CLASSIFICATION OF RENAL AND URETERAL ANOMALIES[1]

By Edmund Papin, M.D.
of Paris, France
and
Daniel N. Eisendrath, M.D.
of Chicago, Ill.

Our object is to attempt to classify in as complete a manner as possible all the various anomalies of the upper urinary tract. In place of a lengthy description, we prefer to illustrate the different groups in a diagrammatic way, and limit the description as much as it can be done.

We classify the anomalies as follows:

A. *Anomalies of the Kidneys.*
- 1. *Anomalies of Number.*
  - a. Solitary kidney (Figs. 1 and 2).
  - b. Supernumerary kidney (Fig. 3).
- 2. *Anomalies of Volume.*
  - a. Hypoplasia (Fig. 4).
  - b. Supplementary lobe (B of Fig. 5) or hypertrophy (A of Fig. 5).
- 3. *Anomalies of Form.*
  - Short, long, lobulated kidneys (Fig. 6).
- 4. *Anomalies of Location.*
  - a. Simple or ordinary unilateral ectopia (A of Fig. 7).
  - b. Simple or ordinary bilateral ectopia (B of Fig. 7).
  - c. Crossed ectopia with or without fusion (Figs. 8 and 8A).
- 5. *Median Fusion.*
  - a. Horseshoe kidney (Figs. 10 and 11).
  - b. L-Shaped kidney (Fig. 11).
  - c. Cake kidney (D of Fig. 10).
  - d. Sigmoid kidney (C of Fig. 11).
- 6. *Anomalies of Rotation.*
  - a. Faulty rotation (A of Fig. 12).
  - b. Excessive rotation (B and C of Fig. 12).
- 7. *Reduplication of the Pelves and Ureters* (Figs. 13, 14, 15).
- 8. *Anomalies of the Pelvis* (other than reduplication). (Figs. 16 and 17).
- 9. *Anomalies of the Vessels* (Figs. 18, 19, 20).
  - a. Arteries (Figs. 18 and 19).
  - b. Veins (Fig. 20).
- 10. *Nonclassifiable Anomalies* (Fig. 21).

B. *Anomalies of the Ureters.*
- 1. *Anomalies in Number* (See A 7) (Figs. 13, 14 and 15).
- 2. *Anomalies of Calibre and Form.*
  - a. Congenital strictures (Fig. 22).
  - b. Congenital dilatation (Fig. 23).
  - c. Valves (Fig. 24).
  - d. Spiral twists and kinks (Fig. 25).

[1] This is the first chapter of the monograph on Renal and Ureteral Anomalies to be published shortly.

3. *Anomalies of Origin or Termination.*
   a. Abnormal modes of origin.
   b. Ureterocele or cystic dilatation of lower end (Fig. 26).
   c. Blind ending ureters (Fig. 27).
   d. Ectopic ending of the lower end (Fig. 28).
4. Diverticula of the ureter (Figs. 29 and 30).

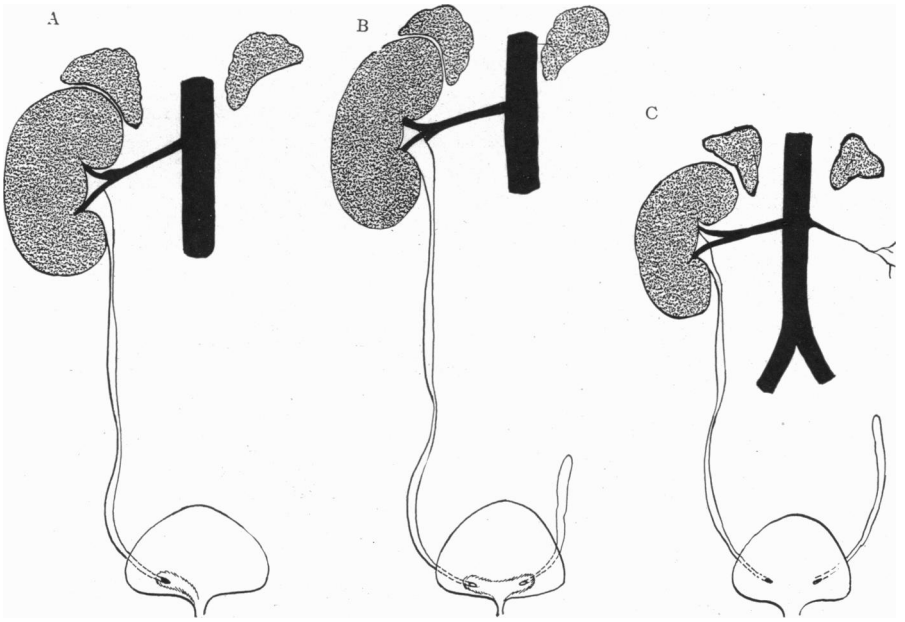

FIG. 1.—*A*, Absence of kidney, ureter and ureteric orifice. Asymmetric trigone. *B*, Absence of kidney but rudimentary ureter with normally placed and formed ureteric orifice, and symmetric trigone. *C*, Same as *B*, but with rudimentary renal artery.

C. *Combined Anomalies.*
   1. Double kidney and abnormal ending ureters (Fig. 31).
   2. Double and horeshoe kidney (Fig. 32).
   3. Vascular anomalies and renal anomalies.
   4. Ectopia and horeshoe kidney (Fig. 33).
   5. Hypoplasia and double kidney.
   6. Hypoplasia and horseshoe kidney.

D. *Concomitant Anomalies* (Fig. 34).
   a. Of urinary tract.
   b. Of genital tract.
   c. Of other structures.

Let us consider these a little in detail:

A. I. ANOMALIES OF NUMBER OF KIDNEYS

We will omit bilateral absence of the kidneys, which is a monstrosity incompatible with life.

The number of kidneys can either be decreased or be in excess.

(a) *By Default (Absence).*—Under this heading should be placed the congenital solitary kidney. The term should only be employed when there

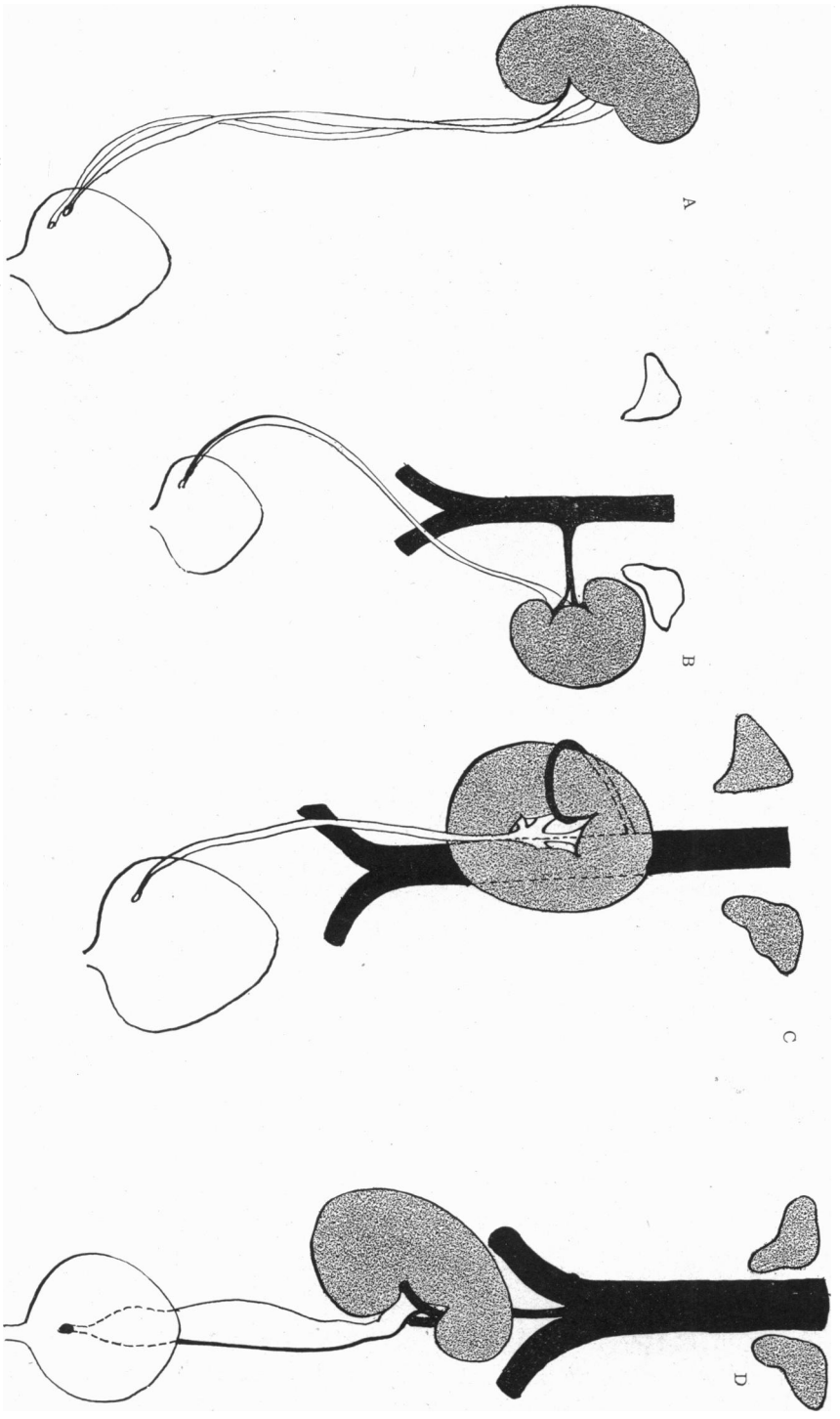

FIG. 2.—*A*, Solitary kidney with reduplication of ureters. *B*, Solitary kidney in crossed ectopia position. *C*, Solitary kidney in median line. *D*, Solitary ectopic (pelvic) kidney.

are no traces of the opposite kidney. Congenital agenesis or aplasia are synonymous with congenital solitary kidney. One should not confuse the condition with unilateral fusion of two kidneys each having a ureter which ends at opposite ends of the trigone. The term crossed ectopia is a more correct one to apply to such an anomaly (Fig. 8).

