c'. High origin of *abductor minimi digiti* from fascia of forearm.
d'. Muscular slip connecting the *brachialis anticus* with the *supinator longus*. Also in the next notice in the same column.
e'. Superficial slip connecting the two portions of *flexor brevis pollicis*.
f'. Origin of *stylo-glossus* from the angle of the lower jaw.
g'. Subcutaneous slip from sternal fascia to cervical fascia.
h'. Musculo-tendinous slip from *flexor pollicis longus* to indicial portion of *profundus*.
i'. *Flexor carpi radialis accessorius*, a separate muscle connected with the origin of *longior*, to be inserted into the base of the metacarpal of *pollex*, giving a slip to *abductor pollicis*.
k'. Slip of *pectoralis minor* inserted into costo-coracoid membrane and clavicle.
l'. Double muscle, the lower inserted into annular ligament and origin of *abductor pollicis*.
m'. *Flexor longus hallucis* exchanged slips with *flexor longus digitorum*.
n'. *Third lumbricalis* arose from *flexor perforatus* instead of *perforans*.
o'. *Flexor brevis hallucis* sent a large slip to base of first phalanx of second toe.
p'. Muscular slip from insertion of *subscapularis* to the neck of the humerus and tendon of *latissimus*, an imperfect *coraco-brachialis brevis*.
q'. A distinct muscle from front of manubrium to lower border of clavicle, under fibres of *pectoralis major* (*Sterno-clavicular*). *Subclavius* also present.
r'. Distinct muscle arising from first rib with *sterno-thyroid*, and inserted into cervical fascia under *sterno-cleido-mastoid* (*costo-fascialis cervicalis*).
s'. Muscular slip from *latissimus dorsi* to join *coraco-brachialis* just below coracoid process, across the vessels of the axilla.
t'. On the left side a muscular slip from *brachialis anticus* to the fascia of the forearm; on the right side a fusiform muscle forming a high origin of the *pronator rad. teres*.
u'. *Perforatus* tendon of little toe from *flexor accessorius*.
v'. Muscular slip from *splenius colli* to *serratus magnus*.
w'. Third *lumbricalis* to inner side of *middle* finger. Fourth absent altogether.
x'. First *dorsal interosseus* double. Also in 27.
y'. Tendinous slip from *flexor carpi ulnaris* to base of *fourth*, as well as the fifth metacarpal
z'. Separation of anterior fibres of *gluteus minimus*, forming distinct muscle.

X. "On the Muscular Arrangements of the Bladder and Prostate, and the manner in which the Ureters and Urethra are closed." By James Bell Pettigrew, M.D. Edin., Assistant in the Museum of the Royal College of Surgeons of England. Communicated by Dr. Sharpey. Received June 21, 1866.

(Abstract.)

The present communication, which is based on an extensive series of dissections* and illustrated by photographs, is intended to show that the muscular fibres of the bladder, contrary to the received opinion, are spiral fibres, and with few exceptions form figure-of-8 loops. The loops are variously shaped, according as they are superficial or deep, the more superficial loops being attenuated or drawn out so as to resemble longitudinal or

* Of these upwards of sixty are preserved in the Museum of the Royal College of Surgeons of England.

vertical fibres, the deeper ones being flattened from above downwards, and resembling circular fibres.

These loops are directed towards the apex and base, and are arranged in four sets; an anterior and a posterior set which are largely developed, and a right and left lateral set which are accessory and less fully developed. The bladder is consequently bilaterally symmetrical.

