits and head, but they have the general appearance of those of the male beard, though usually somewhat thinner. They are spirally twisted, have a medullary canal throughout, are stronger than the hairs of the head, and show on section a triangular, irregularly fluted outline (Waldeyer).

Beneath the integument of the mons pubis is a thick cushion of fat in which are found numerous elastic fibres continuous with those of the labia and the suspensory ligament of the clitoris. These cause a gaping of incised wounds made transversely in this region.

The Labia.—These tegumentary folds, often distinguished as the labia majora, correspond to the scrotum of the male, and their external appearance is not unlike

that organ when empty and considerably retracted. They are about 25-35 mm. long, 8-15 mm. in depth, and 3.5 mm. thick. They are limited on either side by a deep extension from the inguinal furrow known as the genito-femoral sulcus. Like the scrotum their outer surface is darkly colored, somewhat roughened, and covered with hair which is extended in a scattered manner to the marginal part of the inner surface. The deeper part of this surface has the appearance of the lips of the face, being smooth, reddish and humid. The groove between it and the nymphæ is called the nympho-labial furrow.

Immediately below the mons pubis the labia unite over the back of the clitoris (*torus clitoridis*) in an anterior commissure (*commissura labiorum anterior*). Behind they gradually narrow and are lost on the perineum.

Within their substance, the labia contain a layer of smooth muscular fibres analogous to the dartos of the scrotum, a considerable quantity of connective tissue, including many elastic fibres, and subcutaneous fat. A considerable mass, called the adipose body of the labium, almost wholly fills the middle portion of the lip, resembling somewhat the fat-ball found in the cheeks of the face. It is a derivation from the subperitoneal fat with which it is often continuous along the round ligament of the uterus, which, it will be remembered, passes through the inguinal canal and is inserted here. The canal of Nuck is sometimes continued down into the labium and may be the seat of a hydrocele.

The Nymphæ.—This name was introduced by Severinus Pinaeus and Spigelius in the early part of the seventeenth century, "*ut enim nymphæ scaturientibus aquis præsent*," because, like nymphs, they control the gushing streams, it being supposed that they directed the course of the urinary jet. Though this view of their function is incorrect, the name lends itself well to combinations and ought to be retained. They are often called the labia minora or lesser lips, from their close association with the outer lips or labia proper. When the genital cleft is parted they appear as two cutaneous folds (Figs. 4242, 4243) running parallel with the labia, often more reddish in appearance, and not as smooth, being slightly roughened on their inner surfaces by small elevations, and often irregularly denticulated or incised on their free edges, an appearance which led Spigelius to compare them to a cock's comb. Their size varies much in different individuals. At birth they usually extrude beyond the labia, which are then but slightly developed. In the adults of European races they are ordinarily concealed, having a length of 25-35 mm., a breadth of 8-15 mm., and a thickness of 3-5 mm. They may, however, be large enough to extrude, and their exposed surfaces then take on a brown coloration like that of the areola of the nipple. In some African races they are enormously developed, being six to eight inches wide, extending upon the thighs to form what has been called the "Hottentot apron."

The outer surface of each nymphæ is separated by the nympho-labial furrow from the corresponding labium, from which it differs by its absolute freedom from hairs. The inner surface, more rough, is in contact with the opposite nymphæ when the genital cleft is closed. The attached surface is in contact with the bulb of the vestibule.

The anterior extremity is continued forward and embraces the clitoris by dividing into two branches (Fig. 4244), the anterior one of which unites with its fellow of its opposite side to form for the organ a small prepuce or foreskin, similar, on a diminished scale, to the prepuce of the penis of the male. It does not usually cover the glans, but may be sufficiently developed to admit of circumcision, which is said to be practised by the Abyssinians. The posterior branch is inserted, with its fellow, on the glans of the clitoris and forms a restraining band, the *frenulum* of the clitoris. Owing to the traction of the nymphæ through this band, the clitoris is bent downward toward the vaginal orifice.