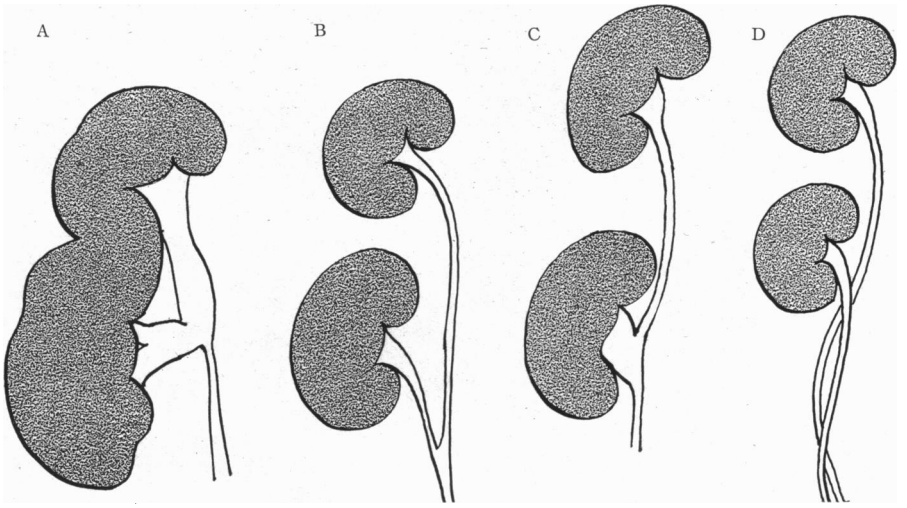

FIG. 3.—Reduplication and supernumerary kidney. *A*, Reduplication of pelvis alone with partly divided kidney. *B*, Reduplication (incomplete) of ureter and completely separated kidneys. *D*, Reduplication (complete) of ureter and completely separated kidneys. *C*, Most common form of supernumerary kidney. Upper ureter empties into lower pelvis or ureter of lower (supernumerary) kidney.

There are three principal types of solitary kidney:

1. With symmetric or asymmetric trigone (A of Fig. 1). No trace of opposite kidney or ureter.

2. With symmetric trigone, two ureteral orifices and a ureter on the agenesis side which is of variable length (B of Fig. 1).

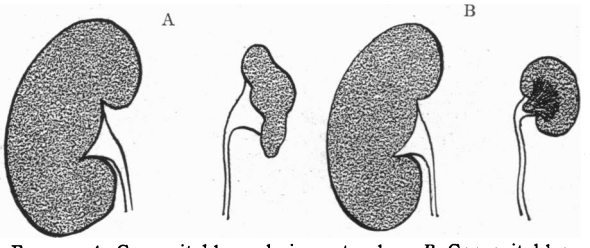

FIG. 4.—*A*, Congenital hypoplasia or atrophy. *B*, Congenital hypoplasia with single papilla.

3. With more or less developed ureter on the agenesis side and rudimentary renal vessels (C of Fig. 1).

The solitary kidney may be of normal or of increased volume. The adrenal on the agenesis side is either in its normal location or ectopic. One may encounter some atypical conditions, such as:

1. Solitary kidney with two ureters ending side by side in the bladder (A of Fig. 2).
2. Solitary kidney in crossed ectopia (B of Fig. 2).
3. Solitary kidney in median ectopia (C of Fig. 2).
4. Solitary kidney and pelvic ectopia (D of Fig. 2).

b. *Multiple Kidneys, i.e., Excess (Supernumerary).*—These are rare and one must consider four forms:

1. Pseudo-double kidney, *i.e.,* single mass of parenchyma but two pelves and a single ureter (A of Fig. 3).

2. Two kidneys with two ureters uniting to form a single ureter (B of Fig. 3).

3. Same as above but the two ureters open separately into bladder (D of Fig. 3).

4. Two kidneys but ureter of upper opens into lower (C of Fig. 3). (Most common form of supernumerary kidney).

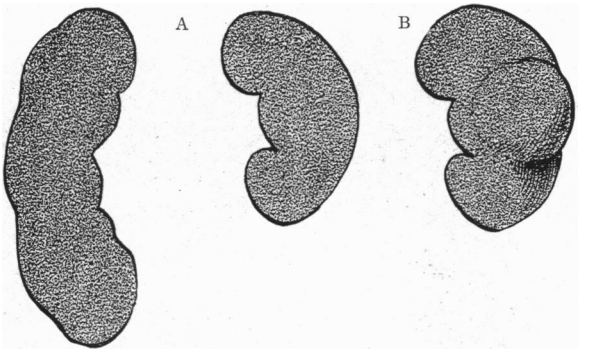

FIG. 5.—*A*, Congenital hypertrophy of one kidney. *B*, Supplementary anterior lobe.

Numbers 1, 2, and 3 are rare and the only published cases are unilateral.

A. 2. ANOMALIES OF VOLUME

(a) *Congenital Atrophy or Hypoplasia.*—The two normal kidneys are seldom of the same weight or volume. The ureter of an atrophic kidney is usually patent. It can be dilated or obliterated either at its upper or lower end, or at portions of its course, or in its entirety.

(b) *Congenital Hypertrophy.*—The kidney can be hypertrophied compensatorily because the opposite one is atrophic, but it can also be enormous while the opposite one is normal, as in Papin's (A of Fig. 5) case.

(c) *Supplementary Lobes.*—In Papin's case this formed a marked protrusion (B, Fig. 5) on the anterior surface. On section one found one pyramid and a corresponding calyx directed sagittally.

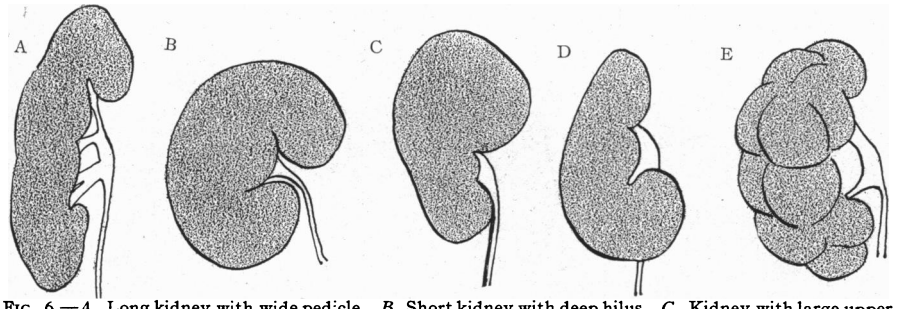

FIG. 6.—*A*, Long kidney with wide pedicle. *B*, Short kidney with deep hilus. *C*, Kidney with large upper half. *D*, Kidney with large lower half. *E*, Kidney with fetal lobulation.

A. 3. ANOMALIES OF FORM OF KIDNEYS

There are many variations in form, thus:

(a) Long kidney with wide pedicle (A of Fig. 6).

(b) Short kidney with closed hilus (B of Fig. 6).

(c) With large upper half (C of Fig. 6).
(d) With large lower half (D of Fig. 6).
(e) With fetal lobulation (E of Fig. 6).

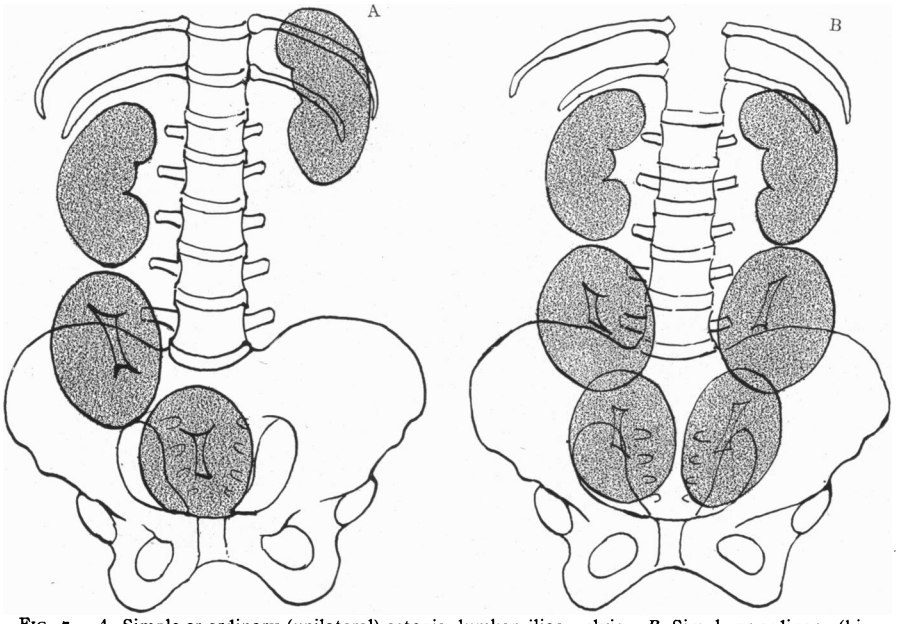

FIG. 7.—*A*, Simple or ordinary (unilateral) ectopia, lumbar, iliac, pelvic. *B*, Simple or ordinary (bilateral) ectopia, iliac, pelvic.

