THE URETERS

The ureters are the two tubes which convey the urine from the kidneys to the urinary bladder. Each commences within the sinus of the corresponding kidney as a number of short cup-shaped tubes, termed calyces, which encircle the renal papillae. Since a single calyx may enclose more than one papilla the calyces are generally fewer in number than the pyramids—the former varying from seven to thirteen, the latter from eight to eighteen. The calyces join to form two or three short tubes, and these unite to form a funnel-shaped dilatation, wide above and narrow below, named the renal pelvis, which is situated partly inside and partly outside the renal sinus. It is usually placed on a level with the spineous process of the first lumbar vertebra.
The ureter proper measures from 25 to 30 cm. in length, and is a thick-walled narrow cylindrical tube which is directly continuous near the lower end of the kidney with the tapering extremity of the renal pelvis. It runs downward and medially in front of the Psoas major and, entering the pelvic cavity, finally opens into the fundus of the bladder.

The abdominal part (pars abdominalis) lies behind the peritoneum on the medial part of the Psoas major, and is crossed obliquely by the internal spermatic vessels. It enters the pelvic cavity by crossing either the termination of the common, or the commencement of the external, iliac vessels.

At its origin the right ureter is usually covered by the descending part of the duodenum, and in its course downward lies to the right of the inferior vena cava, and is crossed by the right colic and ileocolic vessels, while near the superior aperture of the pelvis it passes behind the lower part of the mesentery and the terminal part of the ileum. The left ureter is crossed by the left colic vessels, and near the superior aperture of the pelvis passes behind the sigmoid colon and its mesentery.

The pelvic part (pars pelvicis) runs at first downward on the lateral wall of the pelvic cavity, along the anterior border of the greater sciatic notch and under cover of the peritoneum. It lies in front of the hypogastric artery medial to the obturator nerve and the umbilical, obturator, inferior vesical, and middle hemorrhoidal arteries. Opposite the lower part of the greater sciatic foramen it inclines medially, and reaches the lateral angle of the bladder, where it is situated in front of the upper end of the seminal vesicle and at a distance of about 5 cm. from the opposite ureter; here the ductus deferens crosses to its medial side, and the vesical veins surround it. Finally, the ureters run obliquely for about 2 cm. through the wall of the bladder and open by slit-like apertures into the cavity of the viscus at the lateral angles of the trigone. When the bladder is distended the openings of the ureters are about 5 cm. apart, but when it is empty and contracted the distance between them is diminished by one-half. Owing to their oblique course through the coats of the bladder, the upper and lower walls of the terminal portions of the ureters become closely applied to each other when the viscus is distended, and, acting as valves, prevent regurgitation of urine from the bladder.

In the female, the ureter forms, as it lies in relation to the wall of the pelvis, the posterior boundary of a shallow depression named the ovarian fossa, in which the ovary is situated. It then runs medially and forward on the lateral aspect of the cervix uteri and upper part of the vagina to reach the fundus of the bladder. In this part of its course it is accompanied for about 2.5 cm. by the uterine artery, which then crosses in front of the ureter and ascends between the two layers of the broad ligament. The ureter is distant about 2 cm. from the side of the cervix of the uterus. The ureter is sometimes duplicated on one or both sides, and the two tubes may remain
distinct as far as the fundus of the bladder. On rare occasions they open separately into the bladder cavity.

**Structure** (Fig. 1134).—The ureter is composed of three coats: **fibrous, muscular, and mucous coats**.

The **fibrous coat** (tunica adventitia) is continuous at one end with the fibrous tunic of the kidney on the floor of the sinus; while at the other it is lost in the fibrous structure of the bladder.

In the renal pelvis the **muscular coat** (tunica muscularis) consists of two layers, longitudinal and circular: the longitudinal fibers become lost upon the sides of the papillae at the extremities of the calyces; the circular fibers may be traced surrounding the medullary substance in the same situation. In the ureter proper the muscular fibers are very distinct, and are arranged in three layers: an external longitudinal, a middle circular, and an internal, less distinct than the other two, but having a general longitudinal direction. According to Kölliker this internal layer is found only in the neighborhood of the bladder.

The **mucous coat** (tunica mucosa) is smooth, and presents a few longitudinal folds which become effaced by distension. It is continuous with the mucous membrane of the bladder below, while it is prolonged over the papillae of the kidney above. Its epithelium is of a transitional character, and resembles that found in the bladder (see Fig. 1141). It consists of several layers of cells, of which the innermost—that is to say, the cells in contact with the urine—are somewhat flattened, with concavities on their deep surfaces into which the rounded ends of the cells of the second layer fit. These, the intermediate cells, more or less resemble columnar epithelium, and are pear-shaped, with rounded internal extremities which fit into the concavities of the cells of the first layer, and narrow external extremities which are wedged in between the cells of the third layer. The external or third layer consists of columnar or oval cells varying in number in different parts, and presenting processes which extend down into the basement membrane. Beneath the epithelium, and separating it from the muscular coats, is a dense layer of fibrous tissue containing many elastic fibers.

**Vessels and Nerves.**—The arteries supplying the ureter are branches from the renal, internal spermatic, hypogastric, and inferior vesical.

The nerves are derived from the inferior mesenteric, spermatic, and pelvic plexuses.

**Variations.**—The upper portion of the ureter is sometimes double; more rarely it is double the greater part of its extent, or even completely so. In such cases there are two openings into the bladder. Asymmetry in these variations is common.

**The Urinary Bladder** (Vesica Urinaria; Bladder) (Fig. 1135).

The **urinary bladder** is a musculomembranous sac which acts as a reservoir for the urine; and as its size, position, and relations vary according to the amount of fluid it contains, it is necessary to study it as it appears (a) when empty, and (b) when distended. In both conditions the position of the bladder varies with the condition of the rectum, being pushed upward and forward when the rectum is distended.

**The Empty Bladder.**—When hardened in situ, the empty bladder has the form of a flattened tetrahedron, with its vertex tilted forward. It presents a fundus, a vertex, a superior and an inferior surface. The **fundus** (Fig. 1152) is triangular in shape, and is directed downward and backward toward the rectum, from which it is separated by the rectovesical fascia, the vesicula seminales, and the terminal portions of the ductus deferentes. The **vertex** is directed forward toward the upper part of the symphysis pubis, and from it the middle umbilical ligament is continued upward on the back of the anterior abdominal wall to the umbilicus. The peritoneum is carried by it from the vertex of the bladder on to the abdominal wall to form the middle umbilical fold. The **superior surface** is triangular, bounded on either side by a lateral border which separates it from the inferior surface, and behind by a posterior border, represented by a line joining the two ureters, which intervenes between it and the fundus. The lateral borders extend from the ureters to the vertex, and from them the peritoneum is carried to the walls of the pelvis. On either side of the bladder the peritoneum shows a depression, named the **paravesical fossa** (Fig. 1037). The superior surface is directed upward, is covered by peritoneum, and is in relation with the sigmoid colon and some of the coils of the small intestine. When the bladder is empty and firmly contracted, this surface is convex.