The nymphæ are composed of a network of vascular, areolar tissue without fat, enclosing numerous large veins with associated, smooth, muscular fibres, which give the

organ an erectile character. Its outer investment is stratified epithelium, which resembles a mucous membrane by its coloration, its smooth and humid character and its absence of hair; while, on the other hand, it resembles the skin by the character of its epithelium, which has scale-like cells that lose their nuclei, tactile corpuscles, and sebaceous glands in great numbers. In the lower animals these glands are especially active during rut, and doubtless entice the male by some characteristic odor. The epithelium becomes darker during pregnancy.

While the erectile tissue of the female genitalia is somewhat widely distributed, being found in the nymphæ and to some extent along the vagina, it is especially marked in two organs, which together are homologous with the penis of the male. These are the clitoris and the bulbs of the vestibule.

The Clitoris.—The name is neo-Latin, from the Greek *κλειτορίς*, said to be derived from *κλειειν*, to close or shut. Hyrtl thinks it is related to *κλειτορίζειν*, to titillate. This would be analogous to *Kitzler*, the German vernacular name for this organ.

It represents a small appendage, resembling a diminutive penis, suspended at the summit of the pubic arch (Figs. 4242, 4243, 4244, 4245, 4246) and enfolded by the anterior juncture of the nymphæ. Like the penis it possesses two corpora cavernosa, small

glans is not perforated by the urethra, and there is no corpus spongiosum attached to it. When lax the organ is so withdrawn within the folds of the nymphæ and labia that it is difficult to make out its form and dimensions.

The crura are attached on either side to the inner aspect of the pelvic arch, half-way between the tuberosity of the ischium and the symphysis. Wholly hidden within the folds of the labia, they pass forward, inward, and a little upward, along the external face of the triangular ligament, surrounded by the ischio-cavernosus muscle (*erector clitoridis*) and join each other below the symphysis to form the body, room being left between their junction and the arch to permit the passage of vessels and nerves.

Almost immediately the body is bent downward and backward, forming what is called the *angle* of the clitoris. Unlike the angle of the penis, this does not become obliterated when the organ is erect, and this doubtless subserves the function of the organ. Movements are prevented by the frenulum, which, as already mentioned, draws the glans down toward the vaginal orifice, and by the *suspensory ligament*, a fibrous band like the

similar organ of the penis, that passes from the angle to the linea alba. The body of this little organ is nearly cylindrical in shape, usually slightly grooved on its under surface because of its duplex structure. An imperfect divi-

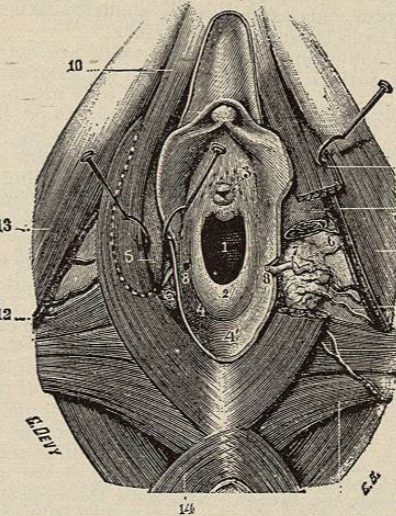


FIG. 4244.—Dissection of the Vulva, showing the Vestibular Glands. 1, Orifice of the vagina; 2, hymen; 3, meatus urinarius; 4, navicular fossa; 5, bulb of the vestibule; 6, vestibular or vulvo-vaginal glands; 7, 8, duct; 10, constrictor vaginae; 11, transversus perinei muscle.