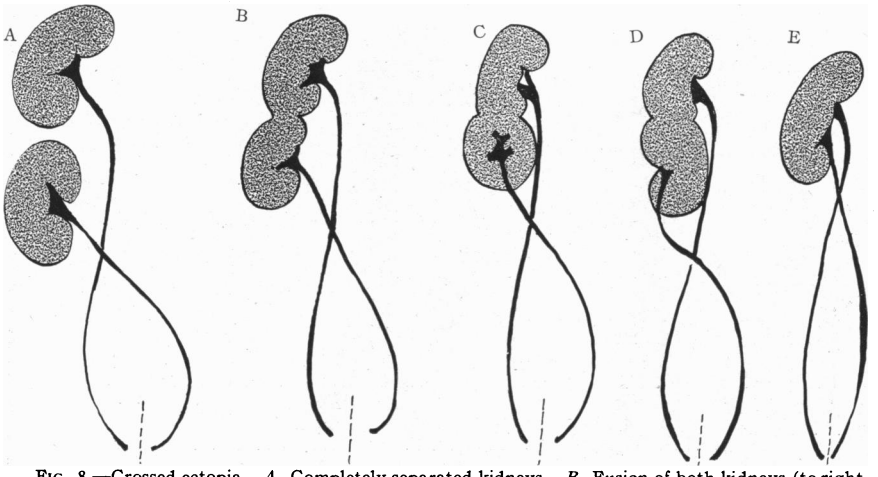

FIG. 8.—Crossed ectopia. *A*, Completely separated kidneys. *B*, Fusion of both kidneys (to right or left of midline as indicated by vertical dotted line). *C*, Hilus of lower of the two incompletely fused kidneys faces ventrally. *D*, Same as *C*, but lower hilus faces laterally. *E*, Complete fusion of the two kidneys.

A. 4. ANOMALIES OF POSITION OF KIDNEYS

1. The kidney can be found in an abnormal location either by arrest or faulty development. One must differentiate them from the kidneys whose abnormal location is of acquired origin. Ectopia can be lumbar, iliac or pelvic

(Fig. 7, A) or it can be unilateral or bilateral (Fig. 7, B). The last named may be symmetric or asymmetric in position. All such ectopias are called homolateral.

2. Heterolateral or crossed ectopias are where one of the two kidneys has crossed the midline to reach the opposite side. There are three forms:

(a) The kidneys are not fused (A of Fig. 8).

(b) The kidneys are fused but the line of fusion is still distinct. The lower of the two may have its pelvis directed mesially (B of Fig. 8), ventrally (C of Fig. 8) or laterally (C of Fig. 8).

(c) The two are fused so that there is no external sign of such fusion (E of Fig. 8). As a rule it is the lower of the two which is ectopic, but in some it is the upper (F of Fig. 8). The case of Lichtenstern of bilateral crossed ectopia (G of Fig. 8) is open to question.

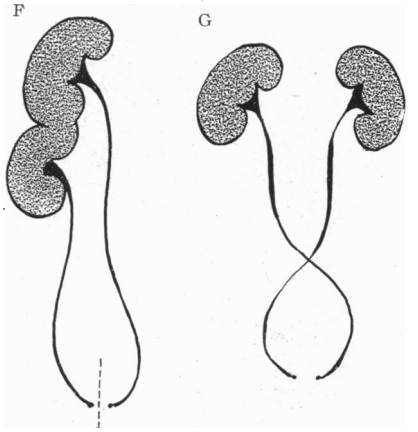

FIG. 8.—*F*, Unusual condition in which the ectopic kidney which belongs to opposite side of body lies above the normally migrated kidney. *G*, Unusual condition in which right kidney has crossed over to left side of body and vice versa.

A. 5. MEDIAN FUSION

We include in this group all cases in which there is a union of the two kidneys to a greater or lesser extent at their mesial borders. As long as one-half extends beyond the midline of the spine, the anomaly belongs in this group. When, however, both halves lie entirely either to the right or left of the midline of the spine, the anomaly is better classified as a crossed ectopia (Fig. 8). The true cases of median fusion therefore include other cases than those usually referred to as horseshoe kidneys. In the latter the degree of median line fusion varies from a nar-

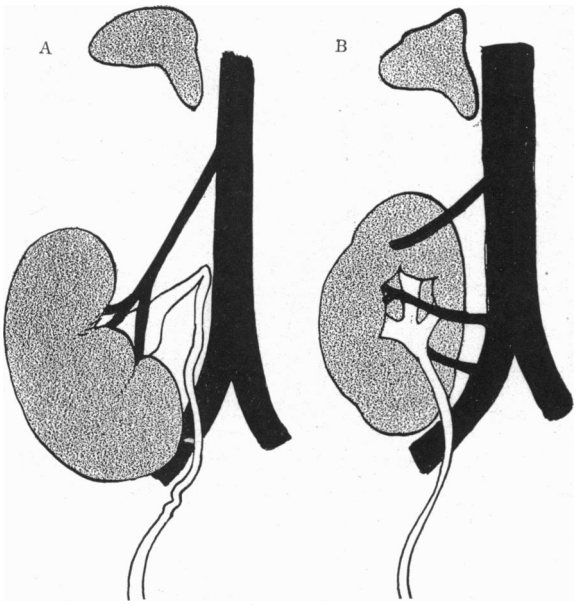

FIG. 9.—To show difference between an abnormally mobile (dropped) and a congenitally (simple or ordinary) ectopic kidney. In the former the vessels arise (*A*) at the normal level while in latter (*B*) they arise from the immediately adjacent vessels.

row fibrous or parenchymatous bridge to complete fusion along the mesial borders, *i.e.*, a cake-kidney. Cases, however, of L-shaped or S-shaped (sigmoid) kidneys in which one-half extends beyond the midline should be equally as well classified under the heading "Median Fusion." All such anomalies lie much lower than the normally formed and placed kidneys. Their

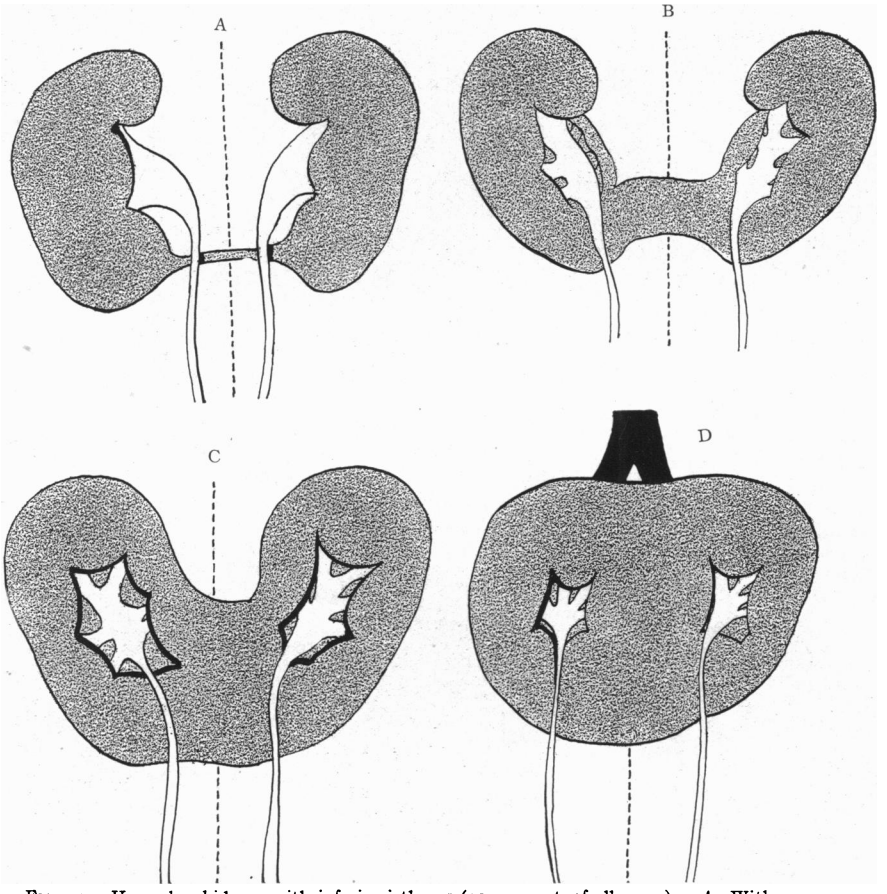

FIG. 10.—Horseshoe kidneys with inferior isthmus (90 per cent. of all cases). *A*, With very narrow isthmus. *B*, With isthmus of average (4–5 cm.) width. *C*, With very wide isthmus. *D*, With isthmus so wide that there is no line of demarcation between the two halves (the so-called cake kidney).

pelves, however, are on the ventral aspect, a point of much importance from a diagnostic standpoint. We may, therefore, find the following forms:

1. Fusion of two of the poles.

(a) Inferior (narrow, median and wide isthmus) (A, B and C of Fig. 10).

(b) Completely along their mesial border (D of Fig. 10) (cake kidney).

