OBSERVATIONS ON THE URINARY BLADDER AND URETHRA.

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WHILE conducting some physiological experiments on dogs, with the view to the study, first, of the mechanism, both nervous and muscular, of the natural retention and expulsion of urine and, secondly, of the function of each nerve going to the bladder and urethra, I soon became convinced that no satisfactory progress could be made unless an investigation into the anatomy of the muscular wall of the bladder and urethra and of the nerves of each were undertaken as a preliminary step to these experiments. Such a preliminary investigation was indeed necessary, because of the discrepancies and want of uniformity that exist concerning these parts in the various descriptive text-books of anatomy. Accordingly, I began the investigation in the human subject, but soon found that difficulties arose which could only be cleared up by examining the same parts in the lower animals. I, therefore, have supplemented my studies in the human subject by those derived from many of the lower animals, but chiefly from the domesticated ones. I propose to confine myself in this, the first part of my paper, chiefly to the anatomy of the muscular apparatus of the bladder and urethra.

The Urinary Bladder.

Before proceeding to refer to the more recent observations on the anatomy of the urinary bladder, it may perhaps be of interest to review in brief the history of the study of the anatomy of this organ. In doing this I shall do little more than make use of extracts from the works of such anatomists as seem worthy of note.

The urinary bladder received a certain amount of attention even in the earliest times in the history of scientific medicine. But so far as I have been able to gather from various old anatomical works, no observation of any importance seems to have been made on the

anatomy of this part of the urinary apparatus before that by Galen. In Laut's *l'Histoire de l'Anatomie* the following account of Galen's description of the urinary bladder is given:—

"L'Urine descend par les uretères, formés par une seule tunique, plus forte que la tunique des Veines et plus forte aussi que la vessie urinaire, mais plus foible que la vesicule du fiel.

"La vessie, que reçoit l'urine des uretères est formée par une membrane dont les fibres sont longitudinales, transverses et obliques, parce que la vessie attire, excrète et retient.

"L'uretre fèminin est court; mais celui de l'homme est grand, fléche en S romain, et il faut une portion de la verge. L'origine de l'urètere est entourée en sortant de la vessie par une musclé sphincter."

Thus, Galen conceived of the urinary bladder as composed of a single membranous tunic made up of longitudinal, transverse, and oblique fibres, and having around its neck a sphincter presumably to prevent the constant escape of the urine. As no progress of any significance was made in anatomical science for centuries after this, we may at once proceed to the account given in the earliest English text-book of anatomy, written by Thomas Vicary,[1] who was senior surgeon to St Bartholomew's Hospital, and on several occasions the President of the Company of Barber-Surgeons. The following extract may serve to show his knowledge, and presumably that of his contemporaries, of the anatomy of these parts.

"The first thing that cometh in sight [in the pelvis] is the Bladder, the which is an official member compound of two nervous Pannicles, in complexion colde and dry, whose neck is carnous and hath muscles to witholde and let go. . . . . The form of it is rounde; the quantitie is a pitcherfull; in some more; in some less," etc.

In this description one recognises an attempt to subdivide the single membranous tunic, as described by Galen, into two layers or pannicles; the neck of the bladder "hath now muscles to witholde and to let go" urine; and the capacity is noted as being variable. This means, so far as I can gather, variable as regards capacity in different persons, and not in one and the same person. What was Vicary's conception of the mechanism of micturition is difficult to imagine, as he gives no clue as to the manner of working of the bladder, except this much, that it possessed muscles around its neck to "*witholde* and *let go*" urine. The arrangement of fibres in the wall of the bladder, as described by Galen, is lost sight of, to be again discovered by a later anatomist.

In less than half a century after Vicary, a new interest arose in connection with this organ, as indeed in the whole field of anatomical science, when Vesalius published his great work on anatomy, and in which the bladder was thus described. The wall of the bladder is said to be composed of longitudinal, transverse, and oblique fibres, and the bladder to vary in its capacity; the latter I take to mean variation in capacity in one and the same person. The former is, as has been above mentioned, merely a re-discovery of what Galen

[1] "Anatomie of the Bodie of Man," *Early Eng. Text Soc.*

had observed and described. This seems to have been the first attempt since Galen at describing somewhat minutely the structure of the wall of the urinary bladder; and it is a decided advance on what was taught by Thomas Vicary, inasmuch as the latter only conceived of two nervous pannicles or tunics forming the wall of a bladder that varied in size in different persons. The following quotation may serve to indicate the new doctrine as taught by Vesalius :—

