

**Malformations of the kidney, and displacements without mobility, with illustrative cases and specimens / by David Newman, M.D., Surgeon, Royal Infirmary, Glasgow.**

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MALFORMATIONS OF THE  
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WITHOUT MOBILITY, WITH  
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M.D.

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MALFORMATIONS OF THE KIDNEY,  
AND DISPLACEMENTS WITHOUT MOBILITY,  
WITH ILLUSTRATIVE CASES AND SPECIMENS.

By DAVID NEWMAN, M.D.,  
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ANOMALIES of the kidney have until recently been looked upon simply as pathological or anatomical curiosities; but now that many of the diseases of the kidney come to be placed under the surgeon for treatment by operation, all departures from the normal, whether in respect of number, form, size, or situation, must be considered of moment to those who have frequently to operate upon the renal organs. The amount of literature on the subject published within the last ten years is a testimony to this.

Since early times anomalies in size, situation, and form of the kidney have been recorded, but very often only as curiosities, and little attention was given by the authors to points of detail. Recently, however, the records of cases have been carefully given, and much interest has been shown in the subject from the surgical, as well as from the pathological, stand-point.

Vesalius, Spigelius, Duretus, Valsalva, and Sylvaticus were about the earliest authors to describe the anomalies we are about to consider; since their time many hundreds of cases have been recorded, so that now we have a considerable basis to work upon.

We shall not endeavour to reconcile the various classifications of malpositions and malformations of the kidney which have been advanced from time to time.



If we simply study the cases recorded it will be found that they group themselves together, and may be naturally classified under the following heads:—

- A. DISPLACEMENTS WITHOUT MOBILITY: I. Congenital displacement without deformity; II. Congenital displacement with deformity; III. Acquired displacements.
- B. MALFORMATIONS OF THE KIDNEY: I. Variations in number: (1) Supernumerary Kidney; (2) Single Kidney, (*a*) Congenital absence of one Kidney, (*b*) Atrophy of one Kidney; (3) Absence of both Kidneys. II. Variations in form and size: (1) General variation in form, lobulation, etc. (2) Hypertrophy of one Kidney; (3) Fusion of two Kidneys; (*a*) Horse-shoe Kidney, (*b*) Sigmoid Kidney, (*c*) Disc-shaped Kidney.
- C. VARIATIONS IN PELVIS, URETERS, AND BLOODVESSELS.

- A. DISPLACEMENTS WITHOUT MOBILITY: I. Congenital displacement without deformity of the organ is by no means uncommon.

Perhaps no organs in the body vary more in their position than do the kidneys. Their relative distance from the spine, and their position in relation to other organs, is observed to vary considerably. For instance, without any evident cause one kidney may be found close up to the spleen, almost touching the diaphragm and the vertebral column, while the other organ is situated considerably below the crest of the ilium, and removed some distance from the spine. From observations which I made regarding this point, it seems clear that malposition of the kidney within certain limits is of frequent occurrence, and may exist without causing any disturbance. In 1000 post-mortem examinations, 24 instances occurred where the position of one or both kidneys might be described as abnormal. In 9 of these cases there was also malposition of the suprarenal capsule. Malposition of the kidney does not therefore necessarily involve an alteration in the position of the suprarenal capsule, although the intimate anatomical relationship which exists between them might lead one to

expect that any condition causing the kidney to occupy an anomalous position would also cause a disturbance of the corresponding suprarenal body.

### CASE 1.

*Fixed displacement of the right kidney above Poupart's ligament simulating a perityphlitic abscess. Operation.<sup>1</sup>*

The patient was admitted to the Glasgow Royal Infirmary on the 2nd of November, 1894, complaining of pain in the right iliac region. In September, 1890, he began to complain of pain in the lower dorsal region, but although the pain continued with more or less persistence, he continued at his work till the winter of 1893. It then became so severe that he went to bed and remained there for over a month. He first felt pain in the abdomen about this time, and for six months after this he could walk about only with the aid of two sticks; the swelling in the abdomen he noticed about seven months before his admission. There was a slight fulness of the abdomen in the right iliac and lower lumbar regions, and a rounded swelling was felt passing upwards and backwards. It appeared to be fluctuant. The dulness on percussion

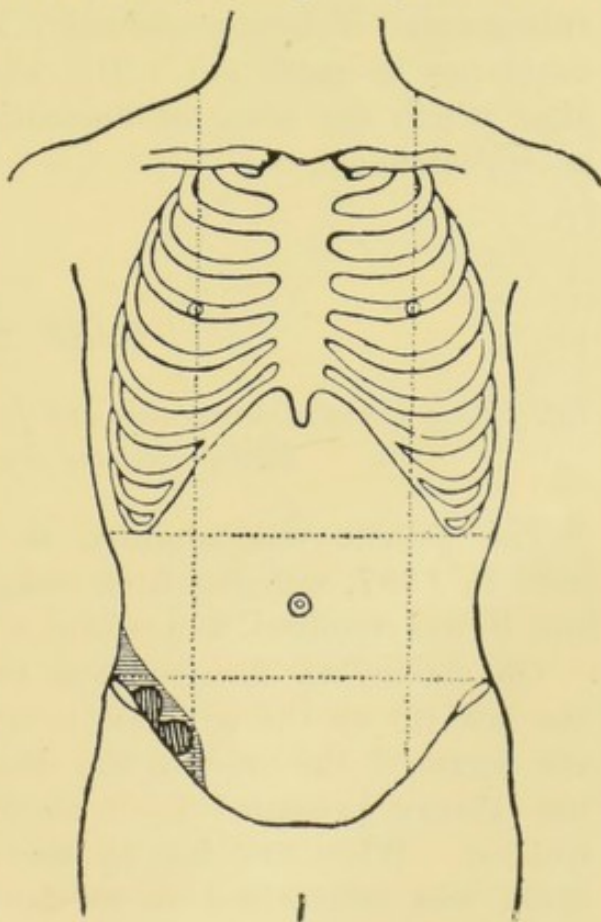


FIG. 1.

<sup>1</sup>This case is published in detail in the *Scottish Medical and Surgical Journal*, Vol. I. No. 1, p. 53.



did not exactly coincide with the opinion formed of the size of the swelling as made out by palpation; it was obtained over an area of about two inches in breadth running parallel with Poupart's ligament. The swelling was cut down upon, and as soon as the muscles were cut through the sense of fluctuation was lost. The incision was then enlarged, when the swelling was found to have a rounded outline with a distinct hilum towards the inner and upper aspect, and being semi-elastic but firm, immediately suggested a displaced kidney (Fig. 1).

A very thick adipose capsule was dissected through and the kidney exposed. It was quite immobile. There was no enlargement or hydronephrosis. The condition of the ureter could not be made out. The wound healed in a few days, after which the sense of fluctuation was again as deceptive as on admission.

## CASE 2.

*Left kidney displaced downwards and forwards in a patient upon whom lumbar colotomy was performed.*

The patient was admitted to Sandyford Nursing Home early in 1897, suffering from malignant disease of the rectum, and it was resolved to perform a lumbar colotomy.

On making an incision from the lower border and tip of the last rib on the left side to a point half an inch behind the centre of the crest of the ilium, the upper border of the left kidney presented itself at the lowermost limit of the incision. When first felt by the finger in the wound, some doubt was entertained as to the nature of the hard mass; but by drawing aside the surrounding adipose tissue, the renal cortex was easily recognized. The kidney, as far as could be made out, was normal in size and form, except that the surface was slightly lobulated (Fig. 2).



## CASE 3.

*Right kidney displaced downwards and rotated on its antero-posterior axis, shortened ureter entering upper aspect of bladder.*

The patient was admitted to the Glasgow Royal Infirmary in September, 1887, and died from severe abdominal injury with rupture of the liver and spleen.

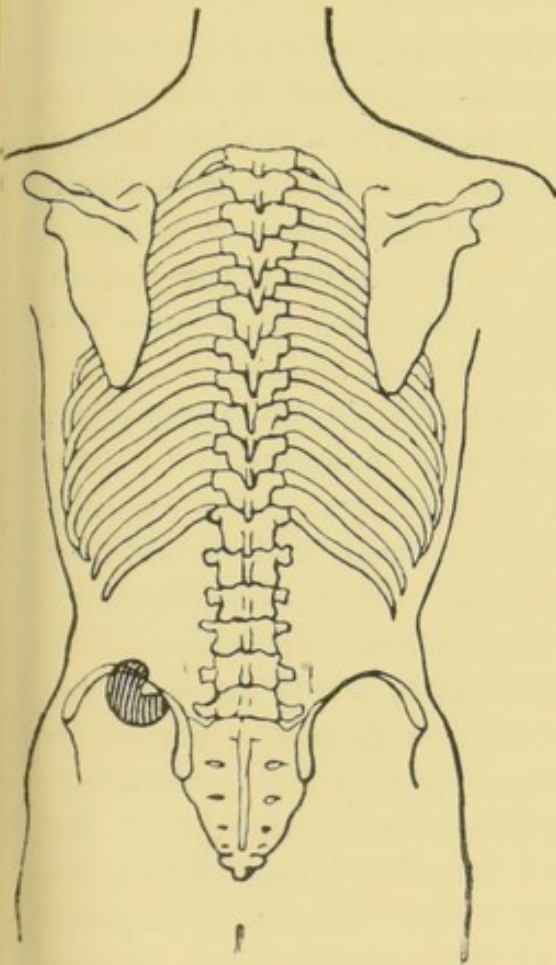


FIG. 2.