(c) Superior isthmus (A of Fig. 11).

2. Sigmoid (C of Fig. 11), one in normal location and the other attached to lower pole of first one.

3. One remains higher than the other (L-shaped) (B of Fig. 11).

A. 6. ANOMALIES OF ROTATION OF KIDNEYS

(a) Incomplete—kidney faces ventrally, it is flattened and pelvis is at middle of anterior surface, vessels cross the front to reach the hilus and the ureter descends in front of kidney (A of Fig. 12).

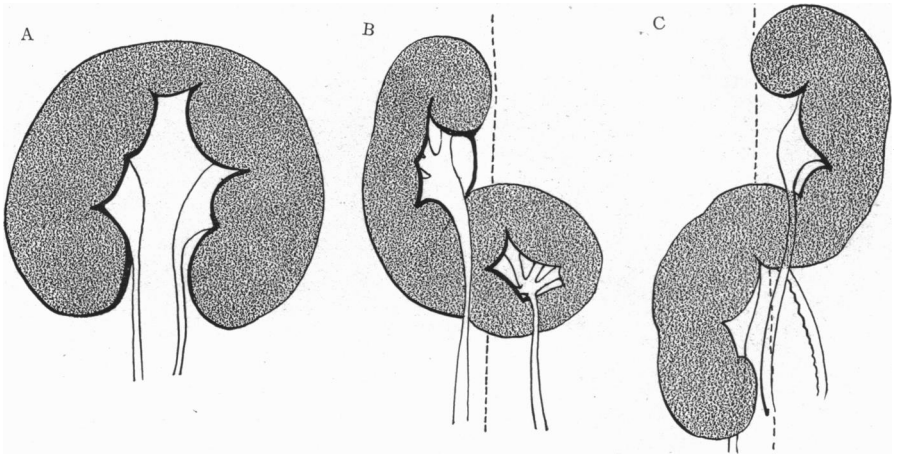

FIG. 11.—Unusual types of horseshoe kidneys. *A*, With isthmus at upper poles (10 per cent. of all cases). *B*, L-shaped horseshoe kidney. *C*, Sigmoid form with pelves facing laterally. Differs from crossed ectopia (Fig. 9) by fact that the halves extend to both sides of midline.

(b) Excessive rotation. Hilus on dorsal aspect and latter is crossed by vessels to reach hilus (B of Fig. 12).

(c) The convex border is mesial and pelvis faces laterally (C of Fig. 12).

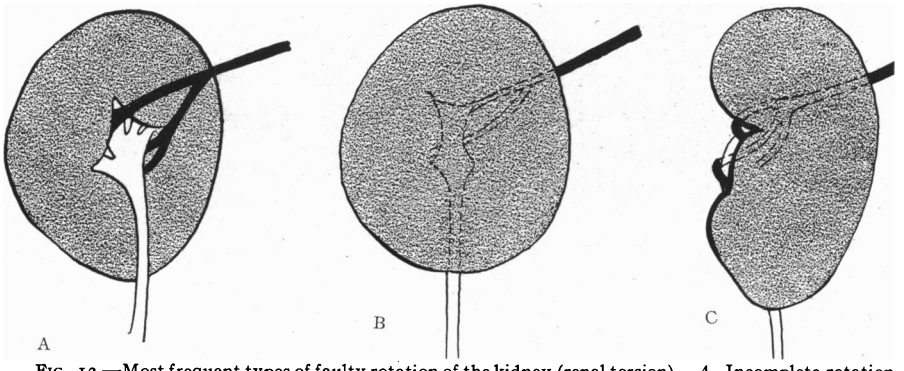

FIG. 12.—Most frequent types of faulty rotation of the kidney (renal torsion). *A*, Incomplete rotation with hilus on ventral aspect. *B*, Excessive rotation with hilus on posterior aspect. *C*, Excessive rotation with hilus facing laterally.

The vessels cross the dorsal aspect and the ureter descends along lateral border.

A. 7. REDUPLICATION OF THE PELVES AND URETERS (DOUBLE KIDNEY) (FIGS. 13, 14 AND 15)

Under normal conditions the ureter divides into two major calyces with or without a pelvis proper. An early division may occur, *i.e.*, one just external to the hilus. The kidney then has two pelves, an upper and a lower.

The ureter may divide more distally, *i.e.*, anywhere from the hilus to the bladder. If the division occurs within the bladder wall itself there will be

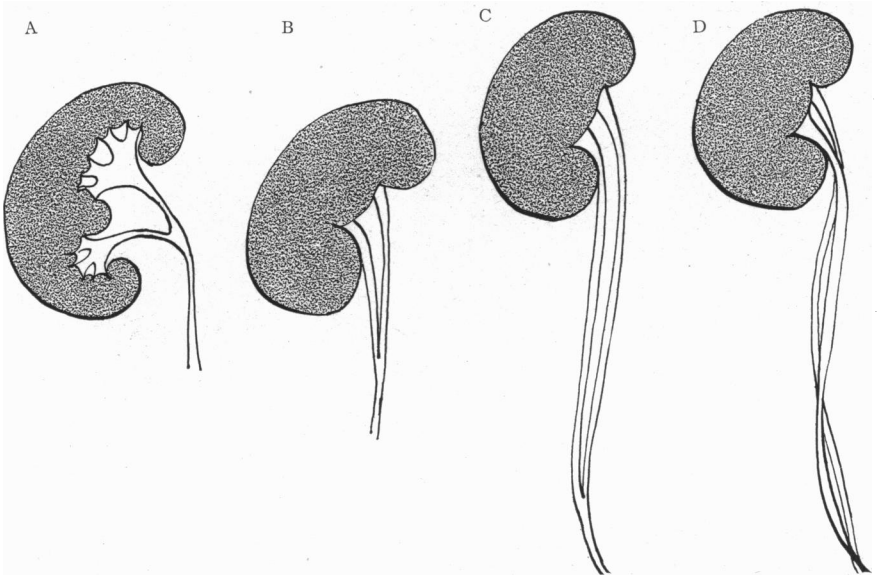

FIG 13.—Transition from bifid pelvis to double kidney. *A*, Bifid type of renal pelvis. *B*, High division of ureter (incomplete reduplication of the ureters but complete of pelves). *C*, Low division of ureter (incomplete reduplication of ureters but complete of pelves). *D*, Complete reduplication of ureters and of the renal pelves. In *B*, *C* and *D* there is no external demarcation to indicate a double kidney (compare with *B*, of Fig. 15).

two ureteral meati and we speak of a double ureter. When there are two ureters one will always find two pelves. No case has ever been proven to

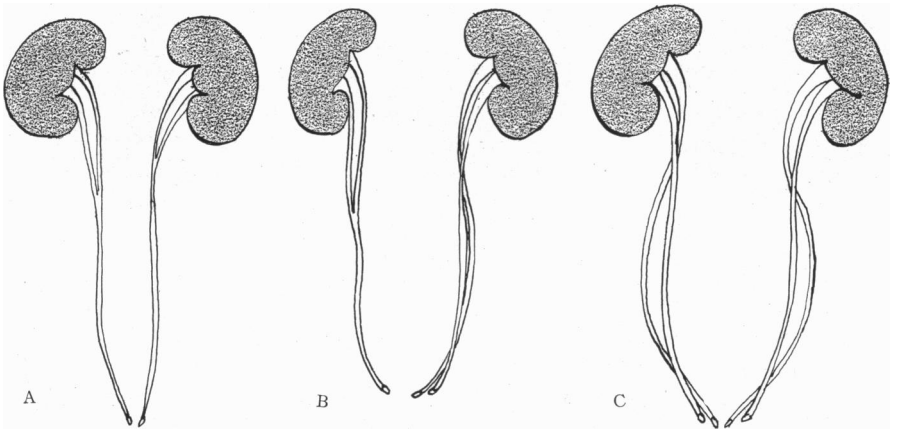

FIG. 14.—Various types of double kidney (unilateral). *A*, Incomplete (high division) reduplication of the ureters and pelves of both sides. *B*, Incomplete (right-sided) and complete (left-sided reduplication. *C*, Complete reduplication of ureters and pelves on both sides.

have two ureters and one pelvis. The ureter belonging to the upper pelvis always ends lower and more mesial.

Reduplication or bifidity of the ureters can be observed in association with

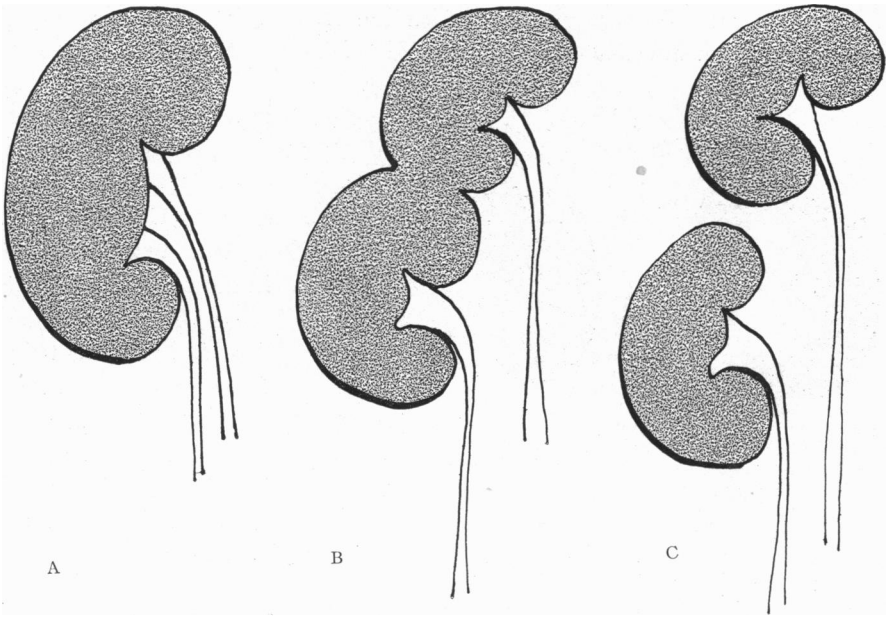

FIG. 15.—Various types of "double kidney" (unilateral). *A*, Without external demarcation (same as *A*, *B* and *C*, of Fig. 14). *B*, With well-marked groove indicating line of fusion of the two halves. *C*, Complete separation of the two halves. This diagram exaggerates the distance between the two pelves and the corresponding parenchyma.