"Vesicam implicantes fibræ, eadem, qua fibræ Ventriculi, et bilis vesiculæ, collocantur serie. Rectæ enim intimæ sunt, extimæ transversæ mediæ vero obliqua pro functionum ordine adipiscentis. Lib. v. p. 399, *D. Corp. Hum. fab.*

When the study of anatomy thus received a new impulse, other and new investigators, pupils of the school of Vesalius, soon appeared, and amongst them was Fallopius,[1] who was the first to regard the muscular fibres of the bladder, discovered by Galen, and subsequently described by Vesalius, to be of a muscular nature. He even went so far as to include these muscle-fibres amongst the other muscles of the body, and maintained that they were likewise under the influence and control of the will; this conception is shared by many authorities of the present day. Not many years later, Spiegel[2] gave the name of *detrusor urinæ* to the longitudinal fibres of the muscle-coat, because he conceived these were in the main the muscular fibres concerned in the expelling of the urine. The name has since been retained, but there are evident signs of its gradual disappearance from anatomical works, which may well be the case, forasmuch as the fibres which he describes do not form a separate muscle and have not a separate function.

Cowper gives a short description of the bladder in his work entitled *The Anatomy of the Human Bodies*, and published in Oxford 1698:—

"The bladder of urine may be said to be a dilatation of the ureters: the intimate of the membrane of both agree, except that the muscular fibres of the bladder are stronger and larger than those of the ureters; the superior and largest of them embracing the bladder like a hand, as Spigelius compares them; the internal are the less, and decussate the superior with the various angles: some anatomists reckon these among the muscles, and call them *detrusores urinæ*."

Even at this period the muscular nature of the wall of the urinary bladder was not universally acknowledged, nor was its muscle placed amongst the other muscles of the body; indeed, from the above quotation one would gather that only a few anatomists of that period held that the muscle of the bladder deserved such a recognition.

Cheselden, a few years later, gives the following description :—

"The bladder of urine is seated in the pelvis of the abdomen; its shape is orbicular, and its coats are the same as with those of the guts and other hollow muscles already described, viz., an external membranous, a middle muscular, which is the *musculus detrusor urinæ*, and an inner membranous coat, exceeding sensible, as is fully shown in the cases of the stone and

[1] *Obs. Anat.*

[2] *De Corp. Hum. fabricia*, lib. iv. 512.

gravel. The use of this nice sense is, to make it capable of that uneasiness which excites animals to exclude their water, when the bladder is much extended" (1722, 2nd ed., p. 214).

In the above account given by Cheselden, the whole of the muscular coat of the bladder is distinctly recognised as forming the detrusor urinæ, and not only the external longitudinal fibres, as understood by Spiegel; further, the wall of the bladder is compared to the muscular wall of any hollow viscus, such as the stomach. Again, the arrangement of the muscular fibres is supposed to be the same in all of these hollow viscera with muscular walls.

After this there appears to have been no progress in the study of the anatomy of these hollow organs, and especially of the urinary bladder, until the time, comparatively recent, when Mr Ellis gave an account of his researches before the Medico-Chirurgical Society of London in the year 1856. In this account he describes the muscular wall of the bladder as being composed of *three* strata or planes, two of which are thick and complete, while the third is thin and incomplete. In each stratum or plane the muscular fibres run in one definite direction, but the direction differs in each plane; for example, in the external stratum or plane, the muscular fibres run longitudinally from apex to base; in the middle, circularly, and in the internal, obliquely. In addition, he noted that the muscular fasciculi derived from the muscular bundles pass from one stratum to another in order that a thorough and intimate binding of all the strata should be ensured. From this he draws the obvious conclusion that one stratum cannot, in consequence of these muscular fasciculi, contract without the others participating. Therefore all the three strata are like one. Not more than ten years later Dr Pettigrew, who had just completed a very careful and elaborate series of dissections of the urinary bladder, as also of the other hollow muscular viscera in man and in many of the domesticated animals, published the result of his researches in the *Proceedings of the Royal Society*, 1865. The main conclusion arrived at in the paper is that the muscular fibres of all hollow muscular organs are arranged in a series of interlacing figures of 8. This description has not been confirmed by others, and does not seem to me to be warranted by the observations of the Pettigrew specimens which are in the Museum of the Royal College of Surgeons.