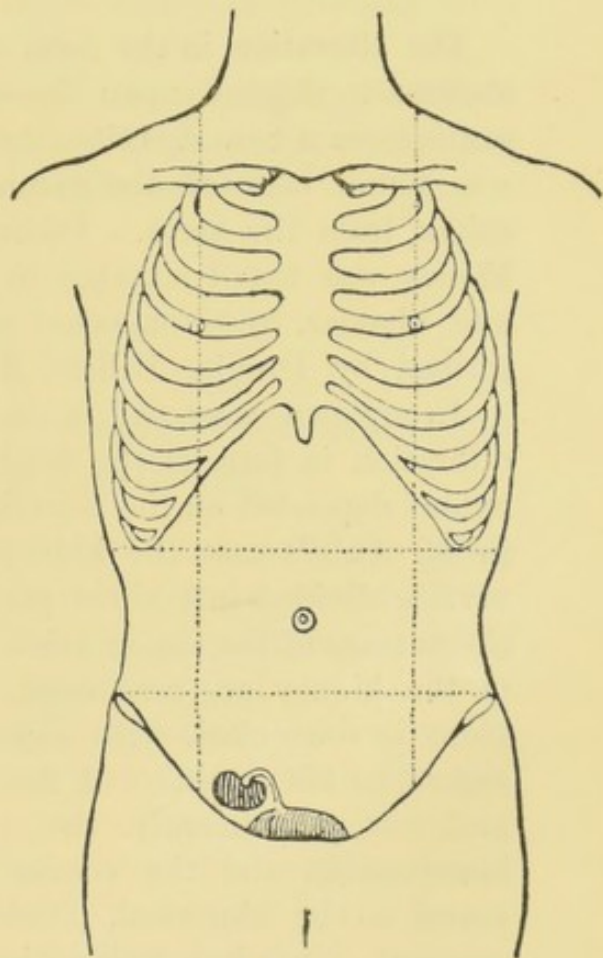


FIG. 3.

At the post-mortem examination the right kidney was found to be displaced and firmly fixed, the pelvis of the kidney looked upwards, inwards, and forwards, while the convex aspect of the organ rested upon the brim of the pelvis. The kidney was normal in shape and size, and the vessels were natural in their distribution, with the exception that both the renal artery and vein were elongated, while the right ureter was shortened and entered the bladder close to the upper

aspect of that viscus. The left kidney, with its vessels and ureter, was strictly normal (Fig. 3).

In the three cases above described, where the kidneys occupied abnormal positions, the fixed misplacements were not associated with any deformity of the organs.

## II. CONGENITAL DISPLACEMENT WITH DEFORMITY.

The alteration in the form of the kidney seems in some instances to depend upon the situation occupied by it, as for example in a case described by M. Aubé where the left kidney was found between the common iliac arteries, close to their origin from the aorta. Pacoud narrates another, in which a kidney was found situated in the pelvis between the rectum and bladder, and somewhat similar instances have been described by Drouin, Bellini, Andral, Bonet, and others.

In my own cases, and in those referred to by these observers, alteration in form of the displaced organ undoubtedly to some extent depended on the situation occupied by it. For example in M. Aubé's case the kidney was flattened, and its anterior surface divided into three parts by two depressions formed by the passage of the two arteries. As a general rule, malpositions of the kidney are associated, particularly when the displacement is congenital, with some deviation from the normal in regard to the position of the large intestine and peritoneum, and, not uncommonly, the distribution and number of the bloodvessels, and the course and length of the ureters are found to be abnormal. Roberts states that in twenty-one cases of congenital malposition of the kidney, which he was able to collect and compare, the abnormality was in every instance confined to one kidney; and the left kidney was much more commonly affected than the right (left 15, right 6). Most frequently the kidney was found lying obliquely on the sacro-iliac synchondrosis. In some cases the organ was fixed beside the uterus, or transversely between the rectum and the bladder, or across the prominence of the sacrum.

As a rule the displaced organ has its long axis vertical or slightly oblique, but it may also occupy, as illustrated by



a case published by Carslaw,<sup>1</sup> a transverse position. In this case the left kidney was found lying on the fourth and fifth lumbar vertebrae, and the long diameter was, transversely from right to left, three inches. The kidney was divided into two lobes, by a fissure running on the anterior surface almost vertically. The ureter was double, one branch coming from each lobe, but these united while still in the hilum of the kidney. Two arteries supplied the kidney, one from the aorta and a second from the right common iliac, and corresponding with each artery there was a vein.

These congenital displacements will be more fully described under malformations of the kidney. At present we may give the following cases in illustration of the subject :

#### CASE 4.

*Right kidney at the brim of the pelvis, anomalous distribution of blood-vessels, and deformity of the kidney.*<sup>2</sup>

The right kidney was found lying on the brim of the pelvis. The anterior aspect of the organ is convex, the posterior surface slightly concave. The front of the organ is marked by a deep groove extending from its upper to its lower extremity. This groove is, roughly speaking, Y-shaped, the right limb of the Y being longer and deeper than the left. At the upper limit of the former an artery enters the kidney directly from the aorta, and before entering the substance of the organ it divides into two branches of equal size. In the centre of the groove, where the two limbs of the Y join, the pelvis of the kidney is seen, and the ureter passes directly down from it. From the kidney, close to the uppermost limit of the pelvis a large vein passes directly to the vena cava. The posterior aspect of the kidney is flat or slightly concave and is penetrated by two vessels, one a vein which passes from the kidney up its lowermost margin to the common iliac vein, and the other an artery, which arises from the

<sup>1</sup> *Glasgow Medical Journal*, Vol. XXXI., p. 381.

<sup>2</sup> Royal Infirmary Museum, Series VII., No. 2.



common iliac artery, and penetrates the kidney at the union of the lower and middle thirds.

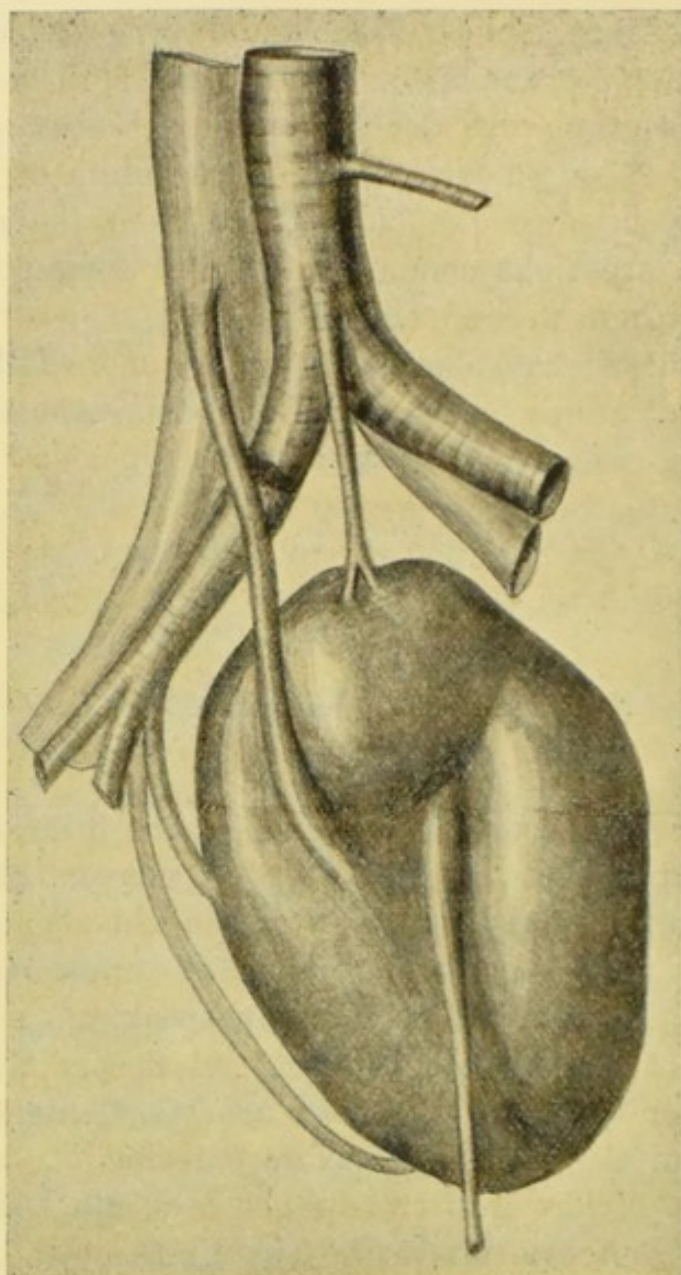


FIG. 4.