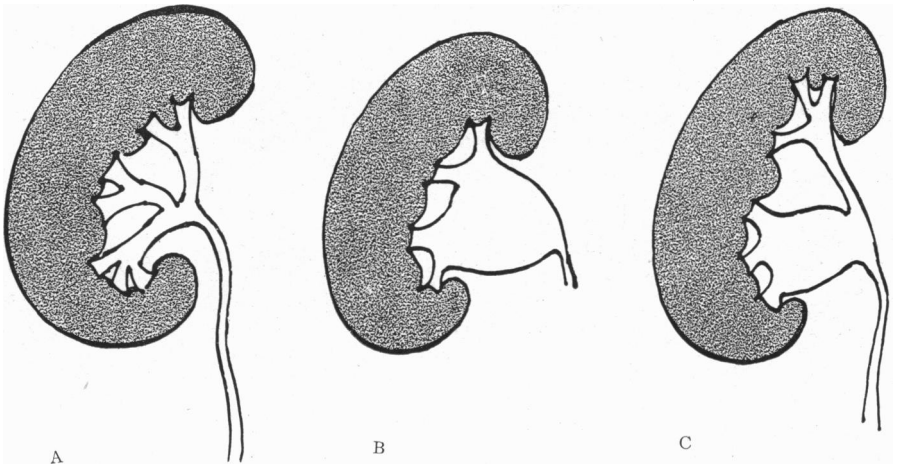

FIG. 16.—Various types of renal pelves. *A*, With relatively small pelvis proper and predominance of major calyces. *B*, Ampullary type of pelvis with typical superior, middle and inferior major calyces. *C*, Peculiar ampullary pelvis with large inferior calyx.

a kidney of normal external appearance (Fig. 13). Ureteral reduplication can be unilateral or bilateral (Fig. 14, A, B, and C).

A. 8. ANOMALIES OF THE PELVIS

Pelvis can present many variations which are not anomalies in strict sense.

(a) The pelvis proper is absent. The ureter divides into major calyces without an intervening pelvis (A of Fig. 16).

(b) An ampullary pelvis into which the minor, *i.e.*, secondary calyces empty without intervening major calyces (B of Fig. 16).

(c) A bifid type (hemibassinet of Hyrtl). One of the major calyces (the inferior) is dilated and ampullary while the other has a number of calyces (C of Fig. 16).

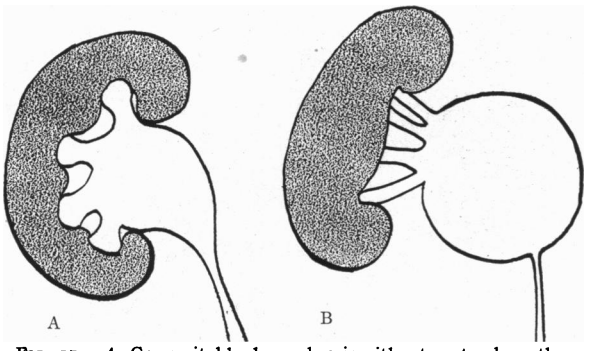

FIG. 17.—*A*, Congenital hydronephrosis without ureteral or other distal obstruction. *B*, Pelvis and major calyces entirely extrarenal.

The true anomalies include the following:

(a) Congenital dilatation, *i.e.*, congenital hydronephrosis or megalopelvis without stricture at the ureteropelvic junction (A of Fig. 17).

(b) The extrarenal pelvis (B of Fig. 17). Both the pelvis proper and most if not all of the major calyces are extrarenal, *i.e.*, lie distal to the hilus of the kidney.

A. 9. ANOMALIES OF THE VESSELS OF THE KIDNEYS

1. *Arteries.*—These are very common (see Figs. 18 and 19). Under normal conditions there is a single artery arising from the aorta and dividing in variable manner into three terminal branches, pre- and retro-pelvic and superior polar. The anomalies may be grouped as follows:

(a) Of number—from one to six arteries have been noted.

(b) Of origin—aorta, spermatic, common iliac, external and internal iliac.

(c) Of course—in front and behind aorta and vena cava.

(d) Of penetration—hilus, pole, front borders. Of particular interest are the polar arteries. The superior polar can arise from the renal or aorta. The inferior polar can arise from the renal, aorta, common or external iliac. The inferior polar may cross in front or behind the ureter and may cause or aggravate a hydronephrosis.

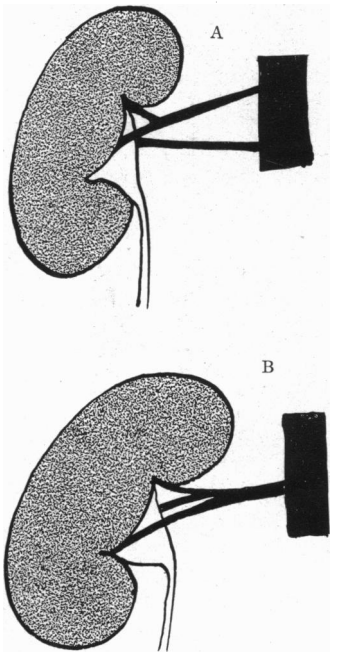

FIG. 18.—Types of renal arteries. *A*, Division before reaching renal hilus. *B*, Two separate renal arteries.

2. *Veins.*—Among the more important anomalies one finds (see Fig. 20):

(a) Presence of a left inferior vena cava.

(b) Retro-colic venous anastomosis.

(c) Superior polar.

(d) Inferior polar—more common and can arise from the vena cava, renal vein and iliac vein.

(e) Renal vein entirely retropelvic.

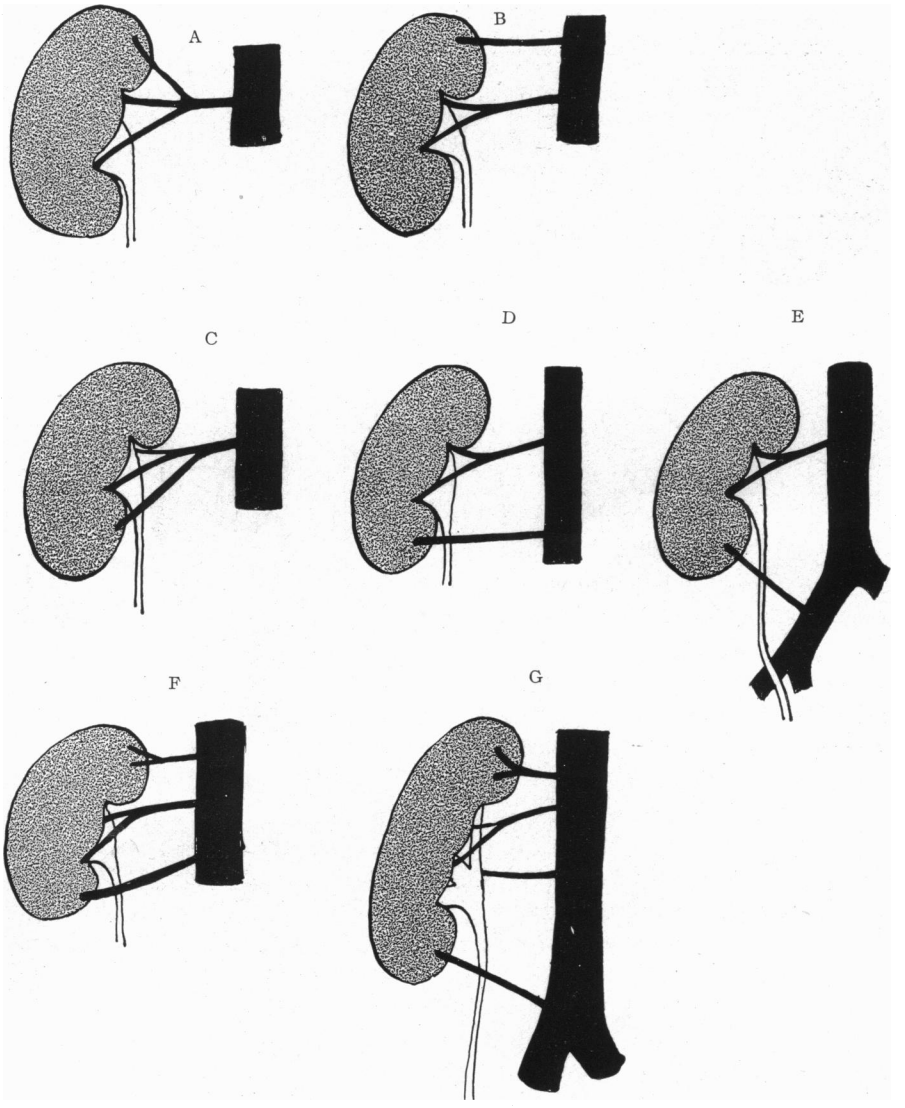

FIG. 19.—Anomalous (accessory) polar arteries. *A*, Superior polar arising from main renal artery. *B*, Superior polar artery arising from aorta. *C*, Inferior polar artery arising from main renal. *D*, Same arising directly from aorta. *E*, Same arising from common iliac artery. *F*, Main renal artery to hilus and superior and inferior (also from aorta) arteries to upper and lower poles respectively. *G*, Same as F, but separate (fourth) artery to back of pelvis,

A. 10. NON-CLASSIFIABLE ANOMALIES (FIG. 21)

Under this heading one must place the cases of Hepburn and Braasch. The ureters of the two normally placed kidneys unite and end at one angle of the trigone.