The superficial loops are confined principally to the anterior, posterior or lateral aspects, but the deeper ones radiate and expand towards the apex and base, so that they come to embrace the entire circumference of the bladder in these directions. The expansion of the fibres is greatest towards the apex, and the aggregation of the terminal loops of the anterior and posterior fibres at the cervix (assisted by the lateral fibres) form a well-marked sphincter vesicæ in this situation. The fibres pursue definite but varying courses, those which are longitudinal or vertical at one point becoming slightly oblique at a second, oblique at a third, and very oblique or transverse at a fourth. The fibres consequently change their direction and position on the vesical parietes gradually and according to a fixed principle. The principle involved is readily explained. The most external and most internal fibres are always the most vertical and most feebly developed; those which succeed or follow becoming more and more oblique and stronger and stronger. The fibres from this circumstance are divisible into two orders, viz., an external and an internal, and these, as has been stated, are grouped in two principal and two subsidiary sets. The two principal sets occur on the anterior and posterior aspects of the viscus, and are so arranged that the terminal or transverse portions of the anterior set intersect the more vertical portions of the posterior set nearly at right angles and the reverse. Similar remarks apply to the subsidiary sets. Between what may be called the vertical or longitudinal and the circular or transverse fibres, other fibres having different degrees of obliquity occur. These consist for the most part of the deeper anterior and posterior spiral fibres, and of the subsidiary spiral fibres from the sides. There is consequently no part of the vesical parietes in which longitudinal, slightly oblique, oblique, and very oblique external and internal fibres may not be found. The additional strength secured by this arrangement cannot well be estimated.

The external and internal fibres are similarly disposed on the anterior, posterior, and lateral aspects, and if the dissection be conducted from without inwards, the fibres first removed are the mesial, vertical, or longitudinal fibres; then the slightly oblique fibres inclined on either side, and crossing at acute angles as in an attenuated figure of 8; then the oblique fibres, crossing at wider vertical angles as in the more perfect figure of 8. Lastly, the very oblique fibres, crossing at such obtuse angles as to have been, up to the present, regarded as circular fibres. The fibres which are still deeper and which constitute the proper internal fibres, have a precisely similar arrangement, but are rudimentary, and consequently not so readily traced. The external and internal fibres, as will be seen from this description, be-

come more and more oblique, both from without and from within, or in proportion as the centre of the vesical parietes is reached, the deepest or most oblique external and internal sets forming, by the blending of their terminal or transverse portions, what is commonly known as the central layer.

The most external or superficial fibres are connected directly and indirectly with the slightly oblique external fibres, the slightly oblique with the oblique, and the oblique with the very oblique. The very oblique external fibres, on the other hand, are connected with the oblique internal, these in their turn being connected with the slightly oblique internal, and the slightly oblique internal with the longitudinal or vertical internal. In some instances the longitudinal external are connected directly with the longitudinal internal, and so of the slightly oblique, oblique, and very oblique external and internal fibres.

The apex and base of the bladder are similarly constructed, and resemble in their general configuration the other portions of the vesical walls; *i. e.*, they are composed of longitudinal or vertical, slightly oblique, oblique, and very oblique or circular fibres which cross in given directions on the external and internal surfaces.

The four sets of longitudinal or vertical fibres have a crucial arrangement at the apex and base, and the slightly oblique fibres are drawn together at the urachus and cervix by the constrictions which in the embryo separate the bladder from the allantois and urethra. The slightly oblique fibres consequently converge towards the apex and base respectively; and this arrangement at the cervix greatly assists in closing the urethra, as the fibres naturally come together to form an impervious funnel-shaped projection which is directed downwards and forwards. The closure of the urethra is completed by the contraction of the very oblique or circular fibres forming the sphincter, and by the prominence of the uvula vesicæ (luette vesicale) and median ridge in the female, and the caput gallinaginis or verumontanum in the male.

The longitudinal or vertical, slightly oblique, oblique, and very oblique external and internal fibres at the base are continued forward within the prostate to the membranous portion of the urethra, and the external and internal surfaces of the corpus spongiosum.

The coats of the urethra are therefore to be regarded as the proper continuation of the walls of the bladder in an anterior direction.

The longitudinal or vertical, slightly oblique, oblique, and very oblique spiral fibres which form the tunics of the bladder and urethra are curiously enough repeated in the prostate of the male, and the analogous structure n the female, so that this gland would seem to be composed chiefly of fibrous offsets from the fibres in question.