### CASE 5.

*Malposition of both kidneys, one to the right of the promontory of the sacrum, the other in the iliac fossa. Right kidney small and with no hilum.<sup>1</sup>*

In this case the kidney was found to be situated about half an inch to the right of the promontory of the sacrum,

<sup>1</sup> Newman, *Surgical Diseases of the Kidney*, page 7.

and the left kidney was discovered in the left iliac fossa two inches to the left of the sacro-iliac synchondrosis. The right kidney was small in size and so altered in shape that there was no hilum, and the ureter passed from the lower aspect of the organ. The parenchyma of the kidney was normal in appearance, and the arteries, two in number, came off from the aorta about one inch above its bifurcation. The left kidney was normal in every respect except its position. There was no evident cause for the abnormality; the other abdominal organs were practically normal, and there was no indication of inflammatory or other mischief within the abdomen.

#### CASE 6.

*Right kidney flat, oval in form, and situated at the brim of the pelvis, supplied with two arteries; one ureter from its anterior aspect.*<sup>1</sup>

In this case the right kidney was situated at the brim of the pelvis, half in the cavity, and half out. The preparation was removed from the body of a man aged 61, who died of erysipelas in the Royal Infirmary.

The right kidney forms a flat oval body about the normal size. It is marked by three grooves on its anterior aspect which correspond to the line of the entrance of the blood-vessels and exit of the ureter. The organ is supplied by two arteries which pass off from the aorta in the middle line in front, just above the bifurcation. These vessels pass slightly to the right, and enter the kidney on its anterior aspect, about one-third from the upper border. The arteries lie each in a separate groove as they pass along the upper third of the kidney, and the grooves demarcate a triangular piece of the organ. The right renal vein passes to the vena cava about one inch above the level of the bifurcation of the aorta, and the vein passes from the kidney along the same groove as the arteries enter it; the ureter also arises from the anterior aspect and passes down in front and has a somewhat tortuous course to the bladder, as if it were too long for the distance to

<sup>1</sup> Royal Infirmary Museum, Series VII., No. 1.



be traversed. The right suprarenal capsule is in its normal position close to the liver. The right kidney was firmly fixed in its abnormal position. No other irregularities were discovered in the vessels. The inferior mesenteric artery came off just above the bifurcation of the aorta (Fig. 5).

The left kidney was normal in size and in its relations, but it showed a distinct tendency to lobulation. The anterior aspect of the organ being marked by three distinct transverse grooves.

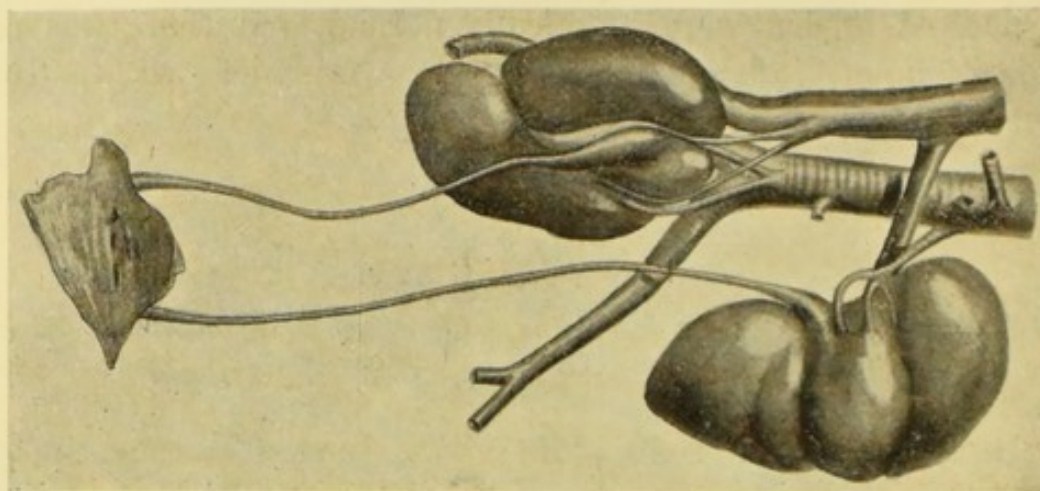


FIG. 5.

Two specimens, very similar to the above will be found in the Western Infirmary Museum, and they are described in a recent paper by Dr. L. R. Sutherland and Dr. G. H. Edington.<sup>1</sup>

In the first case the right kidney, which was found lying at the brim of the pelvis, is greatly altered in form and in relations. The posterior surface is flattened, showing a groove accommodating the right common iliac artery. The anterior surface shows four prominent lobules surrounding the hilum, from which the pelvis springs; the ureter is normal. Two veins emerge, one on either side of the hilum, the left passes upwards in front of the aorta to empty into the left renal vein, while the right empties directly into the inferior vena cava. The right kidney is supplied by two arteries which arise separately from the anterior aspect of the aorta, and pass in grooves to the upper part of the hilum (Fig. 6).

<sup>1</sup> *Glasgow Medical Journal*, February, 1898.



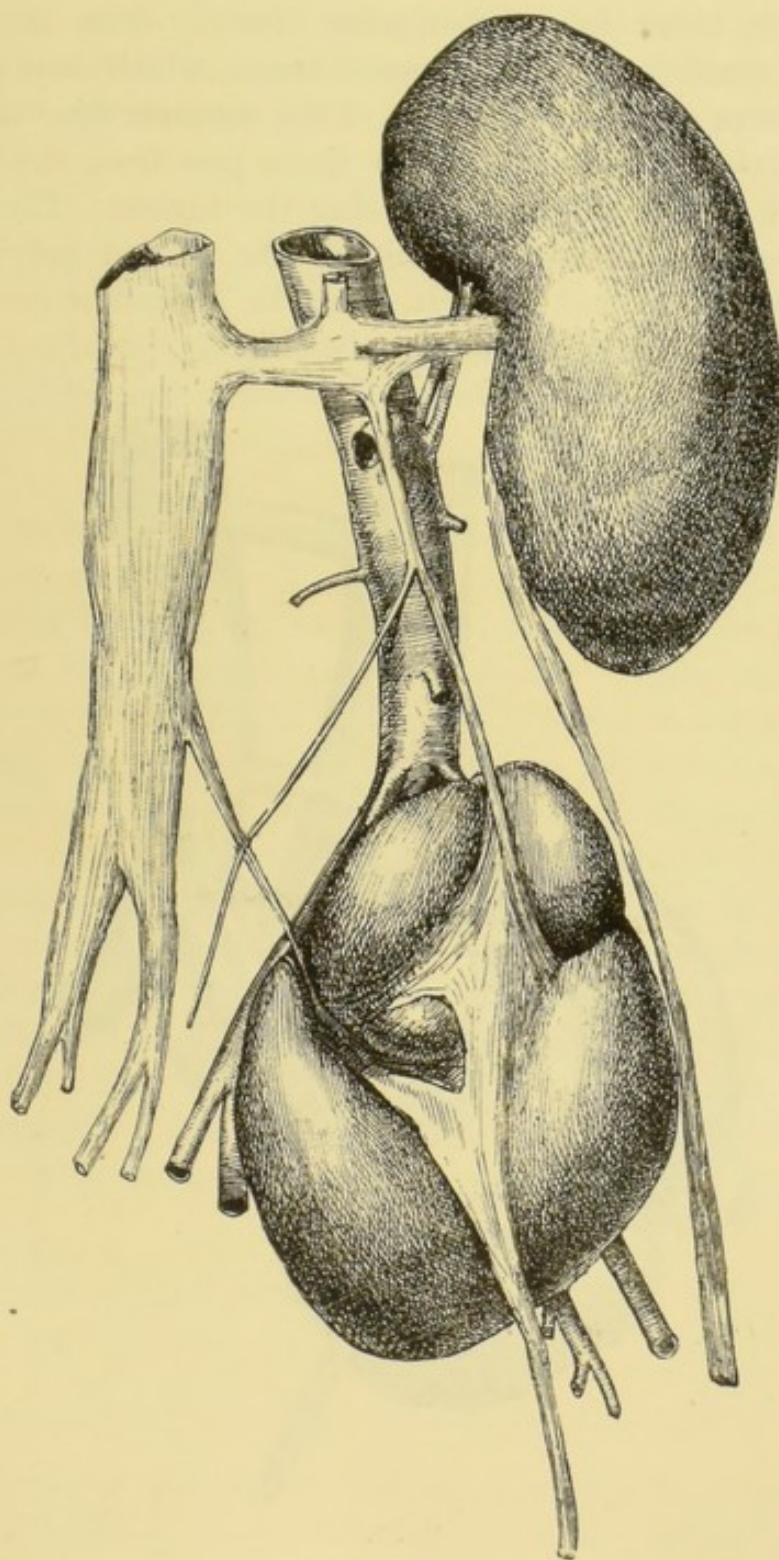


FIG. 6.