B. ANOMALIES OF THE URETERS

B. 1. Anomalies of Number.—These are described under reduplication of the renal pelves (see A 7), because such a condition is never found without reduplication of the ureters to a greater or lesser degree.

B. 2. Anomalies of Calibre and Form.—The ureter normally presents a

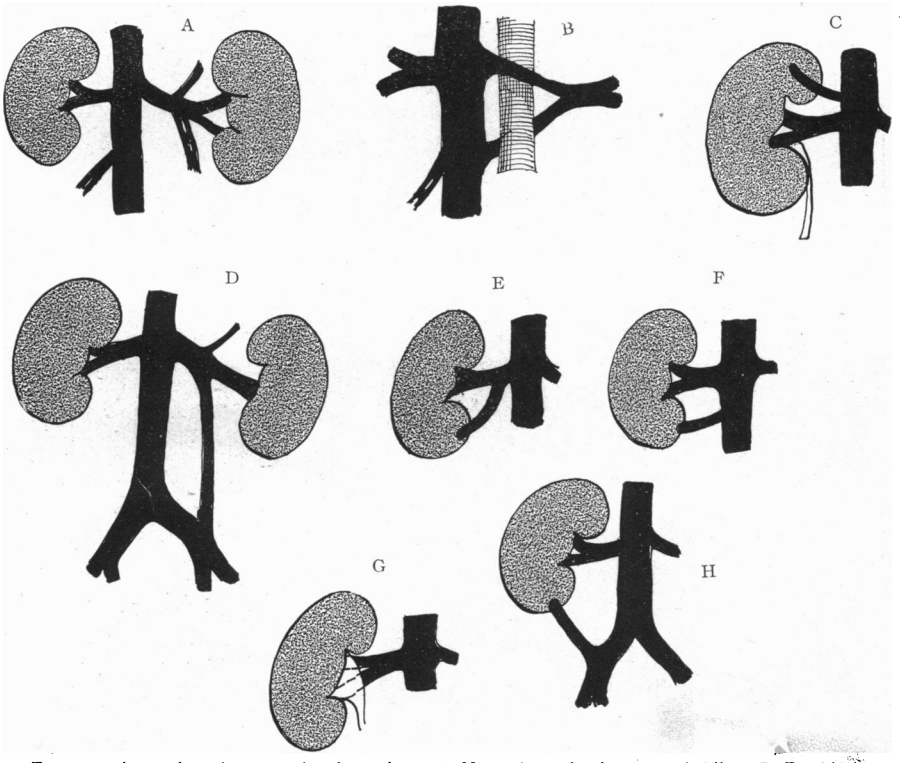

FIG. 20.—Anomalous (accessory) polar veins. *A*, Normal renal veins to each hilus. *B*, Double vena cava. *C*, Venous ring surrounding aorta. *D*, Superior polar vein from vena cava. *E*, Inferior polar vein from main renal vein. *F*, Inferior polar vein from vena cava. *G*, Inferior polar vein from common iliac vein. *H*, Main renal veins pass behind intead of in front of pelvis.

series of dilatations separated by narrowings. These are from above downward the following:

(a) The ureteropelvic funnel or junction (B of Fig. 22).
(b) The narrowing just below the preceding.
(c) The lumbar dilatation or "spindle."
(d) The iliac narrowing (where ureter crosses iliac vessels).
(e) The pelvic dilatation or "spindle."
(f) The juxtavesical narrowing which passes imperceptibly into
(g) The intramural segment and ureteral orifice.

There may be considerable variation, *i.e.*, a certain number of narrowings or of spindles may be absent so that the lumbar and pelvic "spindles" are continuous (A of Fig. 22).

The true anomalies are:

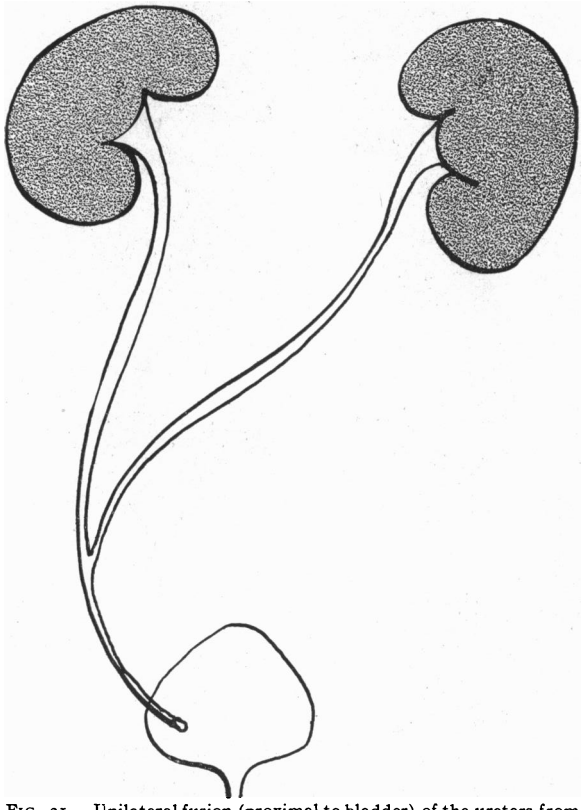

FIG. 21.—Unilateral fusion (proximal to bladder) of the ureters from both kidneys. Only two such cases reported (see text).

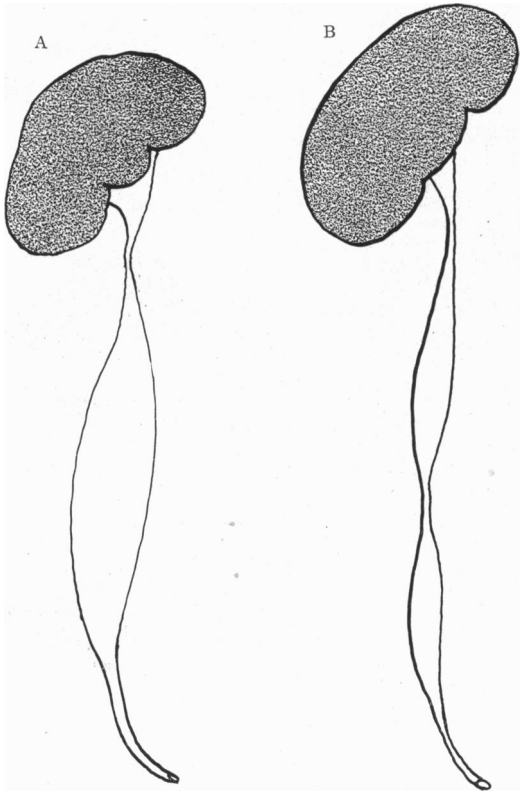

FIG. 22.—To show "spindles" and "narrowings" of the normal ureter *A*, Single spindle instead of two as in "*A*" *B*, To show lumbar and pelvic "spindles".

A. *Congenital Strictures.*—These usually occur at the points of narrowing (A of Fig. 22), but can be found anywhere in the lumen of the ureter.

B. *Congenital Dilatations* (Fig. 23).—These can be (a) total (C of Fig. 23), including the entire ureter and its vesical orifice; (b) subtotal (B of Fig. 23)—all of the ureter except its vesical orifice and (c) partial, *i.e.*, forming a series of spindles as in A of Fig. 23.

The dilatation may be of such a degree that the ureter resembles a coil of intestine.

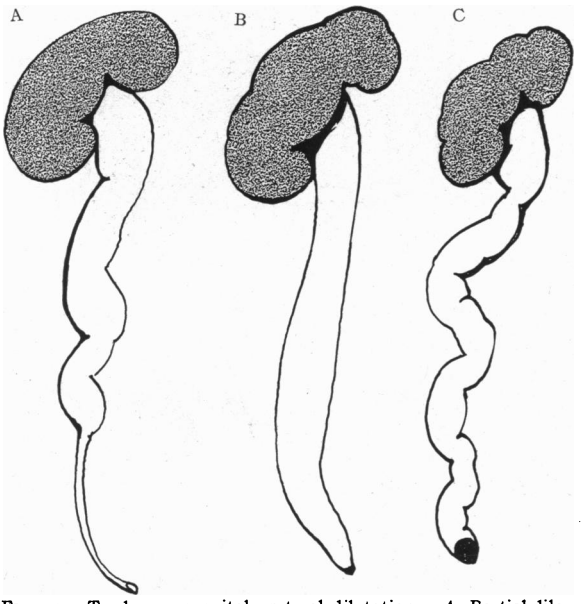

FIG. 23.—To show congenital ureteral dilatation. *A*, Partial dilatation. *B*, Subtotal dilatation. *C*, Total (complete) dilatation.