The relations existing between the prostate, urethra, and cervix of the bladder are best seen when vertical, horizontal, and antero-posterior or transverse sections of the bladder and prostate are made.

In such sections the external longitudinal or vertical anterior, posterior, and lateral fibres are seen to pass forward on the external surface of the

urethra; a certain proportion passing outwards to be inserted into the anterior, posterior, and lateral surfaces of the capsule of the prostate, others passing inwards or through the gland in a vertical or longitudinal and likewise in a horizontal or transverse direction. The crucial arrangement of the four sets of external fibres at the apex and base is thus clearly traceable in the prostate. Such of the external fibres as are not inserted into the capsule of the prostate are attached to the posterior surface of the pubis, the internal border of the aponeurosis of the levator ani, and the fascia covering Guthrie's muscle. The external fibres investing the dorsal, ventral, and lateral aspects of the urethra and prostate are separated by a considerable interval, thus showing that, although the relations existing between the urethra and prostate are of the most intimate description, they may nevertheless be regarded as independent. What has been said of the external longitudinal fibres applies equally to the slightly oblique, oblique, and very oblique external and internal ones, these bifurcating and distributing themselves with considerable regularity to the walls of the urethra, and the substance of the prostate respectively. The urethra and prostate are thus composed of fibres crossing in every direction as in the bladder itself.

The very oblique external and internal fibres are interesting because of the very obtuse angles at which they intersect, and because they are principally concerned in forming the sphincter of the bladder, and the so-called circular layer of the prostate. The very oblique fibres, like the other fibres described, are arranged in an anterior and a posterior set, which are largely developed, and a right and left lateral set, which are developed less feebly. The anterior fibres, which are directed posteriorly, form the posterior half of the sphincter vesicæ, and the posterior fibres, which have an opposite direction, the anterior. The sphincter is thus bilaterally symmetrical, and is somewhat oval in shape, the long axis being directed transversely, or from side to side. The two sets of lateral fibres, which also enter into the formation of the sphincter, intersect the angles formed by the crossing of the anterior and posterior fibres, and render its aperture more circular than it would otherwise be. This circumstance, taken in connexion with the fact that the fibres pursue a very oblique direction, has given rise to the belief that the fibres of the sphincter and neck of the bladder generally are circular fibres, which, as the author shows, is not the case. The fibres of the sphincter are best seen by inverting the bladder and dissecting from within, or by making transverse sections of the prostatic portion of the urethra in the direction of the fundus. They are most strongly pronounced at the cervix, but are continued forward on the urethra and backwards into the bladder. In the female they extend even to the meatus urinarius. The very oblique or circular fibres of the urethra are separated from the corresponding fibres of the prostate by the longitudinal, slightly oblique, and oblique fibres forming the outer half of the urethral wall and the inner portion of the prostate. The interval is particularly evident at the cervix, where the sphincter is most distinctly pronounced;

and here the two sets of very oblique or circular fibres have different axes. Further forward, or towards the apex of the prostate, the space gradually diminishes, the circular fibres of the gland curving in an upward direction into the verumontanum or caput gallinaginis, and blending with the circular fibres of the urethra. While, therefore, the very oblique or circular fibres of the urethra are entirely distinct at one point, they are indissolubly united at another. This is important, as it shows how the sphincter may act independently of the prostate, and the reverse.

The longitudinal or vertical internal fibres posteriorly, connect the median or central portion of the trigone (trigone vesical, trigonum vesicæ, Lieutaud) with the verumontanum in the male, and the uvula and median ridge in the female. The slightly oblique internal fibres bound the trigone laterally, and are continued into the verumontanum, where they cross slightly. The oblique fibres which assist in forming the base of the trigone, are likewise continued in a downward direction on the verumontanum, where they cross, and are mixed up with the continuations of the very oblique fibres which form the sphincter at the neck, and with the circular fibres of the prostate. The arrangement of the fibres in the trigone resembles that found at the cervix and fundus generally, and the author is of opinion that Sir Charles Bell was in error when he described the "muscles of the ureters" as separate structures.

