Retained testes in man and in the dog / by Joseph Griffiths.

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RETAINED TESTES IN MAN AND IN THE DOG.

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Retention of the testes in any part of their course from beneath the kidney to the scrotum is not uncommon in Man and in the domesticated animals. I propose to give here an account of the structure and functional powers of such retained testes; but, before doing so, I shall pass in review, as it were, the different positions in which these organs may be found persistent in different members of the mammalian group of animals.

In all vertebrates below mammals the testes are abdominal organs, and not, indeed, until we pass the more primitive order of mammals, namely, the monotremes, do we find that the testes leave their seat of origin in the abdominal cavity below or beyond the kidneys for an external subcutaneous position in the groin or perineum.

In most mammals the testes pass from the abdominal cavity along the hinder part of the ventral wall of the abdomen to reach the scrotum. The transition, or descent, as it is more commonly called, of these organs takes place in Man during the later months of intra-uterine life, and, as a general rule, the testes reach their destination, the scrotum, before birth. The complete descent may, however, be delayed until shortly after that event, or it may be for months or years.

In some mammals—the monotremes, the aquatic carnivora, the elephant, rhinoceros, and in certain others—the testes remain in the abdominal cavity throughout life, and there carry on their function.

In certain other mammals the testes are neither persistently abdominal nor persistently scrotal, the organs passing to and fro between the abdominal cavity and the scrotum. Among these are many of the rodents and insectivores, and in all of them

there is a period of *rut*. While the rutting season is at its height, that is, at a time when the testes are large and actively producing spermatozoa, the organs are in the scrotum or extra-abdominal; but, with the decline of the season, the testes dwindle and retire into the abdominal cavity, where they remain of small size until the return of the next period of rut.

Accordingly in the first (persistently scrotal) group, the testes having reached the scrotum acquire their full size and spermatozoa-producing powers; in the second (persistently abdominal) they retain their original position, and there attain their full size and spermatozoa-producing powers; in the last (to and fro) group, the testes leave the abdomen temporarily for the scrotum, and while they are in the scrotum acquire and retain their full size and spermatozoa-producing powers, losing it again when they retire into the abdomen.

Thus, in the last (to and fro) group, the testes may be said to be at one time in a state of *activity*, and at another in one of *inactivity*, the scrotal position being associated with activity, and the abdominal with inactivity.

The structure of the testes in these two states, namely, *inactivity* and *activity*, are well illustrated in the hedgehog (*Erinaceus europæus*), an animal that has a rutting season which is at its height in midsummer; but the functional activity of these organs is in complete abeyance during the winter months. In midwinter the testes are abdominal, resting just over the brim of the pelvis, of small size and firm consistency, and all the accessory sexual glands, *vesiculæ seminales* and prostate, are likewise small and firm (see fig. 1). In midsummer, on the contrary, the testes are scrotal (inguinal) in position, of twice, at least, the length and breadth they were in winter, soft and pulpy, the seminal tubules bulging wherever the tunica albuginea is cut through.

In the *inactive* testes the seminal tubules are only half, or even less, the diameter they attain in midsummer, and are not so closely packed together as when the testes are in full functional activity. Each tubule is at this stage a solid column of cells, there being no central lumen which, as well shown in figs. 3 and 4, is very large in the seminal tubules in midsummer. The *tunica propria* is perhaps thicker than natural. Lying

within this is a single layer of cubical epithelial cells with large round nuclei. In many of these cells there is a clear ring-like space around the nucleus. The central part of the tubule is occupied by polygonal cells which have no definite arrangement, but are massed together filling the lumen. These cells also have large round nuclei, and in many of them a clear ring-like space, similar to that in the peripheral layer of cubical cells, is present. No signs of spermatogenesis or spermatozoa could be detected in any of the tubules (see fig. 2).

In the summer the tubules are much larger. The epithelial cells are arranged thus: a continuous peripheral layer of cubical cells, then two or three layers of cells, the nuclei of which are in process of division, and innermost the radiatory bunches of spermatozoa. There is a large lumen occupied by spermatozoa and coagulated secretion (see fig. 4).

In the first group, in which Man is included, when the testes fail to reach the scrotum, from arrest in their course from the abdomen (which may be from some defect in the mechanism of descent [1]) though they grow to some extent at puberty, yet neither then nor at any subsequent period do they reach their full size and acquire their spermatozoa-producing powers.