C. Valves (Fig. 24.)—These are found at both ends of the ureter, *i.e.*, near the renal pelvis or the vesical outlet. They are most commonly seen in the fœtus or in the new-born.

D. *Spiral Twists and Kinks.*—The former involve the entire lumen, the tube appearing to be twisted upon itself (Fig. 25). Kinks usually are found in connection with faulty modes of origin of the ureter from the renal pelvis. They may, however, be found at any level, often as the result of either abnormal mobility of the kidney or redundancy, *i.e.*, excessive length of the ureter.

B. 3. ANOMALIES OF ORIGIN AND ENDINGS

(a) *Anomalies of Origin.*—In this group the ureter instead of arising from the funnel-like ending of the renal pelvis (A of Fig. 22) begins at a higher point so that as the pelvis fills, it compresses the ureter and gradually more and more of a pouch forms below the ureteral outlet. Rarely, as in Manasse's case, the ureter passes entirely around the top of the pelvis before proceeding toward the bladder.

(b) *Ureterocele* (cystic dilatation of lower end of ureter).—Under this heading is included a dilatation of that portion of the ureter just proximal to the ureteral (vesical) orifice. It is usually the result of a narrowing less often a complete closure of the vesical orifice. Although in its early stages it presents (A of Fig. 26) as a cherry-sized swelling, it may attain an enormous size (B of Fig. 26) and occlude the opening of the opposite ureter or become incarcerated in the urethra (C of Fig. 26) or prolapse through the

FIG. 24.—Location of ureteral valves.

FIG. 25.—Spiral twist (torsion) of the ureter.

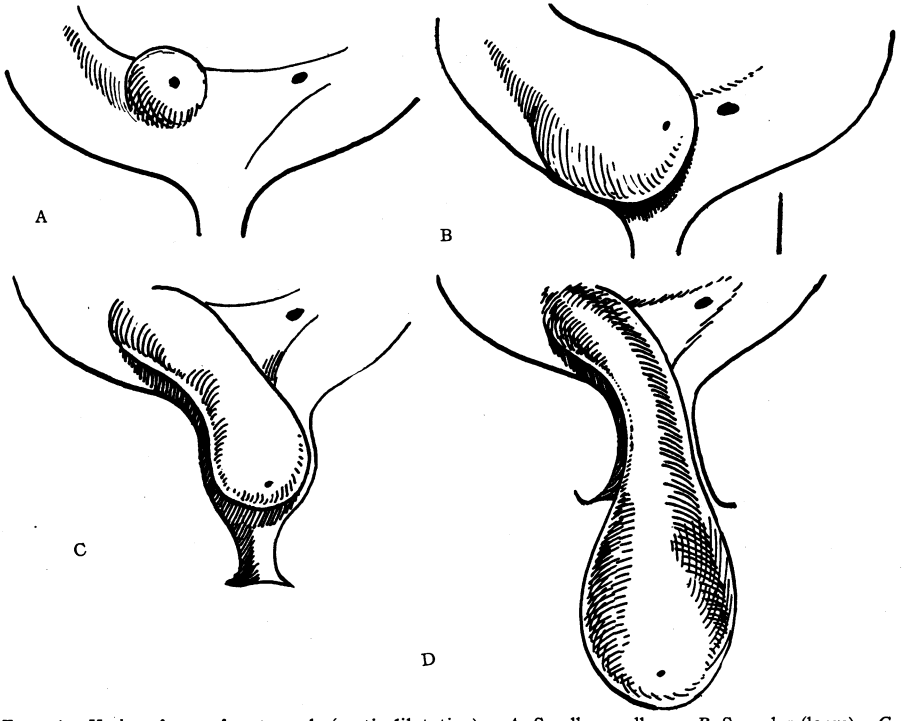

FIG. 26.—Various forms of ureterocele (cystic dilatation). *A*, Small ampullary. *B*, Saccular (large). *C*, Prolapse into urethra (usually female). *D*, Prolapse through urethra (complete).

external meatus and present externally (D of Fig. 26). Such a prolapse usually occurs in the female.

(c) *Blind Ending Ureters.*—These present in two forms, usually as an accompaniment of reduplication of the ureters. In one form (A of Fig. 27) the second ureter is rudimentary and ends blindly above only. In the other form (B of Fig. 27) the second ureter ends blindly above and below. At times there is a hypoplastic half of a double kidney developed around a second ureter which ends blindly below.

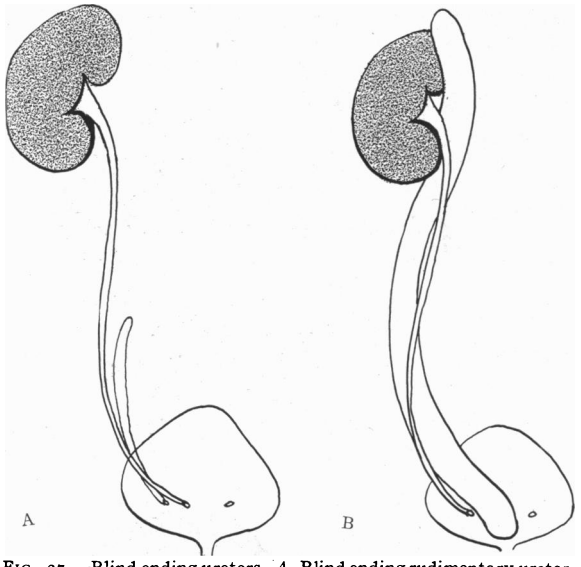

FIG. 27.—Blind ending ureters. *A*, Blind ending rudimentary ureter. *B*, Completely developed blind ending ureter.

(d) *Abnormal Ectopic Endings of the Ureters* (Fig. 28).—Although this may occur in the case of a kidney having but one ureter, it is usually found in double kidneys, *i.e.*, reduplication of the ureters and renal pelves. One of the two ureters (usually the one ending more dis-

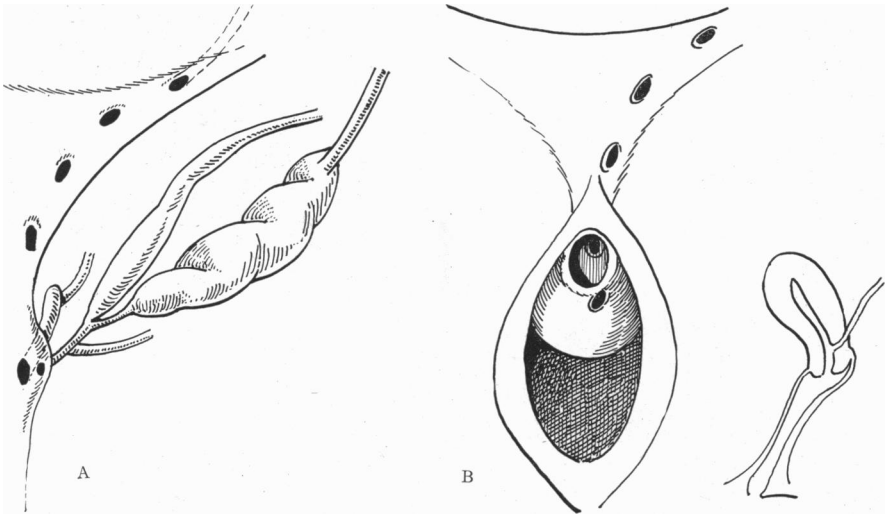

FIG. 28.—*A*, Abnormal (ectopic) ureteral endings in the male. From above downward note the possible endings in the bladder, prostatic urethra, utricle, ejaculatory duct and seminal vesicle. *B*, Abnormal (ectopic) ureteral endings in the female. Note possible endings in the bladder, urethra, at the meatus (external), vagina and uterus (seen in sagittal section).

tally) opens either at some point considerably below the opening of the ureter from the other half or it opens extravesically. The anomaly can be uni- or

FIG. 29.—Various types of single diverticula of ureter. *A*, Simple diverticulum. *B*, Ampullary diverticulum. *C*, Diverticulum ending in fibrous prolongation.

FIG. 30.—Multiple diverticula (Pepere's case).

FIG. 31.—Combination of "double" kidney and ectopic ureteral ending. *A*. Complete reduplication of ureters and pelves. One ureter (from lower half) ends at normal place but the other (from upper half) ends in urethra. A frequent finding in urinary incontinence due to ectopic ureteral ending. *B*. Both ureters of a "double" kidney end in a cystic dilatation.

bilateral both in the case of the ureter of a normal (single pelvis) kidney as well as in that of a reduplication of the pelves and ureters.