Of all the more recent writings on the subject, the one most worthy of notice is that by Professor MacAlister, who, in his recently-published work on Anatomy, modifies in some respects the account given by Ellis. He divides the external layer, which he says is characterised by being of a reddish colour, into several series of groups; these are the (p. 447)

"*Uracho-vesical*, which radiate in three sets; the anterior descend on the front wall, the posterior on the hinder wall from the urachus, and the lateral pass in two series, some oblique, and some directly downwards from the urachus to the prostate. A second set are *pubo-prostatico-vesical*, and radiate on the anterior wall from the attachment of the anterior true ligaments; a third series are *recto-vesical*, coming from the fascia, so named in the male, or *vagino-vesical* in the female. These series freely interlace into a continuous layer, which is sometimes named the *detrusor urinæ* muscle.

From a study of the foregoing extracts it is evident that the dissection of the muscular fibres in the wall of the bladder is beset with no ordinary difficulties.

In my dissections, which have been chiefly conducted on human bladders, I have adopted the common plan of distending the organ, soon after its removal from the body, with strong methylated spirit, so as to render its walls tense and hard.

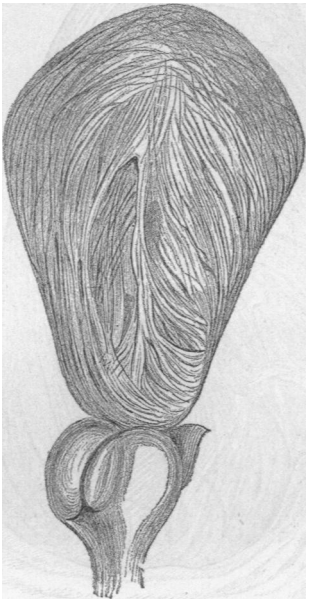

FIG. 1.—A view of the anterior surface of a dog's bladder distended with spirit. Longitudinal external fibres run from apex towards neck of bladder, where they turn outwards on either side of the middle line, and become more or less transversely disposed; the lateral longitudinal fibres are also shown, also the prostate gland and vasa deferentia. Reduced to two-thirds natural size.

After the removal of the peritoneum, fat and loose cellular tissue, it will be observed that the muscular bundles are collected together so as to form somewhat ill-defined bands. These bands are seen to run in different and varying directions, and, on the whole, the arrangement in the two lateral halves of the bladder is symmetrical. In the middle, in front and behind, there is a broad band, which runs from the apex to the

neck, and which is composed of bundles having a longitudinal direction. Near the neck of the bladder the bundles are gradually lost in the connective tissue, and are not inserted into any special part, such as the capsule of the prostate gland and anterior true ligaments of the bladder. At the apex, the

FIG. 2.—View of left lateral surface of human bladder, which was taken from a man who had suffered from a slight stricture of the urethra. The anterior and posterior groups of longitudinally disposed fibres are shown on the anterior and posterior surfaces respectively; some of the longitudinal fibres on the anterior surface turn outwards and become oblique, offshoots from the longitudinal fibres on the posterior surface becoming transverse or circular in direction. Reduced to two-thirds natural size.

bundles are dispersed and join with others in a dense plexus around the base of the urachus; they are blended with much connective tissue. There are no other bands with bundles having a longitudinal direction on the exterior of the organ, and these two, therefore, constitute the *external longitudinal*

coat, which is incomplete, and which was first called by Spiegel the *musculus detrusor urinæ*. Even these two bands, and especially the one in front of the bladder, are not altogether composed of bundles disposed in a longitudinal manner, for, near the neck of the bladder, many of these bundles may be seen to take an oblique or transverse course around the lowermost segment of the organ, as is shown in fig. 2. It may be mentioned that in the dog's bladder, where the longitudinal bundles are especially abundant on the exterior, they may be readily seen thus coursing obliquely and transversely about the lowest segment of the organ (see fig. 1); and, as in man, they have no special attachment or insertion into the prostate gland or its fascia, but are lost in the connective tissue in the region of the neck of the bladder. The same disposition of the longitudinal and external bundles holds good in other animals, especially the cat, in which the *post-prostatic* portion of the urethra (a part not represented in man) is, as in the dog, elongated. On the lateral surfaces of the bladder, between the anterior and posterior longitudinal bands, other muscular bands are seen taking different directions—oblique and transverse. They change direction, and interlace with one another, and, towards the anterior and posterior parts, pass beneath the longitudinal bands. They are superficial and deep, and they cannot be said to have their point of origin, or that of their termination, at either the apex or neck of the bladder.