The ureters enter the vesical parietes at a very obtuse angle, and the angle increases according to the degree of distension of the bladder. These tubes receive accessions of fibres from the longitudinal, slightly oblique, oblique, and very oblique external and internal fibres of the bladder in their vicinity, and are continued upon each other within the bladder in the form of a strong transverse band. The transverse band which connects the ureters together within the bladder, or between the uretral orifices, is equal in volume to the ureters themselves within the vesical parietes. The band in question is best seen when the base of the bladder is detached and held against the light, and seems to be formed by the obliteration of the uretral tubes between the uretral orifices.

The uretral channels seek the internal surface of the bladder even more obliquely than the ureters, and the inner walls of the ureters become so thin, particularly towards the uretral orifices, that they act mechanically as moveable partitions or valves, as in the smaller veins*. The canals of the ureters are consequently closed, partly by the contractions of the muscular walls, and partly by the mechanical pressure exercised by the urine about to be expelled.

From the foregoing description it will be evident that the various sets of external and internal fibres forming the bladder, urethra, and prostate are antagonistic, not only as regards themselves, but also as regards the territory or region they occupy; the loops formed by the anterior fibres crossing

* "On the Relations, Structure, and Functions of the Valves of the Vascular System in Vertebrata," by the author, Trans. Roy. Soc. Edin. p. 763.

each other at more or less acute angles according to their depths, the anterior fibres, as a whole, crossing the posterior or homologous fibres as a whole. While, therefore, the fibres, in virtue of their twisted looped arrangement, antagonize each other individually, the aggregation of the fibres in any one region check, antagonize, and coordinate a similar aggregation of fibres at an opposite point; the anterior fibres, *e.g.*, acting on the posterior, and the right lateral upon the left lateral. This arrangement, which is productive of great strength, ensures that the external and internal fibres shall act in unison or together, and fully explains the views of the older anatomists, who described the bladder as consisting of fibres crossing in every direction, and forming an intricate network. It likewise accords with the more modern opinion, that the fibres of the bladder may be divided into strata or layers.

The fibres, when their points of attachment are taken into consideration, can only contract spirally from above downwards, and from without inwards; they in fact converge, or close spirally in the direction of the cervix, which may be said to diverge or open in an opposite direction as the contraction proceeds. As a result of this twisting movement, the urine, like the blood, is projected spirally*.

Finally, the fibres of the bladder, urethra, and prostate pursue at least seven well-marked directions; the fibres crossing with remarkable precision at wider and wider angles, as the central portion of either is reached, as in the left ventricle of the vertebrate heart †. In fact, the fibres of the bladder and heart have a strictly analogous arrangement, and the author is inclined to believe that functionally also they possess points of resemblance. Very similar remarks may be made regarding the structure and functions of the stomach and uterus.

XI. "Results of the Magnetic Observations at the Kew Observatory.—No. III. Lunar Diurnal Variation of the three Magnetic Elements." By Lieut.-General Edward Sabine, P.R.S. Received June 21, 1866.

(Abstract.)

The subject of this paper is the lunar-diurnal variation of the magnetic declination and of the horizontal and vertical components of the magnetic force, derived from a seven years' series of photographic records obtained at the Kew Observatory between January 1, 1858 and December 31, 1864.

The discussion which it contains has for its objects—1st, to exemplify the consistent and systematic character of the lunar-diurnal influence thus derived; and 2ndly, to serve both as a guide and as an encouragement to the several establishments at home and abroad which have adopted, or are

* *Op. cit.* p. 794.

† "On the arrangement of the Muscular Fibres in the Ventricles of the Vertebrate Heart," by the author, Phil. Trans. part iii. 1864, p. 451.