In the second case the right kidney was found at the level of the bifurcation of the aorta, and to the right of that vessel. In this case also the hilum is situated anteriorly; and the

bloodvessels, three in number, arise directly from the aorta. The veins unite to form a common trunk, which empties into the vena cava above the junction of the common iliac veins.

The pelvis is bifid, and the two limbs pass from the kidney at different levels, the left one being the higher. The ureter comes from the lowermost limit of the united pelvis. It passes downwards and inwards, lying in a shallow groove on the anterior surface of the lower lobe (Fig. 7).

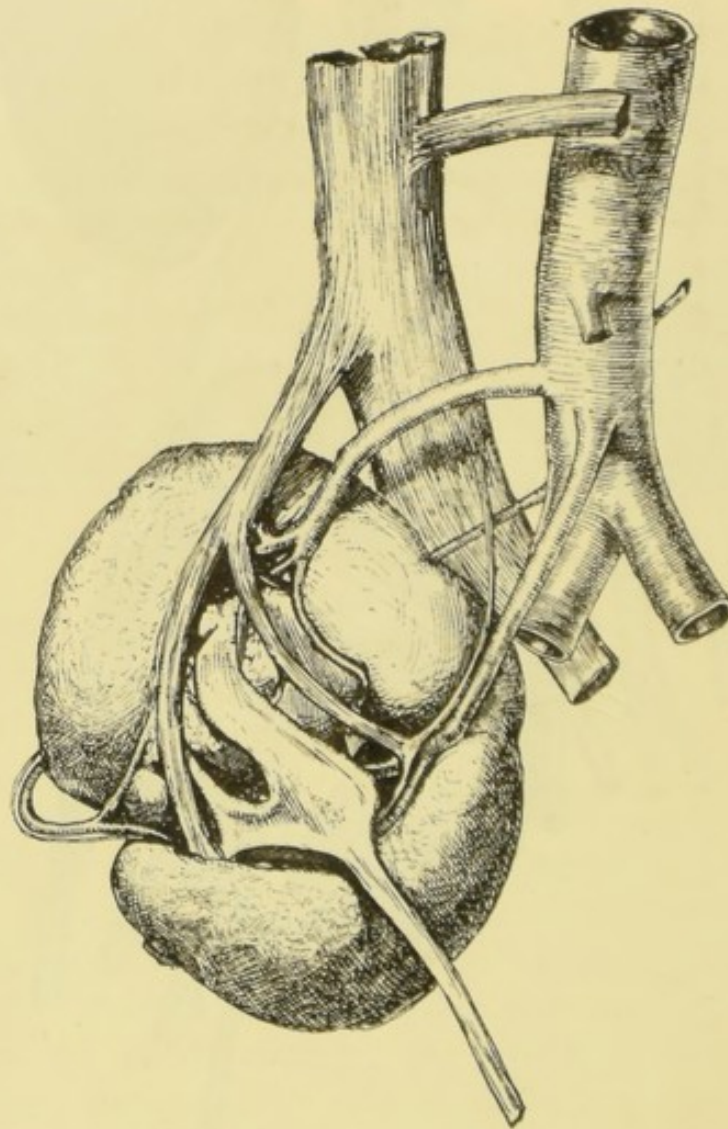


FIG. 7.

These remarkable cases of malposition of the kidney seldom give rise to serious symptoms, and generally escape observation during life.

Cases, however, have been recorded where the misplaced



kidney has been mistaken for an abdominal tumour, or, in the female, has from its position in the pelvis become a serious obstacle to parturition.

### III. ACQUIRED DISPLACEMENT OF THE KIDNEY.

Besides being liable to congenital malposition the kidney may be displaced upwards, downwards, or laterally from the enlargement of other organs, such as the liver, spleen, suprarenal capsule, or pancreas, or from the pressure of tumours near them. When the right kidney is depressed by an enlarged liver—not an uncommon accident—it is most usually rotated on its short axis, the hilum is turned downwards, and the upper portion of the kidney is more depressed. Rayer mentions an instance where the right kidney was forced down by an enlarged suprarenal body, and cites a case of Hohl's where the kidney, situated deeply to the inner side of the psoas muscle, offered an obstruction to parturition by retarding the passage of the child's head; Laennec also describes a case in which the right kidney was pressed downwards to the opposite iliac crest by a greatly enlarged liver, and Morris mentions an instance where the left kidney was depressed on to the brim of the pelvis by a large cyst in its lower part, which contained a pint of yellow fluid. The cyst had dragged the kidney down, and itself occupied the greater part of the pelvic cavity.

#### CASE 7.

*Acquired displacement of the right kidney by a perinephric abscess.*

In a case of perinephric abscess upon which I operated in 1890, on opening the abscess by a lumbar incision, after the pus was evacuated, great difficulty was experienced in finding the kidney. By enlarging the incision upwards, the kidney was discovered with its convexity looking upwards, and lying close to the diaphragm, while the pelvis was turned downwards. The kidney was quite denuded of adipose tissue so that its



contour could be easily made out, the organ was firmly fixed in its abnormal position, probably by inflammatory adhesions, and, as far as could be discovered by examination with the finger, the upper border of the kidney was resting on the vertebrae, while the renal bloodvessels and ureters must have been elongated.

Many similar cases have been recorded where the kidneys have been displaced in one direction or another and anchored by their vessels and ureter. The displacements naturally cause rotation of the organ on its short axis.

Probably the most important fixed displacements, either congenital or acquired are those where the kidney comes to occupy the cavity of the pelvis, or where the organ is placed in such a position as readily to be mistaken for an abdominal tumour.

When the kidney has been displaced and occupies the cavity of the pelvis, the swelling may possibly be made out by a rectal or vaginal examination, but in all cases the diagnosis is extremely difficult, as in many instances the organ is not only displaced but also malformed, so that the normal reniform outline is lost as a guide in diagnosis. When, however, the normal shape is maintained it is an important aid to the diagnostician, and when superadded to the presence of a reniform swelling in an abnormal situation there is a loss of the usual fulness and resistance in the loin, a suspicion of misplacement of the kidney may be aroused.

Fixed malpositions of the kidney have seldom been diagnosed, as they almost never give rise to symptoms or even to inconvenience during life. Up to the present time most of these anomalies have been discovered after death, but now that operations upon the kidney are of frequent occurrence, the clinical aspect of the subject is likely to be more fully recognized.

B. MALFORMATIONS OF THE KIDNEY : I. Variations in number :

- (1) Supernumerary kidney; (2) Single kidney, (*a*) Congenital absence of one kidney, (*b*) Atrophy of one kidney; II. Variations in form and size: (1) General



variations in form, lobulated kidney; (2) Hypertrophy of one kidney; (3) Fusion of two kidneys, (a) Horse-shoe kidney, (b) Sigmoid kidney, (c) Disc-shaped kidney.

B. MALFORMATIONS OF THE KIDNEY: I. Variations in number:

(1) *Supernumerary kidney*: Supernumerary kidney is extremely rare. It must be considered simply as an anatomical curiosity, and consequently very little requires to be said regarding the condition. Although very few instances have been met with where more than two kidneys exist in the human subject, still cases have been recorded by Rayer, and other writers, where a supernumerary gland has existed. We have only seen one instance of this anomaly; it was at a post-mortem examination which was made many years ago upon a gentleman who died from malignant disease of the ascending colon. As no record was kept beyond what was sent at the time to the family attendant, I am unable to give details; but, from a clear recollection of the case, I can say that lying close to the upper margin of the left kidney there was a small pear-shaped body, supplied by a branch of the renal artery, and having a distinct ureter which passed into the left ureter half an inch below the pelvis of the left kidney. Sections of this mass were examined microscopically, and found to be healthy renal tissue. The mass was completely separated from the kidney proper, being united to it only by the little ureter.

This anomaly may be regarded as an extreme variety of segmentation of one of the kidneys. Generally when a supernumerary kidney has been seen, it has been found to lie close to a normal kidney, but in order to be placed in this class of malformations, the part ought to be so separated as to possess distinct vessels and have a ureter of its own, which, however, always unites with the ureter of the normal kidney before it reaches the bladder.

(2) *Single kidney*. The anomalies which have been included under this term have been so various and so entirely different, even in their main characteristics, that it is difficult to avoid confusion, and at the same time follow the classification at present adopted.



The existence of so-called "single kidney" was known to many of the older writers such as Vesalius, Duretus, and Eustachius, but Morgagni, in 1769, was the first writer to classify these abnormalities of the kidney into two groups, namely: those instances in which two organs had become coalesced; and secondly, those where only one kidney had developed; but unfortunately to both of these conditions he applied the term "solitary kidney." Then, following upon Morgagni, Rokitansky limited "solitary kidney" to those cases in which the malformation was due to the fusion of two organs, of which the lowest degree is seen in "horse-shoe kidney," and the highest in those instances in which the two kidneys approach one another more and more, and form one "disc-shaped" organ lying in the median line, and provided with a double ureter. To the other class of kidneys where there is a "right or left kidney which is normal in regard to position and formation, and occasionally rather enlarged, its fellow being deficient," he applied the term "unsymmetrical kidney." We do not understand why two kidneys fused together as in horse-shoe kidney, where the two organs may be united only by a narrow band (see Fig. 12) and having distinct sets of vessels and ureters, should be spoken of as a "solitary" or "single kidney," any more than that the double monsters Eng and Chang should be considered as one individual. So much confusion has arisen regarding the use of the terms "unsymmetrical kidney" and "solitary kidney," that it would be well not to employ them. For example, "sigmoid" kidney, a condition where two kidneys are fused together, as shown in Fig. 16, and occupying one side of the body, has been described under the heading "solitary kidney," even although the mass was provided with a double set of vessels and two ureters.