Each *band* is composed, as I have already intimated, of several *bundles* of muscular fibres, which, I need scarcely say, are unstriped; these bundles divide and give off branches, which join with similar branches from adjacent bundles, and in this way form a network connecting the several bundles in a band. In like manner each band is connected with neighbouring bands by fasciculi of muscular fibres, so that the several bands, like the several bundles in each band, are connected by intervening muscular fibres, and the uniformity of action of the entire thickness of the wall of the bladder is ensured, as stated by Ellis. In accordance with what is said above regarding the arrangement of the muscular bands in the wall of the bladder, a section in the mesial line shows two more or less distinct coats, the one external or longitudinal, with its fibres running parallel to the

line of section, and the other internal or circular, with its fibres running across it. In all bladders that I have examined and obtained, the inner or (apparently) circular layer is at all ages and in all degrees of distension the thicker. This is best exemplified in cases of bladders hypertrophied in consequence of some mechanical obstruction to the outflow of urine, for in these the internal coat usually becomes three or four times as thick as the external.

Trigonum Vesicæ.

The trigone of the bladder, first described by Lieutaud and often named after him, is formed by the close binding together of the innermost bands of the muscular fibres of the bladder in the situation between the level of the openings of the ureters and the urethro-vesical orifice; their binding together is effected by means of a considerable amount of a somewhat dense fibrous connective tissue. In its density the trigone resembles the non-striped muscular coats of the urethra, and, as in them, the range of movement is limited. In this respect it is very unlike the remainder of the wall of the bladder, whose range of movement is very free and very great; and owing to this it does not yield during distension of the organ, and it varies but little in its superficial extent and in its thickness in the different states of distension that the bladder assumes.

As I have mentioned, the trigone is composed only of the innermost bands of muscular bundles, while the outermost band, which is here longitudinal, passes onwards towards the neck of the bladder without becoming incorporated in the dense trigone. This outermost band is separated, as may be seen in saggital sections, from the trigone proper by means of a thin and delicate layer of loose connective tissue, and it may consequently be easily depressed behind and beneath the trigone, which is left as an upstanding edge, upon and beneath which the mucous membrane is reflected, as may be seen in cases of long-continued retention. Thus is formed the retro-uretral pouch, so commonly associated with enlarged prostate and retention. I have found the trigone as a distinct structure only in man and some monkeys, and I conclude therefore that it may have some relation to the erect posture.

Internal Sphincter of the Bladder.

Galen[1] considered some such structure necessary, and Vicary[2] says "the neck [bladder] is carnous and hath muscles to witholde and let go [urine];" but Vesalius seems to have been the first to describe it as a distinct muscle. Sir Chas. Bell[3] gives a full and minute description of it as the *sphincter vesicæ internus*, and maintains that it can be easily demonstrated by turning the bladder inside out and reflecting the mucous membrane. Wilson[4] and Guthrie,[5] however, failed to corroborate the view of Vesalius, upheld so strongly by Bell.

In quite recent works on anatomy, such as Cruveilhier's *Anat. Descriptive*, this sphincter muscle is represented only in the male between the base of the prostate gland and the anterior wall of the bladder in front, not behind, and not in any part of the female bladder and urethra.

Although I have investigated this matter with great care in numerous bladders taken from both sexes and of all ages, yet I cannot say that I have met with a single instance where there was a thickening of muscle around the commencement of the urethra sufficient to constitute a sphincter, or indeed anything approaching one. What is thus described as a special muscle I find to be nothing more than a few of the outer bundles of the muscular wall of the bladder passing through some loose connective tissue between the base of the prostate gland and the wall of the bladder before becoming lost in the connective tissue of this region and perhaps in the capsule of the gland. I may here, for the purpose of making the matter more clear, refer to what I have written in a former paper on the "Prostate Gland" published in the *Journal of Anatomy and Physiology*, vol. xxiii. p. 381.

But, as already said, there is no thickening of the muscular fibres at the neck of the bladder such as deserves the appellation of sphincter or such as to act as a sphincter. The process of retention and expulsion of urine I propose to consider in a subsequent paper (Part II.).

The Urethra.

In man the urethra is anatomically divisible into *three* parts —namely, prostatic, membranous, and penile, each part corresponding to a definite and well-known region.

[1] *Loc. cit.* [2] *Loc. cit.* [3] *Trans. Med. Chir. Soc. Lond.*, vol. i.
[4] *Lect. on the Urinary and Genital Organs*, 1821, p. 57.
[5] *Anat. and Dis. of the Bladder*, p. 15.