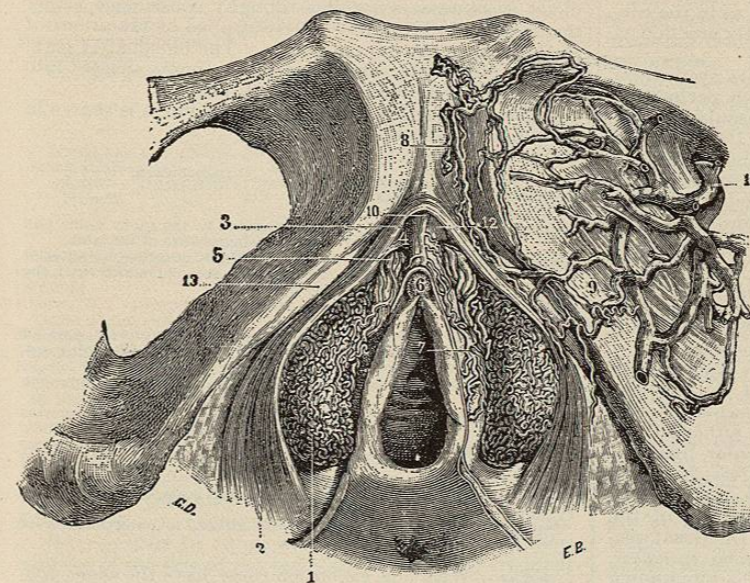


FIG. 4245.—The Bulb of the Vestibule and the Venous System of the Clitoris seen from the Front. (Kobelt.) 1, Bulb of the vestibule; 2, constrictor vulvæ muscle; 3, anterior portion of same; 4, portion that passes under the clitoris; 5, pars intermedia; 6, glans of clitoris; 7, veins from nymphæ; 8, veins passing to superficial veins of abdomen; 9, veins communicating with the obturator vein; 10, dorsal vein of clitoris; 11, obturator vein; 12, body of clitoris; 13, right crus of clitoris.

rods of erectile tissue, united in front to form the *body* of the organ, diverging behind as its *crura*. The body is crowned with a small *glans*. Unlike the penis, the

body of this little organ is nearly cylindrical in shape, usually slightly grooved on its under surface because of its duplex structure. An imperfect divi-

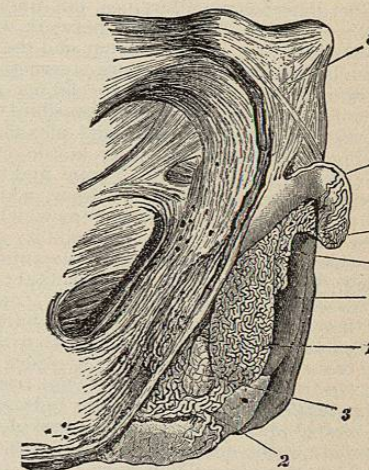


FIG. 4246.—Bulb of the Vestibule and the Clitoris seen from the Side. (Kobelt.) 1, Right bulb of the vestibule; 2, veins from its lower end, that discharge into the internal pudic vein; 3, vestibular gland; 4, introitus vaginae; 5, pars intermedia; 6, glans clitoridis (the clitoris is somewhat elevated); 7, dorsal vein of clitoris; 8, symphysis pubis.

possess a penis bone have sometimes a minute bone or *septum pectiniforme* separates the two lateral halves. Females of animal species in which the males possess a penis bone have sometimes a minute bone or

cartilage in this septum. The greater part of the body is concealed under the anterior commissure of the labia, its swelling outline forming the *torus clitoridis*.

The glans, which terminates the organ, is a small, rounded, conoid tubercle. It is independent of the corpora cavernosa, capping over their fusiform ends as in the penis. It has a small prepuce derived from the nymphae, and a preputial sac in which small collections of smegma may accumulate. To its under surface is attached the frenulum.

The following measurements of the clitoris are given by Krause:

	When relaxed.	When erect.
Length of body	18 mm.	29 mm.
Thickness of body	5 mm.	9 mm.
Length of crura	40 mm.	45 mm.
Thickness of crura	5 mm.	8 mm.
Diameter of glans	4-7 mm.	6-9 mm.
Total volume	2 c.c.	6 c.c.

Considerable individual variations are found. The organ may be of such size as to be mistaken for a small hypospadiate penis, and thus lead to mistake in determining the sex of a child.