Under the term "single kidney" we purpose only to include those cases in which one active organ is found, either as a consequence of atrophy, or from congenital absence of its neighbour. The other abnormalities, such as "horse-shoe kidney," "sigmoid kidney," and "disc-shaped kidney," may be considered under the general heading of "fused kidney."



A careful distinction must be drawn between "single kidney" due to congenital defect of development of the opposite organ, and those instances in which a kidney has become wasted and functionally useless as a consequence of disease, while its neighbour has undergone compensatory hypertrophy.

In the former instance no trace of the kidney or of its ureter, or bloodvessels is found, as shown in Fig. 8, while in atrophy of one kidney as a consequence of disease the rudimentary kidney and its vessels are as a rule represented.

The following specimens illustrate (*a*) *congenital absence of one kidney* :

#### CASE 8.

*Complete absence of the left kidney, ureter, and vessels. Compensatory hypertrophy of right kidney.*

On the 23rd June, 1885, we made a post-mortem examination on a patient, Mrs. H., aged 53, who was admitted to the Royal Infirmary under the care of the late Dr. Scott Orr, and died from tubercular ulceration of the bowels and secondary tubercular peritonitis (Fig. 8).

The right kidney was normal in its position, but the whole organ was greatly enlarged, weighing  $12\frac{1}{2}$  ounces, and measuring 5 inches in length and 4 inches in breadth. All the parts of the kidney were proportionately increased, the right ureter and pelvis were strictly normal, and the kidney was supplied by one artery and one vein, both of which were normal in their course and distribution. The right suprarenal body was normal in size and situation, the left suprarenal body was found under the last left rib and was normal in size and structure. No trace was found of the left kidney or of its vessels and ureter, and no opening into the bladder could be discovered corresponding to the entrance of the ureter.

The microscopic examination of the enlarged kidney was gone into very carefully and the inquiry was a most interesting one, showing very clearly how compensatory hypertrophy takes place.

The minute changes occurring in compensatory hypertrophy we have described elsewhere. They do not demand attention here, further than to say that as far as could be made out the

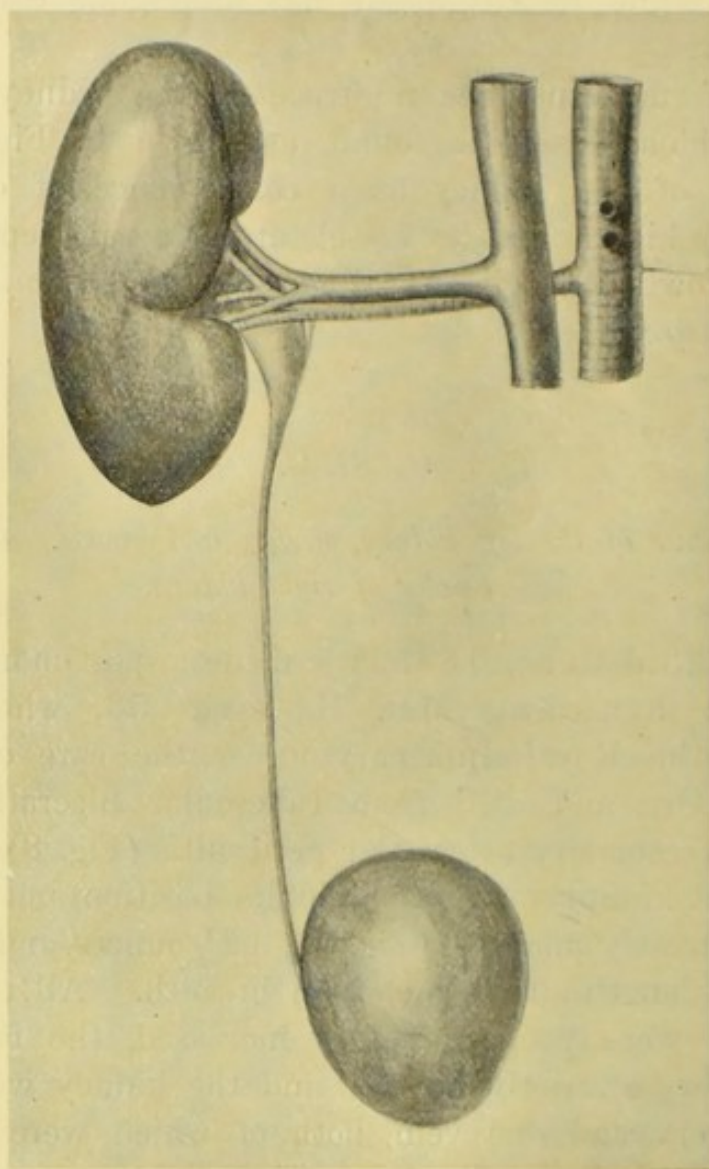


FIG. 8.

increase in the size of the kidney was due to an augmentation in the bulk of the glomeruli, and to an elongation and increased convolution of the uriniferous tubules, rather than to any numerical hyperplasia.

The changes taking place in compensatory hypertrophy have been carefully studied by Eckardt, Ebstein, Guttman, Polk, and others.



## CASE 9.

*Congenital absence of the left kidney, vessels and ureter.*

The specimen about to be described was placed in the Museum of the Glasgow Royal Infirmary by Dr. J. Lindsay Steven, and in the Catalogue is described by him as follows:<sup>1</sup>

"The preparation shows with the right kidney the bladder and the right ureter. A most careful search at the time of the post-mortem examination failed to find any trace in the body of the left kidney or ureter, the right suprarenal capsule was normal in appearance and situation and perhaps slightly enlarged, the right renal artery had normal characteristics; the left was scarcely thicker than a stout thread, and was lost in the tissue of the left renal region. The right ureter was quite normal; no left ureter could be found after careful search. The patient was a boy, age 11, who suffered from morbus coxarius, complicated by tubercular disease of the lungs."

The case and specimen described above illustrate single kidney due to the congenital absence of one organ.

The following cases show how (*b*) *one kidney may atrophy* or become functionally inactive, either as a consequence of want of growth, or from disease in early life:

## CASE 10.

*Extreme atrophy of the left kidney with double pelvis but single ureter.*<sup>2</sup>

I have no details of the post-mortem examination in this case. The kidney tissue is almost completely destroyed, and the whole organ is about the size of a walnut. The pelvis is branched, and there is no hilum, the upper limb of the pelvis springs from the inner and upper aspect of the atrophied organ, while the lower limb arises from the lower border

<sup>1</sup>Glasgow Royal Infirmary Museum, Series VII., No. 8a.

<sup>2</sup>Glasgow Royal Infirmary Museum, Series VII., No. 9.

of the kidney. Both limbs unite about one and a half inches below the level of the kidney, each branch is of sufficient size

to admit the little finger, and after uniting form a channel three-quarters of an inch in diameter. Below this the pelvis gradually narrows and forms a ureter which is a little wider in lumen than normal. In the preparation the vessels have not been preserved (see Fig. 9).



FIG. 9.

### CASE 11.

*Atrophied kidney, the renal tissue being almost entirely replaced by fat.<sup>1</sup>*

The patient from whom this specimen was removed was under my care in 1887. He suffered for many years from chronic cystitis, and ultimately died from cardiac disease complicated with passive hyperaemia of the lungs.

At the post-mortem examination the right kidney was found to be in a state

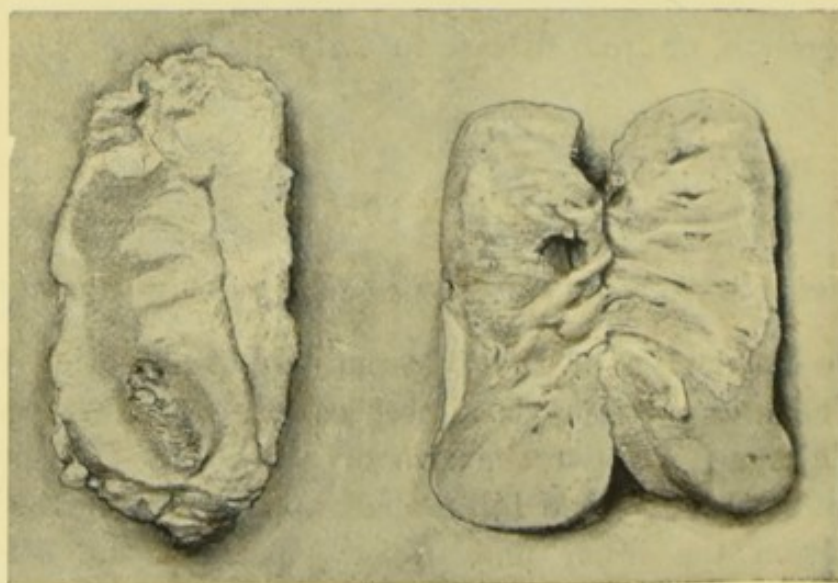


FIG. 10.