We learn, therefore, that though in some animals the abdominal position is compatible with the full development and sperm-producing powers of the testes, yet that for some reason it is not so in the case of those animals in which they persistently or occasionally occupy the scrotum. The same remark applies to the inguinal region, for in animals in which the testes are naturally and persistently inguinal they become fully developed; whereas in those in which they are unnaturally arrested in the inguinal region, the functional, spermatozoa-producing, powers are not developed. In short, for the functional activity of the organ the testes must occupy the terminal part of the course which they are destined to traverse, though the reason of that is not very easy to determine. This subject I do not propose to discuss here.

[1] Failure in transition, or descent of the testes, has been referred by some to a congenital defect in the structure of the testes, which in consequence fail to stimulate the muscular mechanism of descent into activity, and by others to imperfections in the mechanism of transition, the organs themselves being healthy.

Failure in transition of the testes is usually unilateral, but sometimes it affects both sides; and the transition is said to be naturally later and more liable to defect on the right than on the left side. When the failure in transition is bilateral, as in one of the cases hereafter described (cryptorchid), then of course the question of the exact structure and functional powers of the organs is important. When one organ is fully descended (monorchid) and fully grown, as is well known, the person is as capable of reproducing his species as if he had two organs endowed with full powers. On the contrary, a person in whom both organs have failed to reach the scrotum, whether they were arrested in the iliac fossa, at the internal ring, in the inguinal canal, or just outside the external ring (a favourite situation) is, and the subsequent observations prove this, sterile, the testes being incapable of producing spermatozoa, and this although there is no indication of want of virility in the penis or general development of the individual. Indeed, in a person (cryptorchid) in whom both testes are arrested in any part of their course, all the manly characters, namely, broad shoulders, narrow pelvis, bearded face, &c., and the penis, are as fully developed as they are in a man whose testes are natural and in the scrotum. He has erection of the penis and emissions of secretion which, as will be shown later, is in all probability derived from the prostatic and other urethral glands, and is therefore devoid of spermatozoa.

Such a person (cryptorchid) is very different from the eunuch[1] deprived while young of his testes. In such the shoulders are narrow, the pelvis broad, and the face beardless, &c.—in those points approximating to the features of the female. In the eunuch also the external organs of generation remain small, the penis like that of a boy eight to ten years old, and the accessory sexual glands, namely, prostatic and Cowperian glands, remain small and otherwise imperfect.[2] How far erection of the penis is present in eunuchs, and also in eunuchoid persons in whom the testes remain small from disease and atrophy in early

[1] One deprived of his testes after attaining adult life possesses the male features, and is subject, for a time at least, to the same sexual influence as the entire and mature male.

[2] See paper by me on the "Prostate Gland," *Jour. of Anat. and Phys.*, vol. xxiv. p. 32.

life, is difficult to ascertain. This much, however, may be said, that in some eunuchoid persons (to this I draw attention in a subsequent paper, see page 221), sexual desire is present, and some get married. I have known one married eunuchoid person, but how far he had the power of erection, and what quantity of secretion he was capable of expelling, I was unable to ascertain, because he was unwilling to disclose to me any information upon this subject.

Hitherto this fact of sterility in cryptorchids has not been fully recognised, and thus it is, I believe, that persons are somewhat reluctant to accept the statement that the retained testes, though capable of giving impulse to the formation of the characteristics of the male sex during growth at puberty, are yet incapable of producing spermatozoa. Whatever may be the channel through which the testes exert this influence upon the growth of the body, whether it be by a reflex mechanism through the central nervous system, or by the influence of some as yet obscure secretion of the organs finding its way along the lymph channels into the circulation, it would seem that the general influence of the testes upon the growth of the body is distinct from its spermatozoa-producing power; and further, that the exercise of the former function necessitates less expenditure of energy than the production of sperm-cells which may be regarded as the most highly differentiated and power-giving cells in the animal kingdom.

Some observers state they have found the retained testes fully formed, have detected spermatozoa in their secretion, and have also seen evidences of the production of spermatozoa in the epithelial cells of the seminal tubules. But in by far the majority of cases hitherto reported, spermatozoa were not found in the seminal tubules or in the secretion lodged in the tubules of the epididymis or in the cavity of the corresponding vesicula seminalis. To this subject I shall revert later.

Retained Testes in Man.

With regard to the retained testes in Man, the following examples which I have collected and examined illustrate very well the different structural conditions met with. Four of the

specimens were removed from persons (monorchids) in whom the opposite testis was fully descended and natural, the fifth was from a man (cryptorchid) in whom the condition was symmetrical, both organs being situated just outside the external abdominal ring.