The structure of the clitoris repeats, on a diminutive scale, that of the penis. Each corpus cavernosum is surrounded by a firm, elastic, fibrous envelope, the *tunica albuginea*, from whose deep surface are given off numerous bands or trabeculae, along which run smooth, muscular fibres. These trabeculae divide the substance of the organ into numerous small spaces, termed areolae, which are really venous sinuses, as they are lined with endothelium and communicate widely with the veins. Into these areolae empty arterioles (helicine arteries). Erection occurs from the rapid filling of the areolae by the expansion of the arterial orifices through the action of vaso-dilator nerves, and the impeding of the venous discharge by the ischio-cavernosus muscle and the elastic envelope. This apparatus is by no means as well developed as in the corresponding organ of the male, consequently erection is less complete.

The glans has no albuginea, but under its epithelium is a considerable fibro-elastic network which performs a similar function. Areolae occur and the vascular supply is similar to that of the corpora cavernosa. Its cutaneous investment is supplied with special nerve endings, which give it remarkable and special sensibility. According to Dogiel there are intra-epithelial plexuses with filaments ending in flattened platelets, tactile corpuscles within the papillae, corpuscles of Pacini and the end bulbs of Krause in the subcutaneous tissue, while at the base of the papillae are the special endings which Krause believes to be related to the peculiar sensibility of the organ and has named corpuscles of sexual pleasure (Wollustkörperchen). They are usually called genital corpuscles.

The Bulbs of the Vestibule.—The corpus spongiosum urethrae of the male, including the bulb of the urethra, is represented in the female by two oval masses of erectile tissue that lie beneath the nymphae on either side of the vestibule and in front of the triangular ligament (Figs. 4245, 4246). Their lower ends are free, but they are united above over the lower end of the urethra, thus simulating the form of a horseshoe set astride of the vaginal opening. They were called by De Graaf *corpora retiformia*, by Taylor *semibulbi corporis spongiosi*, but, since the time of Kobelt (1844), are generally known as the *bulbs of the vestibule* (*bulbi vestibuli*). They should be considered as the male organ separated into two portions by the intrusion of the vaginal opening in the median line.

Enlarged and rounded at their lower extremities, they are bulb-like in form. Their shape has also been compared to that of an almond, a fig, or, still more aptly, to that of an engorged leech, which they closely resemble because of their long, tapering, upper extremities which unite with each other and with the clitoris. Their

dimensions vary in different individuals. Usually reaching as far back as the navicular fossa, they may not extend beyond the middle of the vaginal opening, or, on the other hand, they may be continued behind on to the perineum. When not turgid, each bulb is, in ordinary cases, about 30-40 mm. long, 10-15 mm. broad, and 5-10 mm. thick.

The bulbs are only about 8-10 mm. from the pubic arch, but are so situated with regard to the vaginal opening that they are pushed forward and away from the bones as the fetal head descends. Rupture of one of them may, however, occur during labor, especially if instruments are used. This occasions a large hæmatoma in the corresponding labium, or, if the rupture extends through the entire integument, a serious hemorrhage.

The upper or deeper surface of the organ is applied to the ischio-vulvar or outer sheet of the triangular ligament, to which it is attached by some lax, areolar tissue. Its inferior or superficial surface is covered by the basis of the nymphae. Like the bulb of the urethra in the male, it is invested externally by a sphincter muscle, the bulbo-cavernosus, which, by the separation of the two bulbs, becomes applied to the outer surface only, forming a constrictor of the vagina. Its internal surface embraces the vestibule, skirting the orifice of the urethra, the vagina, and the vestibular glands. Its anterior extremity, pointed and drawn out, communicates above the opening of the urethra with the plexus of the clitoris and with the opposite bulb. The plexus thus formed was called by Kobelt the *pars intermedia*. It lies immediately under the habenule urethrales, and with them constitutes a vestige of the corpus cavernosum urethrae of the male.

In structure the bulbs resemble the corresponding organ of the male. They are invested by a thin tunica albuginea, within which is a plexus of large veins surrounded by muscular fibres sparsely distributed. The organ has the general structure of erectile tissue, but is much less perfect in that function than the clitoris, and very far below the male penis. When engorged with blood it assumes a swollen, doughy consistence rather than a complete rigidity. It is supplied by the artery of the bulb from the internal pudic. The blood, after leaving the plexus of veins found in the organ, passes into the pudic, perineal, and clitoridian veins.