<sup>1</sup> Glasgow Royal Infirmary Museum, Series VII., No. 13.



of moderately advanced chronic interstitial nephritis, but up to the time of his death there were no symptoms pointing to renal incompetency. The kidney weighed ten ounces. The left kidney, as represented in Fig. 10, weighed half an ounce, very little renal tissue could be found in the mass, and what remained was completely embedded in firm fat. In this case the fat appeared to have developed outside the kidney, pushed its way into the interior of the organ by the hilum, and so spread towards the periphery of the organ.

The following specimen was placed in the Museum by Dr. J. Lindsay Steven, and he has allowed me to make use of it :

#### CASE 12.

*Atrophy of the right kidney with compensatory hypertrophy of the left kidney, disease of the suprarenal capsules.*

The following is Dr. Steven's note in the Museum Catalogue:

"Both kidneys are preserved, the right only weighed one ounce, the left seven and a half ounces. The organs were obtained from the body of a man suffering from spinal caries. The small right kidney was embedded in a mass of adipose tissue, and at its upper extremity there was a small cavity with smooth walls the size of a hazel nut filled with pultaceous material. The ureter of this kidney was considerably thickened, and its lumen was practically obliterated. The urinary bladder was much hypertrophied. The left suprarenal capsule was enlarged and was converted into a cream-coloured structure, but little tissue of normal appearance remained. The right suprarenal presented similar appearance."

The left kidney was healthy. Fig. 11 shows the atrophied kidney entire and on section, also the healthy kidney.

In the Royal Infirmary Museum there are many other specimens illustrating atrophy of the kidney as a consequence of disease.

Bright's disease and tubercular lesions are undoubtedly the most frequent causes of wasting of the kidney, and it is not uncommon in very chronic cases of interstitial nephritis to find

both kidneys weigh less than two or two and a half ounces. Such cases are, however, beyond the scope of this paper.

Again, renal atrophy as a consequence of obstruction to the ureter or from endarteritis, cannot be considered at present. It is to cases of congenital atrophy, or wasting of the kidney in early life, that we desire more especially to direct attention, and the cases described above appear to come under this category.

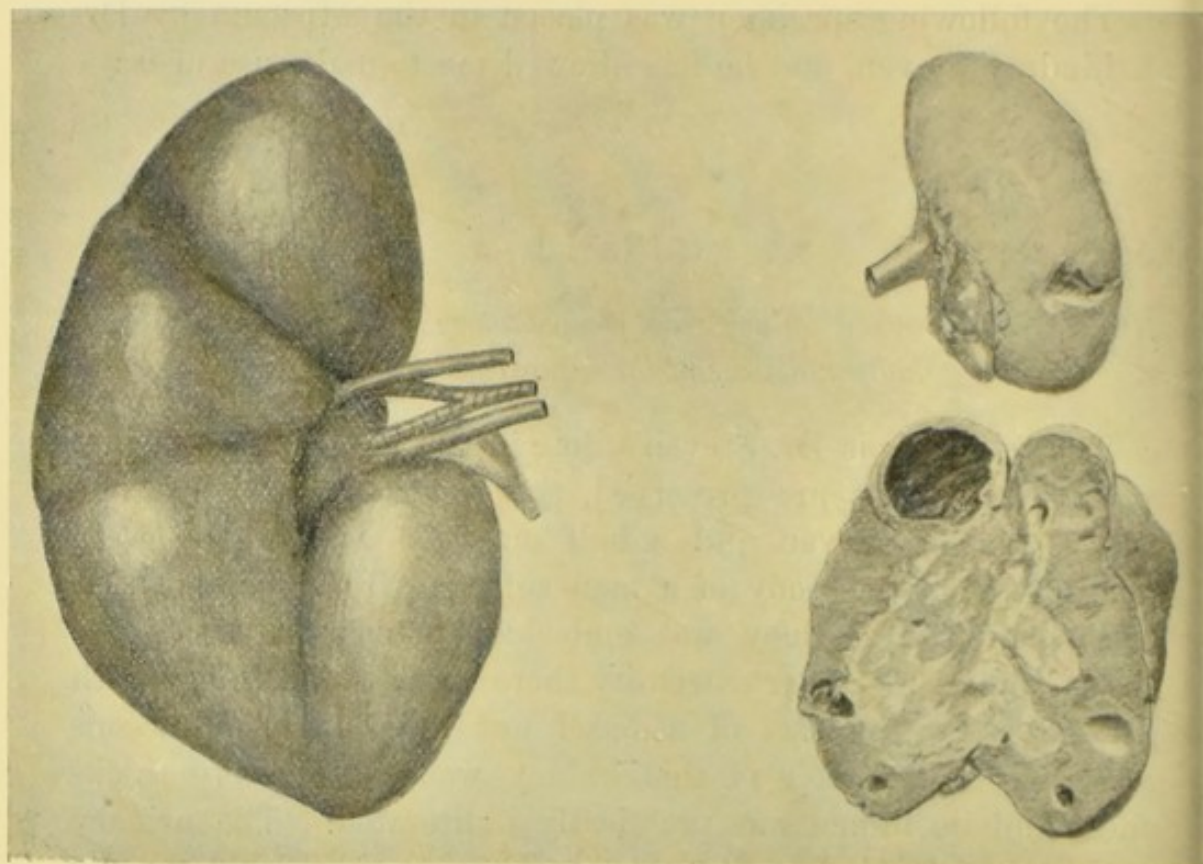


FIG. 11.

We may now consider some general questions connected with "single kidney" whether due to congenital defect or to complete atrophy of the neighbouring organ. It is of interest to observe that "single kidney" is not peculiar to the human subject, but has been seen in the lower animals also. Sutton, amongst others, states that this condition occurs in such animals as hens, horses, and sheep, and I have observed it in one instance in a calf. In these animals, as in men, the single kidney has been observed to have undergone increase in



bulk. The following points in connection with single kidney may be considered :

- (a) Duration of life of the individual.
- (b) Size of the kidney, compensatory hypertrophy.
- (c) Form, position, and side affected.
- (d) Sex and age of the individual.
- (e) Liability of a single kidney to disease.
- (f) Condition of the kidney, ureters, and vessels on the affected side, and on the side of the single kidney.
- (g) Malformation of the other organs.
- (h) Position of adrenal body.

(a) *Duration of life of the individual.* The absence of one kidney, especially when compensated for by augmentation in size, and by increased functional activity of its neighbour, does not seem to seriously influence the duration of life, so long as there is sufficient renal tissue left in the remaining organ to fulfil the function of life, as doubtless we are endowed, in the normal state, with considerably more renal tissue than is necessary for even active and vigorous life.

In the post-mortem room kidneys containing very little active secreting tissue are frequently found in the bodies of individuals who have, as far as is known, never suffered from any symptoms of renal insufficiency.

The following table shows the age at death of 17 cases of single kidney when death occurred after the age of 60 years was past :

8 persons died between 60-65 years.			
1	"	"	65-70 "
4	"	"	70-75 "
2	"	"	75-80 "
2	"	"	over 80 "
<hr/>			
17			

It can be easily understood, however, that in an individual with only one kidney, if that kidney becomes affected by any serious malady such as obstruction to the ureter, thrombosis, or any local inflammatory infection, the risk to life is greatly



increased by the existence of only one organ. In single kidney compensatory hypertrophy is the rule when the individual survives through the term of infancy, but even in the foetus considerable enlargement of the kidney has been seen. Morris mentions an instance of this in "a well-formed foetus born at full time," where "a right kidney only was present, and was twice its natural size; the ureter was much dilated."

(b) *In estimating the degree of compensatory hypertrophy* in recorded cases, care must be taken to exclude instances where the single kidney has become enlarged by disease; for instance, Morgagni describes a case where one kidney was functionally inactive, while its neighbour was ten times the normal size, and he mentions another case where a single kidney weighed 35 pounds. Again, Rhodius<sup>1</sup> records a case in which a kidney was so enlarged as to give rise to the suspicion of pregnancy. Eustachius, Vesalius,<sup>2</sup> Poupart,<sup>3</sup> Perrin,<sup>4</sup> Breschet,<sup>5</sup> and other old writers have recorded similar cases, in all of which it is very evident that the enlargement was due to disease rather than to a true hypertrophy of the organ. It may be said that when the single kidney is increased to much more than twice the normal size the enlargement is not entirely due to compensatory hypertrophy.