When, however, the urethra is studied from a comparative anatomy standpoint, or from that of embryology, it will be observed that it is made up of two main portions—a *first* or urinary, which extends from the neck of the bladder to the point where the *vasa deferentia* open into the urethra, and which comprises the upper part of the prostatic region in man; and a *second* or *genital* (genito-urinary) portion, formed by the fore part of the prostatic, membranous, and penile portions. I call attention to this morphological and physiological division of the urethra in order to elucidate some of those physiological problems, to be subsequently considered, that arise in connection with the normal retention and expulsion of urine and semen.

In the lowest order of Mammalia, the monotremata, the urethra in the male is short and opens into the uro-genital sinus, and serves only to convey urine. The *first* or urinary portion extends from the neck of the bladder to the level of the entrance of the *vasa deferentia* into the urethra. The muscular wall of this part of the canal is composed of layers of non-striped muscle only, which are continuous with those of the bladder on the one hand and those of the *second* or genital portion of the urethra on the other. (The length of this part varies in different animals.) In man it is very short, measuring only from $\frac{1}{2}$ to $\frac{3}{4}$ of an inch in length; but in the dog it is longer, and in the cat it usually measures about 2 inches.

The first (or *urinary* part) consists of three coats—the *internal* or mucous coat, composed of loose connective tissue, in which there are numerous veins, is lined by transitional epithelium, like that covering the mucous membrane of the bladder; a *middle* or muscular coat is composed of an inner incomplete longitudinal layer in separate bundles, and an outer, thicker, circular layer, both these layers being traceable in serial transverse sections from the neck of the bladder downwards, and found to be directly continuous with the muscular layers (the so-called inner oblique and middle circular) of the bladder; an *outer* fibrous coat composed of loose connective tissue. This first part of the urethra serves to convey urine from the bladder to the *second* or genital part of the urethra, or into the uro-genital sinus or cloaca as the case may be.

The second or genital (*genito-urinary*) part extends from the

openings of the *vasa deferentia* into the urethra to the end of the penis, and is the part developed in the male for the purpose of safely conveying the semen into the receiving organs of the female. It is made up of, as I have stated above, the fore part of the prostatic, the membranous and the penile portions of the urethra. The minute structure of each of these parts is so well known and so fully described in most anatomical text-books that I need hardly refer to it here. This, the second or genital part of the urethra, is covered externally by a sheet of striped muscle, which begins at or about the level of the entrance of the *vasa deferentia* into the urethra, and extends to within two or more inches of the *meatus urinarius*. This sheet of striped muscle is, at its beginning, represented in man by a few transverse fibres on the anterior or ventral surface of the lower or distal half of the prostate gland. They rapidly, however, increase in length, so as to extend on each side of the urethra dorsalwards, and at the beginning of the membranous part they more or less completely encircle the tube. The fibres on the anterior or ventral surface of the prostate gland constitute the "external sphincter" of Henle; but inasmuch as they are not disposed in a sphincter-like fashion, and do not form a distinct muscle, rather the beginning of the sheet above referred to, they hardly deserve to be designated by a special name. The part of this sheet around the membranous part of the urethra is termed the *constrictor urethra;* and the muscle in this situation does not form a complete ring of uniform thickness around the tube. It is in transverse section of the urethra in the form of a crescent, something like a horseshoe with the thickest part in front or ventrally, and the pointed extremities fixed to the connective tissue of the hinder or dorsal wall, as is represented in the urethra of the Hedgehog. This muscle is thus fixed only at the extremities of the crescent, the remainder being free to contract and compress the urethra. Again, the part of the sheet around the senile portion is termed the *accelerator urinæ*, which needs no description, as its arrangement and disposition is well known. It is interesting in this connection to make the following quotation from the works of Jno. Hunter (*Animal Economy*, ed. by Palmer, p. 39).

"I shall call these [acceleratores urinæ] muscles *expulsores semi-*

nis, as I apprehend their real use to be for the expulsion of that secretion [*semen*]; these muscles likewise throw out those drops of urine which are collected in the bulb from the last contractions of the bladder; and they have, from this circumstance, been called *acceleratores urinæ;* but if a receptacle [meaning the bulb] had not been necessary for the semen, those muscles had probably never existed, and the last drops of urine would have been thrown out by the action of the bladder and urethra, as in some measure is the case in the castrated animal."

The name suggested by Hunter may with much appropriateness be applied to the whole sheet of striped muscle around the urethra, for it all has the same function as those designated by him the *expulsores seminis.*

I do not, of course, ignore the use of this muscle in expelling urine from the urethra as well as in closing the urethral canal.

The Changes in the Striped Muscle of the Urethra in Rutting Animals during the Rutting Season.