Example I.—A specimen (1065) in the Pathological Museum of the University of Cambridge, the description of which in the catalogue is as follows :—

"Right testicle situated at the external ring. It [testis] is small though plump, and the epididymis is disproportionately large. There is a sac of a congenital hernia, from which a blue glass rod has been passed into the tunica vaginalis. The left testicle is of natural size, and occupied the natural position in the scrotum. On microscopical examination, after the specimen has been some months in spirit, large cells, like sperm-cells, are found in the epididymis on both sides, but spermatozoa in the left only."

The body of the *right* testis measures 3 cm. in length by 1·8 cm. in breadth; whereas that of the left, which was fully descended into the scrotum, measures 4·5 cm. in length by 3 cm. in breadth. A section of the *right* testis shows the seminal tubules to the eye, as in a normal organ, but they are more distinct, and, therefore, more easily seen, the inter-tubular connective tissue being relatively increased.

Under the microscope the seminal tubules in this right testis are found to be reduced to at least one-half their natural size, and the inter-tubular connective tissue is relatively increased. This inter-tubular connective tissue is composed, in the main, of spindle-shaped connective tissue cells, with but little intervening fibrous matrix; and in it there are hardly any traces of the peculiar *interstitial* cells frequently found in the normal and full-grown organ. The seminal tubules are, in addition to being reduced in size, altered in their structure. The tunica propria is much thickened, and, as seen in transverse section, forms a sort of collar round the tubule. This tunic is composed, as in the natural condition, of two or more layers of flattened connective tissue cells, with but little intervening fibrous matrix, the thickening seen in the specimen being mainly due to the formation on the side next the lumen of a layer of newly-formed, almost transparent, fibrous tissue, with only one or two flattened cells embedded in the matrix. This layer of tissue I have often found, and always in the same position, in other cases of atrophy. The epithelial cells in the seminal tubules are greatly reduced in numbers, and in the majority of instances the cells form only a single layer which lines the thickened and altered tunic and which encloses a small central lumen. The cells differ from the normal, inasmuch as they are of columnar shape, with a broad base and narrow free extremity which projects into the interior of the tubule and bounds the central lumen when present. In each of these cells a round or ovoid nucleus

may be seen occupying a position near the basal or attached end of the cell; and in each the protoplasm is finely granular, with a tendency to fibrillation in the long axis of the cell. Here and there among these cells, smaller cells, with irregular outlines and indistinct nuclei, may be seen. In a few of the tubules the epithelial cells are not so regularly arranged, but they are of irregular outline, and are massed together, as it were, there being no central lumen. In none of these tubules is there any evidence of spermatogenesis in the epithelial cells, and there is no evidence of spermatozoa in the interior of the tubules. In short, the seminal tubules are small, their tunica propria is thickened, and the epithelium is reduced to a single layer of columnar-shaped cells.

Example II.—This specimen was removed during the operation from a young man aged nineteen years, for the radical cure of hernia. The body of the testis is flattened and elongated, measure 4·5 cm. in length by 2·5 cm. in breadth, and 2 cm. in thickness; and on section the seminal tubules are, as in Example I., more distinct than natural. Under the microscope this specimen showed precisely the same structural changes as the preceding, with the exception that the tunica propria is not so much thickened, the fibrous transparent layer already noted being almost absent. There are no spermatozoa in any of the tubules, and no traces of spermatogenesis in the epithelial cells which in most of the tubules are elongated and of columnar shape, as seen in fig. 7, taken from a section of this specimen.

Example III.—This was removed from a man, aged thirty-four years, also in the operation for effecting a radical cure of the associated hernia. The body of the testis is small and also flattened; it measures 3·5 cm. in length by 2·5 cm. in breadth, and 1·5 cm. in thickness; and on section the seminal tubules are seen to be rather more distinct than natural. Under the microscope the tubules are like those in Example I., but there is also some increase of the inter-tubular connective tissue which binds the tubules together more firmly than usual.

Example IV.—This specimen was obtained from a man forty years of age, married, but without issue. Both testes had barely escaped through the external abdominal rings, and were lying in the inguinal region, the scrotum being small and empty. Each was associated with a hernia. The *right* testis was removed in the operation for radical cure by Dr Carver, to whom I am indebted for the specimen. The man was strong and well built, the shoulders broad, and the pelvis narrow, though the hair on face and pubis was scanty. The penis was of natural size.