Arteries.—The arterial supply of the vulva is shown in the following scheme:

Arteries.	Distribution.
<i>From the common femoral artery</i> —	
Superior external pudic...	Small branches to the mons pubis and anterior commissure of the labia.
Inferior external pudic...	Anterior labial branches to anterior half of labia, some of which reach the nymphae.
<i>From the internal pudic artery</i> —	
Dorsal artery of the clitoris.	Glans clitoridis and anterior part of nymphae, a few twigs extending upward to the mons pubis.
Artery of the corpus cavernosum.	Crura and body of clitoris, small branch to bulbs of the vestibule.
Artery of the bulb.....	Bulbs of the vestibule, meatus urinarius (urethral artery), vestibular glands.
Superficial perineal.....	Posterior labial branches to posterior half of labia and nymphae, bulbs of the vestibule, vestibular glands.
Transverse perineal.....	Posterior end of labia, navicular fossa.
<i>From the obturator artery</i>	
Internal terminal branch.	External labial, to outer surface of labia.

Veins.—With one exception these have the same general arrangement as the arteries, discharging into the internal saphenous, the internal pudic, and the obturator trunks (Fig. 4245). The dorsal vein of the clitoris discharges into the vesical plexus (plexus of Santorini), whose efferent vessels terminate in the internal iliac vein. Numerous venous plexuses occur in the different organs. Thus the areolae of the clitoris themselves constitute a plexus, the veins of the bulbs of the vestibule are arranged in a superficial large-meshed plexus and a deep, fine-meshed one, and a plexus also exists within the nymphae.

These communicate freely with each other and with the vesical and vaginal plexuses.

Lymphatics.—The lymphatic vessels of the external genitals are very numerous, especially upon the nymphae and the inner surface of the labia. They discharge, for the most part, into the superior internal or pubic group of superficial inguinal glands. This group lies internal to the saphenous opening and near the spine of the pubis. It includes two to four glands. Some vessels may discharge into the inferior internal group of superficial glands, or even, though rarely, reach some of the external group. In injecting the lymphatics on one side of the vulva, it is often found that the injection reaches the opposite side.

Cunéo and Marcille have recently shown that the lymphatics of the glans of the clitoris ascend by way of the mons pubis to the inguinal canal, through which they pass, to terminate in glands situated along the iliac vessels.

Nerves.—The nervous supply of the vulva is derived both from the cerebro-spinal and from the sympathetic systems. The cerebro-spinal nerves come from both the lumbar and the sacral plexuses, the sympathetic from extensions of the hypogastric plexus known as the cavernous and the utero-vaginal plexuses. From the first are given off two nerves, the greater cavernous nerves, and a number of small nerves, the lesser cavernous nerves that supply the crura, body, and glans of the clitoris. The nervous supply of the organ is far greater, in proportion to its size, than that of the penis. With the cavernous plexus are distributed the branches from the third and fourth sacral nerves that effect erection, the *nervi erigentes* of Eckhard. Other nerves from the cavernous plexus combine with the cerebro-spinal nerves, whose distribution is given in the following scheme:

Nerves.	Distribution.
<i>From the lumbar plexus.</i>	
Ilio-hypogastric—	
Hypogastric branch....	Integument upon upper part of mons pubis.
Ilio-inguinal—	
Inguinal branch.....	Integument upon lower part of mons pubis and upper part of labium.
Genito-crural—	
Genital branch.....	To labia (anterior labial nerves).
<i>From the sacral plexus.</i>	
Internal pudic—	
Perineal branch.....	To labia (posterior labial nerves), nymphae, prepuce and glans of clitoris, vestibule and meatus urinarius (nerve of vestibule), bulb of the vestibule.
Dorsal nerve of clitoris.	Glans, prepuce, body and crura of clitoris.
Small sciatic—	
Inferior pudendal branch.	To labia (posterior labial nerves).

The following have been freely used in the preparation of this article. In Waldeyer, Rieffel, and Nagel excellent bibliographies will be found.

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SEXUAL ORGANS, MALE. See *Genital Organs, Male*.