In true compensatory hypertrophy the kidney is found to be homogeneously enlarged in all its parts, and seldom if ever weighs more than two normal kidneys. Take for example other organs. Sometimes hypertrophy occurs in cases of congenital non-inflation of one lung, the neighbouring organ being increased in bulk, so also in the liver, when one portion becomes atrophied another may undergo hypertrophy. So many cases of compensatory hypertrophy in single kidney have been recorded that it is impossible to mention more than a few of them, but for the sake of reference I may give the following:

<sup>1</sup> Rayer's *Maladies des Reins*.

<sup>2</sup> *De Corporis Humani fabrica*, lib. v., cap. 10.

<sup>3</sup> *Histoire de l'Académie royale des Sciences*, Paris, année 1700, p. 35.

<sup>4</sup> *Journ. de Méd. de Chirur. et de Pharmac.*, Tom. XIII., Novembre 1760, p. 431.

<sup>5</sup> *Medico-Chirurgical Transactions*, Vol. IX., 1818, p. 437.



Duckworth,<sup>1</sup> Macdonald,<sup>2</sup> Palma,<sup>3</sup> Brackenburg,<sup>4</sup> Northrup,<sup>5</sup> Davies,<sup>6</sup> Pollock,<sup>7</sup> Hewett,<sup>8</sup> Gubbin.<sup>9</sup>

On the other hand, it does not always follow that because one kidney is undeveloped or functionally useless the other organ must be considerably enlarged. Instances of single kidney, normal in size, have been seen by Turner,<sup>10</sup> Mayor,<sup>11</sup> Hamy,<sup>12</sup> Bostrom,<sup>13</sup> Brown,<sup>14</sup> and many others.

(c) *Position, form, and side affected.* In the absence of one kidney the remaining organ may (as in Fig. 8) occupy its normal position in the loin. This is usually the case in atrophy of one kidney from disease. Dr. P. W. Macdonald<sup>15</sup> described a case in which the right kidney and ureter were absent, while the left kidney was normal in position, and had a normal ureter entering the bladder in the ordinary situation. Similar cases have been described by Gubbin, Peacock, Lorain, and Gruber. Single kidney, when due to want of development of its neighbour, is more likely to be misplaced and altered in form.

In many cases, however, the single kidney remains normal in shape as well as natural in size, and, even in those cases where there is considerable hypertrophy, the renal form is strictly maintained, the organ being simply increased in all its dimensions. Indeed, alterations in form are not common. In some cases, however, the organ is much elongated, in others disc-shaped, angular, or relatively thickened, and not uncommonly lobulated. Dr. M. Watson<sup>16</sup> described a case of

<sup>1</sup> *Pathological Society's Transactions*, Vol. xx., p. 232.

<sup>2</sup> *Lancet*, May 30th, 1885.

<sup>3</sup> *Präger Med. Wochenschr.*, 1891, xvi. Jahrg. No. 33, p. 380.

<sup>4</sup> *Lancet*, London, 1891, Vol. II., p. 869.

<sup>5</sup> *Medical Record*, New York, Vol. xxxii., p. 608.

<sup>6</sup> *British Medical Journal*, 1885, Vol. II., p. 397.

<sup>7</sup> *Lancet*, 1863, Vol. II., p. 622.

<sup>8</sup> *Lancet*, 1863, Vol. II., p. 622.

<sup>9</sup> *British Medical Journal*, 1883, Vol. I., p. 115.

<sup>10</sup> *Edinburgh Medical Journal*, February, 1865, p. 687.

<sup>11</sup> *Bulletins de la Société Anatomique de Paris*, 1876, p. 592.

<sup>12</sup> *Journ. de l'Anatomie et de la Physiol.*, 1884, p. 193.

<sup>13</sup> *Beiträge zur Pathol. Anat. der Nieren*, Heft I., 1884, p. 36.

<sup>14</sup> *Journal of Anatomy and Physiology*, Vol. xxviii., p. 198.

<sup>15</sup> *Lancet*, May 30th, 1885.

<sup>16</sup> *Edinburgh Medical Journal*, Vol. II., 1874, p. 13.



congenital absence of one kidney, in which the remaining organ was normal in size but circular in form, the surface was distinctly lobulated, and the kidney was situated close to the brim of the pelvis.

Polk<sup>1</sup> also describes a case of single kidney where the organ was displaced into the iliac fossa, while Marzolo<sup>2</sup> records an instance where the right kidney was found lying on the right sacro-iliac synchondrosis. Weisbach<sup>3</sup> and Lombroso<sup>4</sup> publish instances in which misplaced kidney was associated with other abnormalities. The side most frequently affected is the left, especially in male subjects; in the female the right and the left kidneys are equally liable to the malformation.

(d) *The influence of age and sex.* The abnormality is found twice as often in males as in females, a circumstance which may be accounted for by the fact that necropsies are more often procured in the former sex than in the latter. About 10 per cent. of the specimens published were met with in the body of the foetus, or in newly-born children, and, in most of these cases, the anomalous condition of the kidney was associated with some other congenital deformity, such as imperforate anus, deformities of the bladder, uterus, ovaries, etc.

In individuals who have lived, notwithstanding the deformity of the kidney, there is nothing remarkable to note regarding their age at the time of death, the mortality being almost equally distributed up to 60 years of age; over that age, as already shown, seventeen cases are recorded.

(e) *Liability to disease in single kidney is marked.* Chronic nephritis, renal calculus, tubercular disease, hydronephrosis, pyonephrosis, and abscess being the most common maladies met with. Morris<sup>5</sup> says: "Probably, as has been above stated, there is a tendency to chronic albuminuria in early or young life in persons with one kidney atrophied. When only one kidney exists, and that an "unsymmetrical" organ, there would seem to be a considerable disposition to renal calculus.

<sup>1</sup> *Lancet*, 1883, Vol. I., p. 514.

<sup>2</sup> *R. Ins. Veneto di Sc. Elettore*, 1879.

<sup>3</sup> *Wiener medicinische Wochen*, 1867, No. 2, s. 20.

<sup>4</sup> *Gazzetta Medica Italiana*, February, 1860.

<sup>5</sup> *Diseases of the Kidney*, p. 100.



Of the twelve cases of "unsymmetrical" kidney collected by Mosler, death was due more or less directly to calculus in the pelvis or ureter in nine of them; in the other three, cancer of the bladder and rectum involved the ureter; nephritis, and the consequences of obstruction due to severe congenital phymosis, were respectively the causes of death. In the case of cancer (Tulpius), a calculus had been passed per rectum in early life, and there was an opening from the ureter into the rectum through which part of the urine escaped."

I have collected eight cases of "single kidney" in which calculus was present. These were published by Rhodius,<sup>1</sup> Jobi,<sup>2</sup> Rokitansky,<sup>3</sup> Rayer,<sup>4</sup> C. Julia Fontenelle,<sup>5</sup> Everard Home,<sup>6</sup> Sylvaticus.<sup>7</sup>

Chronic tubercular and interstitial nephritis is also very common, a few cases of hydronephrosis have been recorded, and one or two of tubercular disease, pyonephrosis, and abscess.

(f) *The condition of the kidney, ureters, and bloodvessels on the affected side.* In cases of congenital absence of one kidney the ureters and renal vessels on the affected side are absent, or only represented by a cord of fibrous tissue, and in all cases where a rudimentary ureter has been found, the opening into the bladder has been obliterated. Indeed single kidney due to want of development may be distinguished from that caused by disease and atrophy by the condition of the ureters and the bloodvessels.

When "single" kidney is the result of disease the condition of the diseased kidney varies very considerably, it may be represented only by a mass of fibrous tissue, a small congeries of cysts, or a nodule of fat. Sometimes the kidney is very small and occasionally lobulated; there may be remnants of

<sup>1</sup> *Mantissa Anatomica, Observatio*, xxxii., 1661, p. 21.

<sup>2</sup> à Meekren, *Observationes Medico-Chirurgicae*, Amstelodami, 1682, cap. xl., p. 169.

<sup>3</sup> *Lehrb. der Pathologischen Anatomie*, Bd. iii., 1861, s. 317.

<sup>4</sup> *Traité des Maladies des Reins*, Tome i., 1839, p. 404.

<sup>5</sup> *Archives Générales de Médecine*, Tome ii., 1824, p. 517.

<sup>6</sup> *Practical Observations on the Treatment of the Diseases of the Prostate Gland*, London, 1811, Vol. i., p. 68.

<sup>7</sup> Cited by Lieutand, *Historia Anat. Med.*, Tome i., p. 284.



renal tissue remaining, and the ureters may be either occluded, patent, or even dilated. The appearance of the wasted kidney depends upon the causes of atrophy, which are either sudden and complete obstruction to the passage of urine from the pelvis, or obliteration of the renal artery at an early period of life. Frequently we meet with greatly wasted kidneys as a consequence of disease late in life, as for example in tubercular lesions, or in chronic inflammatory affections attacking one kidney only. These, however, do not come within the scope of this paper.