In the intravesical cases of abnormal ending the latter can be found anywhere between the location of the normal orifice and the internal meatus (Fig. 28). The location of the extravesical openings vary according to the sex of the individual. In males it can be located in the prostatic urethra up to the verumontanum, in the prostatic utricle, ejaculatory duct or seminal vesicle (A of Fig. 28). In females, the ureter can open in any portion of

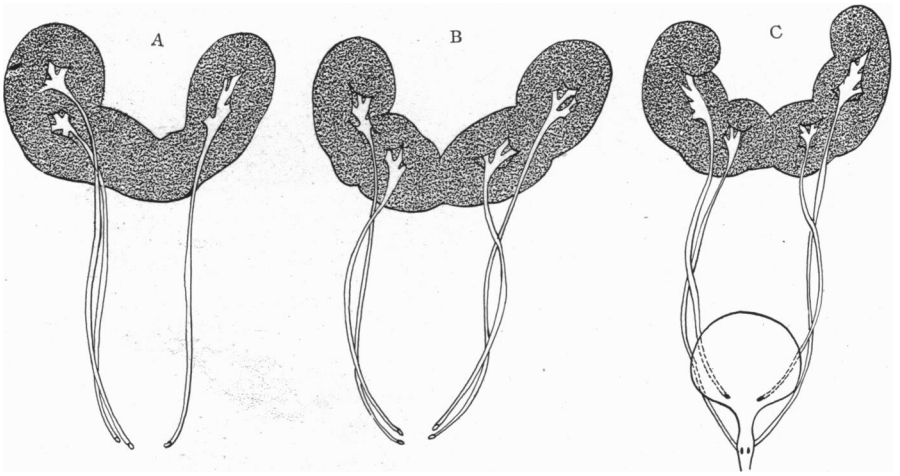

FIG. 32.—Combination of horseshoe and "double" kidney. *A*, Complete reduplication of renal pelves and ureters on one side only. *B*, Same on both sides. *C*, Same as *B* but one ureter on each side ends ectopically (in urethra).

the urethra, at the external meatus, vulva, anterior vaginal wall or neck of the uterus (B of Fig. 28).

(e) *Diverticula of the Ureter.*—One can find reports of cases of simple diverticula with blind upper end (A of Fig. 29) of ampulla-like diverticula (B of Fig. 29) or a termination in a long fibrous cord (C of Fig. 29) and finally as in Pepere's case of multiple diverticula (Fig. 30).

C. COMBINED ANOMALIES

Almost any combination of the principal types of both renal and ureteral anomalies may occur. We will only attempt to name the more common ones:

C. 1. Congenital Solitary Kidney.—(a) The presence of a solitary kidney in the normal renal location and of a rudimentary ureter on the opposite side (B of Fig. 1).

(b) The association of solitary kidney with ectopia (D of Fig. 2).

(c) The presence of the solitary kidney (crossed ectopia) on the side of the body opposite to that on which its ureter ends (B of Fig. 2).

C. 2. Hypoplasia.—(a) The association of hypoplasia of one kidney with a double kidney on the opposite side.

(b) The abnormal ending of the ureter of a hypoplastic kidney, *i.e.*, either blindly or in the urethra, seminal vesicle (Fig. 28), etc.

(c) Hypoplasia of one-half of a horseshoe kidney.

C. 3. Horseshoe Kidney.—(a) The presence of reduplication of the ureters and renal pelves in one or both halves of the horseshoe kidney (Fig. 32).

(b) Ectopia (simple) cake (one of varieties of horseshoe kidney) kidney (D of Fig. 10).

(c) Combination of ectopic ending of the ureter of one-half of a horseshoe kidney.

(d) Association of hypoplasia and horseshoe kidney.

C. 4. Double Kidney.—(a) Association of double and horseshoe kidney (Fig. 32).

(b) Ectopic ending of ureter of one-half of double kidney on one or both sides (A of Fig. 31).

(c) Blind ending or termination in a ureterocele of one or both ureters of a double kidney on one or both sides (B of Fig. 31).

(d) Hypoplasia of one-half of a double kidney on one or both sides.

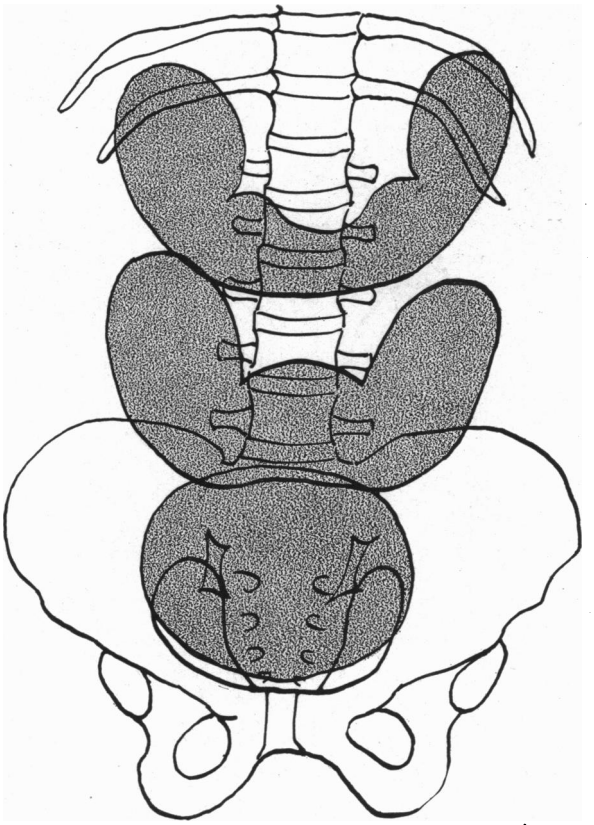

FIG. 33.—Combination of horseshoe kidney and ectopia. Note from above downward low lumbar, iliac and pelvic ectopia of the horseshoe kidney. The first two are the usual levels at which horseshoe kidneys are found. The pelvic type is always of the "cake" variety.

C. 5. Combination of ectopia (ordinary) and horseshoe kidney (Fig. 33).

D. CONCOMITANT ANOMALIES (FIG. 34)

We will simply enumerate without taking up in detail the three principal groups of concomitant deformities, namely, (a) of the urinary tract in both sexes; (b) of the genital tract in the male; (c) of the genital tract in female.

(a) Concomitant urinary defects:

Exstrophy of the bladder.
Congenital dilatation of the bladder.
Diverticula of the bladder.
Congenital strictures or valve formations of the posterior urethra.

(b) Genital tract in the male (Fig. 34, B). Phimosis. Hypospadias. Non-descent of the testis.

Agenesis or lack of formation of the testis, prostate or seminal vesicles.

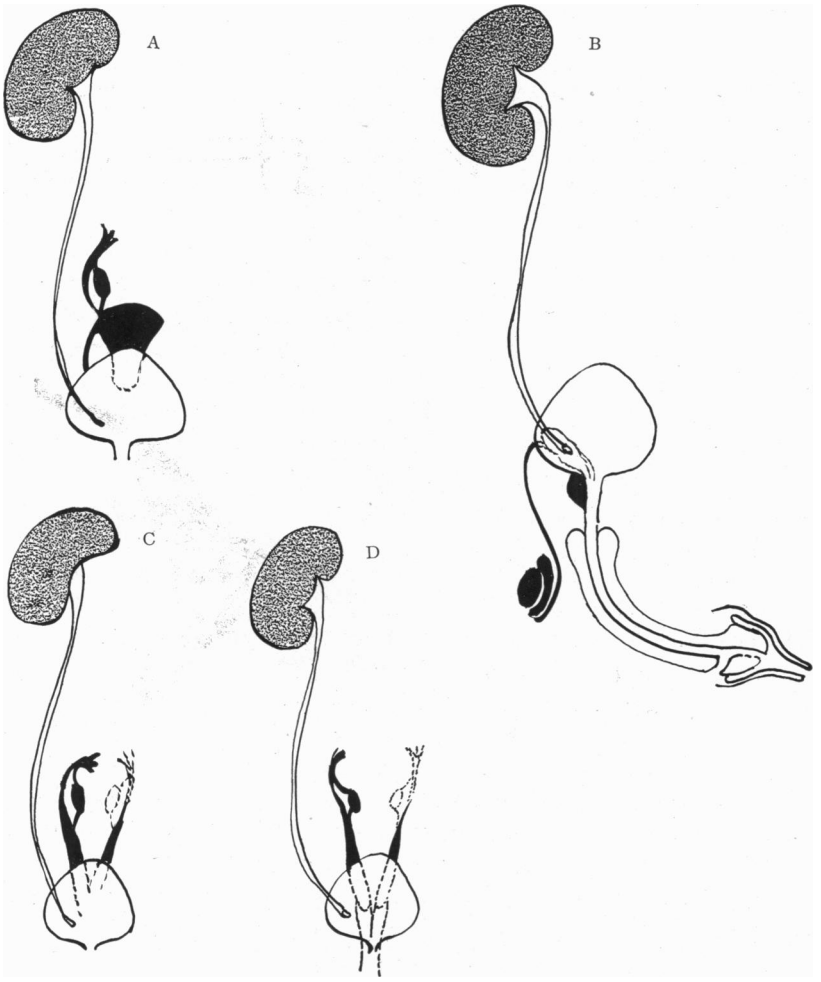

FIG. 34.—Various concomitant genital anomalies. In the female: *A*, Absence of ovary and tube on opposite side in congenital solitary kidney. *B*, Reduplication of uterus and vagina (with or without absence of a tube or of the ovary). *C*, Uterus bicornis (with or without absence of a tube or of the ovary). In the male: Most common anomalies are phimosis, hypospadias, absence of a seminal vescicle, of lobe of prostate, of a testis or of entire genital apparatus of one side.

(c) In the female (Fig. 34, A, C, D): Double vagina. Double uterus. Bicornate uterus. Absence of the ovary on one side. Absence of the tube on one side. Absence of uterine cornu on one side. Infantile uterus.

We have attempted to classify all of the anomalies of the kidney and ureter in as simple a manner as possible without omitting any essential points. We offer it as a plan which will facilitate the writing of articles on this subject.