SEXUAL ORGANS, MALE, INJURIES AND DEFECTS OF.—I. CONGENITAL DEFECTS OF THE PENIS.—*Abnormalities in Shape and Size of the Penis.*—Abnormalities in the size of the penis are of relatively frequent occurrence, although they do not naturally come under the surgeon's observation. No two penes are alike in size, and the general rule that the length of the penis varies inversely to the girth of its possessor is commonly accepted. It is alleged that rudimentary development of the penis is often associated with intellectual deficiency. It is also alleged that men of great intelligence have undersized genitals. Cryptorchids and sufferers from epispadias and hypospadias habitually have small penes. That sexual exercise has any influence upon the

size of the penis is not proven. The so-called penis congestor is a mere gauge of gullibility.

Absence of the Penis.—When the penis is so small as to be apparently or actually absent the testicles are usually retained in the groin or in the abdomen, and the scrotum is split. As a result the genital organs resemble those of the female, and the condition is that of complete male pseudohermaphroditism.

Apparent Absence of the Penis.—The penis may be congenitally adherent to the scrotum; very rarely it is concealed beneath the skin of the abdomen or of the scrotum. Thus Bouteiller reported a case in which the penis appeared to be absent, but could be felt beneath the skin of the scrotum, whence it was liberated by a T-shaped incision. Usually, however, the penis is curved and only partially adherent. Such a condition is commonly accompanied by hypospadias.

Double Penis.—Double penis is extremely rare. A number of cases have been recorded in which the penile abnormality was associated with other evidences of fetal inclusion. Exceptionally, the reduplication of the genital organ is the only abnormality. How frequent such a condition is it is impossible to estimate, since patients so afflicted not only fail to apply for relief, but sedulously shun observation. Four cases have been recorded.*

Torsion of the Penis.—This is an unusual feature of hypospadias and epispadias (*q. v.*). Caddy † has reported a case of torsion unaccompanied by any other defect.

II. PHIMOSIS.—Phimosis is an abnormal tightness of the prepuce. There are two kinds of phimosis: the one consists in an adhesion of the prepuce to the glans penis, and this is a normal condition in every male child at birth. The relief of such a phimosis is accomplished by forcibly stripping back the foreskin until the glans is entirely uncovered, recurrence of the adhesions thus torn being prevented by the application of dusting powders and by repeated retraction of the skin. This minor operation is noteworthy chiefly because its omission is the commonest cause of permanent cicatricial phimosis.

The second variety of phimosis is an undue tightness of the prepuce caused by a chronic thickening at the preputial orifice, and resulting in an inability to retract the prepuce. Such phimosis is commonly spoken of as being either congenital or acquired; but, strictly speaking, it is probably always acquired, since the thickening at the preputial orifice which prevents retraction seems, in the cases called congenital, to be occasioned by the adhesive phimosis noticed above, and by the balanoposthitis to which it gives rise; acquired phimosis is caused by any inflammation of the prepuce, notably by chancroids occurring at the preputial orifice. During the course of any of these inflammations a temporary phimosis, known as inflammatory phimosis, may be caused by inflammatory œdema.

Results of Phimosis.—If the prepuce be unduly tight, or merely unduly long, it may cause two different sets of conditions, the one irritative, the other obstructive. Thus in infancy it encourages balanoposthitis, adhesions, premature sexual excitement, and masturbation; while, from retention, it may cause incontinence of urine, frequent and painful micturition so painful as to lead to the suspicion of stone; while the straining to overcome the obstacle may result in hernia and rectal prolapse. In later life the obstruction may give rise to hypertrophy of the bladder and dilatation of the ureters and kidneys; while chronic retention may result in the form of preputial calculi, in intensified venereal troubles, especially gonorrhœa and chancroid (*q. v.*), and epithelioma of the penis (*q. v.*). Finally, phimosis interferes with coitus, and violent retraction of the tight prepuce may result in paraphimosis.

Treatment.—The treatment of phimosis is circumcision. The operation of dilating the prepuce is not worthy of consideration (*cf. Circumcision*).

*Keyes: "Diseases of the Genito-Urinary Organs," third edition, 1905.
† *Lancet*, 1894, ii., 634.