The *right* testis is small, round, and somewhat flaccid; it measures 2·5 cm. in length by 2 cm. in breadth, but in other respects it seemed natural. The epididymis is small, but large in proportion to the body of the testis, from which it is distanced about 1 inch, consequent on the stretching and yielding of the intervening tissue (fig. 6).

Under the microscope the seminal tubules are seen to have undergone similar changes to those described in the preceding cases, and

even more pronounced; for in some tubules the epithelium has almost entirely disappeared, and the tunica propria has been greatly thickened, so that these tubules are transformed, more or less completely, into rods of fibrous tissue. The remaining epithelial cells are of irregular size and shape, and are without any definite arrangement. In some of the tubules the epithelium is reduced to one or two cells, and in some it has completely disappeared. The inter-tubular connective tissue, which is mainly composed of fusiform cells, is relatively increased, owing to the diminution in the size of the seminal tubules. The pronounced changes observed in this specimen were probably produced by the presence of a truss which he had worn for many years.

Example V.—The *right* testis, removed from a boy aged 12 years, was found just outside the external abdominal ring. There was apparently no gubernaculum extending to the scrotum which was on that side small. The body of this, the *right* testis, measures 14 mm. in length by 8 mm. in breadth, whereas that of the *left* testis, which was properly descended and in the scrotum, measures 15 mm. in length by 10 mm. in breadth. The right epididymis is small and apparently deficient in its lower part. The right vas deferens is short and slender, but otherwise natural. In this, as in similar cases, the tunica vaginalis is large and the processus vaginalis is patent, opening freely above into the peritoneal cavity and below into the capacious tunica vaginalis. Under the microscope the seminal tubules are seen to be small, and filled with small epithelial cells as they are before puberty.

This specimen, which is the only one removed from a boy that I have had an opportunity of examining, is similar, both in external appearance and internal structure, to the undescended testis in a puppy (see vol. xxvii. p. 486), and to the testis replaced in the abdomen in a young dog and examined before the onset of puberty (vol. xxvii. p. 494).

The thickening of the *tunica propria*, which, as seen in the above specimens, seems to have taken place on the inner surface of the original tunic, and between it and the outermost epithelial cells, has been supposed by MIFLET (6) to be produced by the receding epithelium, and to be an instance of epithelial cells transforming themselves into connective tissue cells. I have, however, not been able to confirm this view, and from the fact that this layer of connective tissue is quite distinct and separable from the epithelial cells of the tubule, I scarcely think such a transformation of the epithelial cell of the tubule takes place.

Again, it is of interest to note that the epithelial cells of the tubules acquire a columnar shape. This shape is, as I have shown elsewhere, gradually acquired as the cells diminish in number, the first to disappear being the central cells, then those next to them, leaving ultimately only the representatives of that

continuous single layer of cubical cells found within the *tunica propria* in a normal seminal tubule. Thus the columnar cells noted here are the representatives of that peripheral layer of cubical cells which in the normal tubule give rise to the inner or the spermatozoa-producing cells.

The Retained Testes in the Dog.

Retention of one testis, either in the abdominal cavity or in the groin, is not of uncommon occurrence in the Dog. I have found during the past year no less than four examples, in each of three of which the right testis was retained in the groin, the left being fully descended and occupying the scrotum, and in the fourth the left testis was found hanging down into the pelvis.

The retained organ was in each case of small size, and very like the testes of a young puppy, the epididymis being disproportionately large to the body of the testis. There was no secretion in the tubules of the epididymis (vesiculæ seminales are absent in this animal), and, as will be presently shown, there were no spermatozoa in the tubules of the testes. A description of one of the cases will suffice, as they were all alike.

Example.—A dog, three to four years old. The right testis was found in the groin, just beyond the external abdominal ring. It was small, and measured 15 mm. in length by 12 mm. in breadth. The left testis, which was in the scrotum, was of full size, and its body measured 20 mm. in length by 15 mm. in breadth (see figs. 9 and 10). With the naked eye the only difference observable being that the tubules were more apart, and, therefore, more distinct in the retained organ.

Under the microscope the right testis shows that the tubules are not more than one-half the size of those in the left or descended organ. In each tubule the tunica propria is somewhat thickened, the cells polygonal, abundant, and completely filling the tubule. This difference from the normal is very marked (see further a paper by me in the *Journal of Anatomy and Physiology*, vol. xxvii. p. 483). No evidence of spermatozoa or spermatogenesis.