The division of the urethra which I have adopted in the preceding pages, and which is based upon a study of the physiological uses of its parts rather than upon convenience in description, receives additional support from observations that I have made upon the periodic changes that occur in the striped muscle around the urethra in those animals which have a rutting season; and also upon the alterations that supervene in the structure of the muscle after complete castration in some of the domesticated animals and in man.

In the rutting animal the structural changes in the muscle go *pari passu* and correspond with the changes that occur in the testicles and the accessory sexual glands. As the latter increase in size and activity of function so does the muscle increase in size and in the tranverse striation of its fibres. As the glands shrink so does the muscle lose its structural evidence of functional activity. For instance, in the Hedgehog in midwinter the striped muscle around the second or genital part of the urethra (that around the membranous part selected) is pale and about 1–1·5 mm. in thickness; the muscular fibres are small and atrophied, showing well-marked longitudinal but only faint transverse striation (fig. 3), and they are separated by much

fibro-cellular connective tissue. In midsummer, when sexual activity is at its height, the same muscle is reddish in colour and about twice as thick (2–3 mm.); the muscular fibres are large, presenting the well-known appearances of an active, healthy, skeletal muscle; the longitudinal striation is hardly perceptible, but the transverse well-developed; the fibres are close to one another with only a small amount of intervening

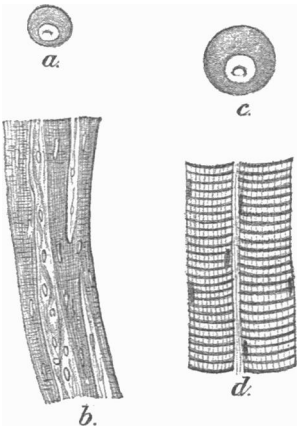

FIG. 3.

delicate connective tissue. The increase in the thickness of the muscle is entirely due to the enlargement of each fibre and not to any new formation of muscular fibres. I have determined the number of muscular fibres, and they are practically the same in each instance. The same is true of the Mole.

The Changes Induced in the Striped Muscle of the Urethra after complete Castration.

Attention was first drawn to this subject by John Hunter, who, in his work on *Animal Economy*, refers to it in the following terms :—

"On the contrary, in the castrated animal, the penis is small and not capable of much dilation; the corpus spongiosum is less vascular; the cavity at the bulb is little larger than the canal of the urethra; and the muscles are white, small, and have a ligamentous appearance. The same observations are true if applied to the erectores penis."

I have been able to confirm the above observations, and may in addition add that the striped muscle around the membranous fore part of the prostatic urethra suffers in like manner, and becomes tough, fibrous, and ligamentous, just as the special muscles of the penis. This may be observed in the bullock, gelding, and other castrated animals. That such is the case in man, may be gathered from the observations of Gruber, Bilharz, and Pelican, to which I have referred in a paper already published by me on the prostate gland (see *Jour. Anat. and Phys.*, vol. xxiv. p. 35).

In a full-grown cat, castrated when a few weeks old, I found that the fibres of the striped muscle-coat were greatly atrophied, with loss of transverse but increase of longitudinal striation, and great development of connective tissue between the fibres which were much separated; this corresponding closely with the condition found in the Hedgehog in mid-winter.

Conclusions.

1. The muscular fibres of the wall of the bladder are collected into broad bands, two of which, from 1 to 2 inches in width, have an external longitudinal direction from the apex to the neck on the middle of the anterior and posterior surfaces. They are the "detrusor urinæ" and form the "external longitudinal coat." The other bands, which form the greater part of the wall, have an oblique or transverse direction, crossing over and under one another, and often changing their direction; these, unlike the former, have no special point of attachment.

2. Each band is composed of anastomosing bundles of muscular fibres, and all the bands are connected with one another by means of intervening muscular fasciculi. All the bands thus connected act together harmoniously.

3. The *trigonum vesicæ* is formed by the innermost bands, the muscular fibres of which are closely and firmly bound together by fibrous connective tissue; the outer longitudinal band passing onwards to become lost in the neck without being incorporated, being, in short, separated from the trigone by loose areolar connective-tissue. It is this arrangement that allows of the easy formation of the retro-uretral pouch, in cases

of long-standing difficulty in emptying the bladder and especially if accompanied by retention.

4. There is no thickening of the so-called circular coat of the bladder at the neck, to constitute an "internal sphincter," neither in the male nor female.

5. The striped muscle around the genital part of the urethra is developed especially in relation to the sexual function.