The preceding observations are confirmed by a series of experiments I performed on the Dog, and published in the paper above referred to. In these I replaced the testis, without injuring the organ itself or the structures of the cord, in the abdominal cavity in young and in full-grown dogs. The results obtained were the following:—

(1) When the testicle of a young animal is replaced in the abdomen, it undergoes but little change, growing somewhat, but not so much as the undisturbed organ, until the onset of puberty.

(2) A testicle so replaced after the onset of puberty continues to grow to some extent, though but little.

(3) The testicle of a full-grown animal when replaced in the abdominal cavity soon dwindles to two-thirds or one-half its natural size, and after a short time presents precisely the same structure as that which is found in the replaced testicle of a young animal above noted.

In each case the epithelium is reduced to a single layer of columnar, tapering cells, with the pointed ends projecting into and filling the lumen more or less completely. The protoplasm of the cells is fibrillated in the long axis of the cells; and the nuclei are small and round, and placed near the basal, broad end of the cells. In none of these tubules are there any traces of spermatogenesis seen in the epithelial cells and no spermatozoa in the interior of the tubules (see fig. 11).

Thus, both in Man and in the Dog, the *retained* testes are of small size, and they alike present a definite structure that is almost, though not quite, peculiar to them; and they are not in that state which is fitted for the production of spermatozoa.[1]

Hunter (1) expressed the view that the *retained* testis were, *ab initio*, imperfect in their structure, and that it was owing to this imperfection that they failed to stimulate into activity the mechanism of descent, and thus they remained undescended. Curling (2) stated that this was not the case in the majority of instances, and he considered that the testes when retained are in structure like the testes before the onset of puberty. That this view, however, is not correct is shown by a comparison between the structure of the retained and of the undeveloped organ. In the former, as we have seen, the tunic of the tubules is thick, and the epithelium consisting, as a rule, of a single layer of columnar cells; whereas in the nominal condition of the child the tubules consist of a solid rod of small polygonal cells surrounded by a thin tunica propria. Godard (3), who is followed by Monod and Arthaud (4), maintains that the *retained* testes acquire their natural structure; but he specified that their secretion does

[1] In the testis of the aged, the epithelium assumes much the same character. See a paper by me ("Structural Changes observed in the Testicles of Aged Persons"), *Jour. of Anat. and Phys.*, vol. xxvii. p. 474.

not contain spermatozoa. A careful microscopical observation would, however, have shown him that although, to outward appearance, the testis in the two cases (descended and retained) are similar, the intimate structure is very different.

Follin and Goubaux (5), with whom I concur, found that, both in Man and in the domesticated animals, the testes were not only of small size, but the seminal tubules were atrophied and incapable of producing spermatozoa.

Conclusions.

1. The *retained* testis in Man and in the domesticated animals is of small size, and the seminal tubules, though smaller, are more distinct owing to the disproportionate amount of intertubular connective tissue.

2. The walls of the tubules are thick from the formation of fibrous tissue on the inner surface of the tunica propria; and the epithelium is scanty and columnar, and there are no traces of spermatogenesis.

3. The testes in cryptorchids, though they are incapable of producing spermatozoa, are yet capable of exerting that influence which the natural testes exert upon the development of the penis and the growth of the body.

4. The function of the testes, namely, that which influences the growth of the body at puberty, is distinct from that of the production of spermatozoa, the latter necessitating a more specialised development of the tubules of the gland than the former.

5. The testes do not acquire their full (spermatozoa-producing) function, except at the furthermost point of descent from their primary position.

LIST OF REFERENCES.

(1) Hunter, *Animal Economy.*

(2) Curling, *Diseases of the Testes*, 4th ed.

(3) Godard, *Rech. sur la Monorchid et Cryptorchid chez l'Homme.*

(4) Monod et Arthaud, "Étude des Alterations du Testicule Ectopique," *Arch. Gen de Med.*, 1887.

(5) Follin et Goubaux, "De la Cryptorchidie chez l'Homme et les principaux Animaux domestique," *Mem. de la Soc. de Biol.*, 1855.

(6) Miflet, *Langenb. Arch.*, Bd. 24, s. 399.

DESCRIPTION OF PLATE VII.

Fig. 1. Diagrammatic representation of the testes of a hedgehog (*Erinaceus europæus*) in midwinter, when sexual activity is in abeyance. *ep*, Epididymis ; T, testis ; *v.d.*, vas deferens (nat. size).

Fig. 2. Transverse section of one of the seminal tubules in the testis of a hedgehog at midwinter. (*a*) Tunica propria consisting of single layer of flattened tissue cells ; (*b*) continuous layer of cubical cells lining tunica propria ; (*c*) polygonal cells with altered nuclei and finely-granular protoplasm occupying the centre. × 300.

Fig. 3. Diagrammatic representation of testes of hedgehog in midsummer, when sexual activity is at its height (nat. size).

Fig. 4. Transverse section of one of the seminal tubules in the testis of a hedgehog at midsummer, when sexual activity is at its height. (*a*) Tunica propria as in fig. 2 ; (*b*) single layer of cubical cells lining tunica propria ; (*c*) spermatogenetic cells, within which are the clusters of spermatozoa. The lumen is occupied by coagulated secretion, in which there are no spermatozoa.

Fig. 5. Diagrammatic representation of a normal full-size testis of an adult man (nat. size).

Fig. 6. Diagrammatic representation of retained testis in Example II. showing the small size of the organ, and the distance intervening between the epididymis and the body of the testis.

Fig. 7. A transverse section of a seminal tubule in the testis of Example III., showing the slightly thickened tunica propria. (*a*) The single layer of columnar slightly fibrillated tapering epithelial cells lining the tubule. × 350.

Fig. 8. Transverse section of a seminal tubule taken from the retained testis in Example II. In it the *tunica propria* is composed of an outer (*a*) thin layer of flattened connective tissue cells with but little intervening fibrous matrix, and an inner (*b*) thick layer of an almost transparent finely-fibrillated connective tissue, in which there are hardly any nuclei of connective tissue cells. The epithelium (*c*) is reduced to a few cells of irregular size and shape, with round nuclei and highly granular, though not fatty, protoplasm. × 350.

Fig. 9 and 10. The testes, right and left respectively, of a dog ; the former was natural and in the scrotum, but the latter small and retained in the groin (nat. size).

Fig. 11. Transverse section of a seminal tubule taken from the retained left testis (fig, 10), showing the tunica propria (*a*) more or less normal, and the epithelium reduced to an almost single layer of columnar tapering and fibrillated cells converging towards the centre, much the same as in fig. 7.

Fig. 1.

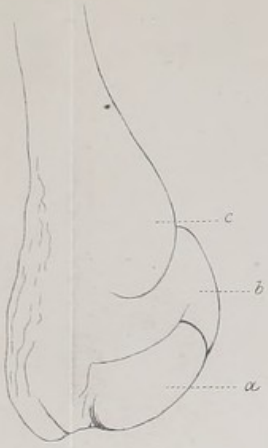


Fig. 3.

Fig. 5.

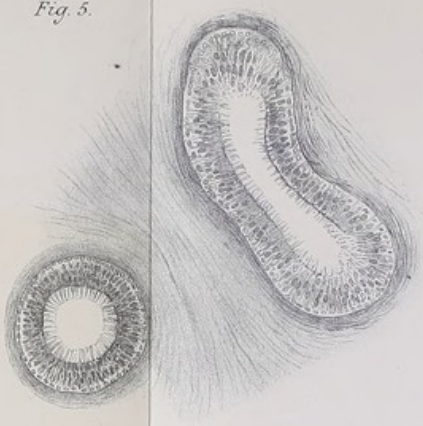


Fig. 2.

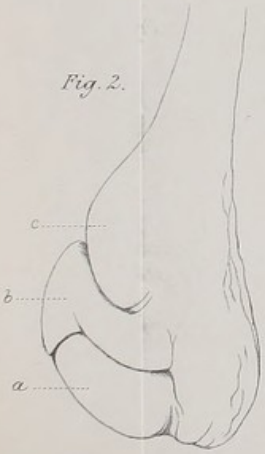
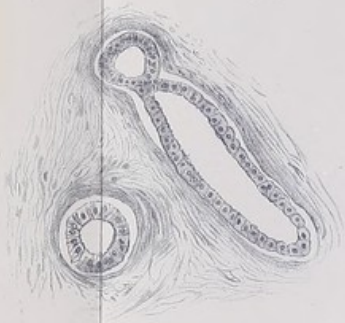


Fig. 4.

Fig. 6.



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TESTIS IN EUNUCHOIDS.

F. Huth, Lith. Edin.