The pelvis and ureter of the "single kidney" are seldom much altered, and are never double, as has been described by some authors. Cases of a kidney provided with double pelves, double ureters, extending to and entering the bladder at different points, must be looked upon as examples of "fused kidney" rather than of true "single kidney." In many congenital cases, however, the arteries and veins are anomalous in their distribution, and as might be expected are collectively larger in size than normal.

Dr. M. Wilson<sup>1</sup> describes a case of congenital absence of the right kidney where the left organ was enlarged, circular in form and lobulated on the surface, and situated close to the brim of the pelvis, in front of the common and external iliac arteries of that side, with which it was in contact. Its duct, which was enlarged at the hilus, so as at first sight to resemble a cyst, gradually narrowed, but continued to be of greater calibre than usual throughout its course, except at the point of entrance into the bladder, where it assumed the normal size. The left renal artery came off from the point of bifurcation of the aorta, passed obliquely downwards and outwards, resting on the front of the left common iliac artery, and entered the upper extremity of the kidney, having previously divided into two branches. Dr. W. F. Menzies<sup>2</sup> describes a case of "single kidney," in which he states that the arterial supply was as follows:

"Just above the bifurcation of the aorta a branch was given off from the anterior aspect, and ran to the inferior

<sup>1</sup> *Edinburgh Medical Journal*, Vol. xx., Part i., p. 13.

<sup>2</sup> *Journal of Anatomy and Physiology*, Vol. xxi., p. 111.



internal corner of the kidney, entering it about a quarter of an inch from the edge of the posterior surface. From the right common iliac a third renal artery took its origin, and entered the organ in close proximity, but inferior to the former. The middle and inferior sources of supply were long straight vessels of similar lumen to the superior."

Similar anomalies of the circulation in "single kidney" have been noticed by Hebb,<sup>1</sup> Strube,<sup>2</sup> Macdonald Brown,<sup>3</sup> Macdonald,<sup>4</sup> Duckworth,<sup>5</sup> Th. Tourtual.<sup>6</sup>

(g) *Malformation of other organs, such as the rectum, the bladder, the uterus, the vagina, and the ovaries*, frequently accompany congenital defects in the kidney. This is not to be wondered at when we remember the close embryonic relationship of these parts, but this is a subject which is rather beyond the scope of this paper.

(h) *The position of the adrenal body on the affected side* varies considerably. Sometimes where the kidney is small or altogether wanting, the adrenal body is natural in size and normal in position; on the other hand, however, commonly the adrenal body is misplaced, and undoubtedly in a few instances may not be present; or again, the "single kidney" may have two adrenal bodies, as in a case published by Liebmann,<sup>7</sup> where a "single kidney," lying in the pelvis, had two adrenals associated with it. Brumer<sup>8</sup> states that in forty-eight cases of "single kidney" which he had collected the adrenal bodies were only absent in five.

3. *Absence of both kidneys* is found in the lower grade of monstrosities only, and, according to Beclard, this anomaly is most frequently met with in acephalous monsters. Chaussier<sup>9</sup>

<sup>1</sup> *Transactions of the Pathological Society of London*, 1885, Vol. XXXVI., p. 281.

<sup>2</sup> *Über Congenitale Lage- und Bildungsanomalien der Nieren*. Virchow's *Archiv.*, Bd. 137, 1894.

<sup>3</sup> *Journal of Anatomy and Physiology*, Vol. XXVIII., p. 197.

<sup>4</sup> *Lancet*, 1885, Vol. I., p. 979.

<sup>5</sup> *Transactions of the Pathological Society of London*, Vol. XX., 1896.

<sup>6</sup> *Zweiter Anatomischer Bericht u. s. w.*, Munster, 1833, S. 69.

<sup>7</sup> *Centb. für Chir.*, 1887.

<sup>8</sup> Virchow's *Archiv.*, Vol. LXXII., p. 344.

<sup>9</sup> *Bull. de la Faculté de Méd. de Paris*, 1810, p. 35.



showed a foetus in which the urinary bladder, kidneys, and uterus were entirely absent, and Mayer<sup>1</sup> also published an example where the same organs were wanting. These cases may be of great interest from the embryological stand-point; and from the physiological side they are also of interest, as illustrating that the most important functions of life may be preserved in utero, without the presence of any renal tissue; but they are of no practical value to the surgeon.

## II. VARIATIONS IN FORM AND SIZE.

1. *General Variations in Form, — Lobulation.* Slight changes in shape from the typical normal kidney are by no means uncommon, and in more marked instances the organ may be elongated so as to become sausage-shaped, or it may be increased in thickness and globular in form, resembling the shape of the kidney in the foetus. In a few cases the kidney has been found to assume the discoid shape. These alterations, from what we may assume as the normal type, are often unassociated with any other anomaly; but when an abnormal condition exists, such as malposition of the kidney, atypical distribution of vessels, or malformations of other genito-urinary organs, then lobulation of the kidney is more frequent in occurrence, and more marked in degree. In the foetus and in young children slight lobulation is seen, but usually after the first year of life the lobules become fused, and are no longer apparent, unless in exceptional cases. In some of these the separation of the lobules may not be very distinct on the surface of the organ, but if a vertical section of it be made the original lobulated condition of the gland is seen. The persistence of this foetal condition is generally more marked at the anterior than at the posterior aspect of the kidney. A section of the kidney shows the medullary substance arranged in wedges, which form the pyramids, separated from one another by the columns of Bertini. These pyramids correspond to the embryonic lobules of the kidney, though several lobules may fuse together in one pyramid.

<sup>1</sup> *Journal des Progrès*, Tome iv., p. 281.



2. *Hypertrophy of one kidney.* Hypertrophy of one kidney is not often met with independently of some condition which has produced a functional weakness of its fellow.

Hypertrophy of both kidneys is, however, often seen in cases of diabetes insipidus, and perhaps also in diabetes mellitus.

Enlargement of one kidney only may however occur independently of any functional inactivity or structural defect of its neighbour. The kidney may go on increasing in size beyond the normal limit, just as we may have excess of growth in one limb, or undue growth of individual fingers, or toes, of the tongue, the larynx, or the lower jaw.

### CASE 13.

*Simple hypertrophy of the left kidney only, right kidney normal in size and appearance.*

At a post-mortem examination upon a man 36 years of age, who died from fracture of the skull, I found the right kidney to be normal in weight,  $6\frac{1}{2}$  ounces, while the left weighed  $10\frac{3}{4}$  ounces. The man was of average height, and weighed  $11\frac{1}{4}$  stones. Both kidneys, on microscopic examination, were found to be typically healthy, with the exception of the histological elements of the left kidney which were uniformly enlarged, as has been observed in cases of compensatory hypertrophy.

3. *Fusion of two kidneys.* (a) Horse-shoe kidney; (b) sigmoid kidney; (c) disc-shaped kidney. The amount of fusion that takes place between two kidneys varies greatly. We may have the two organs united together across the vertebrae, at their lower extremities, by a narrow, thin, and flat isthmus, which may be formed of connective tissue only, as illustrated in Fig. 12, or the union may be made up of kidney parenchyma; these are the lowest grades of coalescence, and from these we meet with all degrees of fusion until we reach a condition where the two kidneys become completely incorporated in one another, so as to form either one disc-shaped organ (Fig. 17), generally situated in the middle line,



or an elongated body on one side of the spine—the sigmoid kidney (Fig. 16); but in fused kidney, however unshapely the renal mass may be;—the renal form may be entirely lost on both sides; the hilum may be absent; the pelvis may be distorted; and the bloodvessels most irregular in their distribution;—there is still one feature in all its varying forms, namely, that they all possess evidence of two ureters, and not one only, as in true examples of single kidney.

We will first consider the lower degrees of fusion, and afterwards will give instances where more complete incorporation of the two organs has taken place.

(a) *Horse-shoe kidney* is the most common form of fusion. The two organs are joined together at their lower ends, sometimes by a simple band of tissue, as for example in Figs. 12 and 13. In other instances the union is more complete, while the renal form of the two lateral segments may not be retained, as in Fig. 14. Or again, as in Fig. 15, not only may the renal outline be considerably distorted, but there may also be marked lobulation, as well as anomalous distribution of the bloodvessels, or deformity of the pelves and ureters.

#### CASE 14.

*Horse-shoe kidney, united by an isthmus of fibrous tissue at the level of the bifurcation of the aorta. Renal form well retained.*<sup>1</sup>

Horse-shoe kidney from the body of a man who died of pneumonia; the isthmus which unites the lower ends of both kidneys to one another is about 1 inch broad, and is situated in front of the bifurcation of the aorta; that vessel is unusually small in size. The right ureter arises from the pelvis by two distinct channels, and passes downwards in a groove, which is more distinctly marked than the corresponding one on the left side. The left ureter occupies a similar position, but the pelvis from which it arises is almost normal in form.

The blood supply is by five arteries, which pass off directly from the aorta. Two arteries supply the right segment, while

<sup>1</sup> Glasgow Royal Infirmary Museum, Series VII., No. 3.



the left is supplied by three. Considering the anomalous distribution, the arterial supply is wonderfully symmetrical.

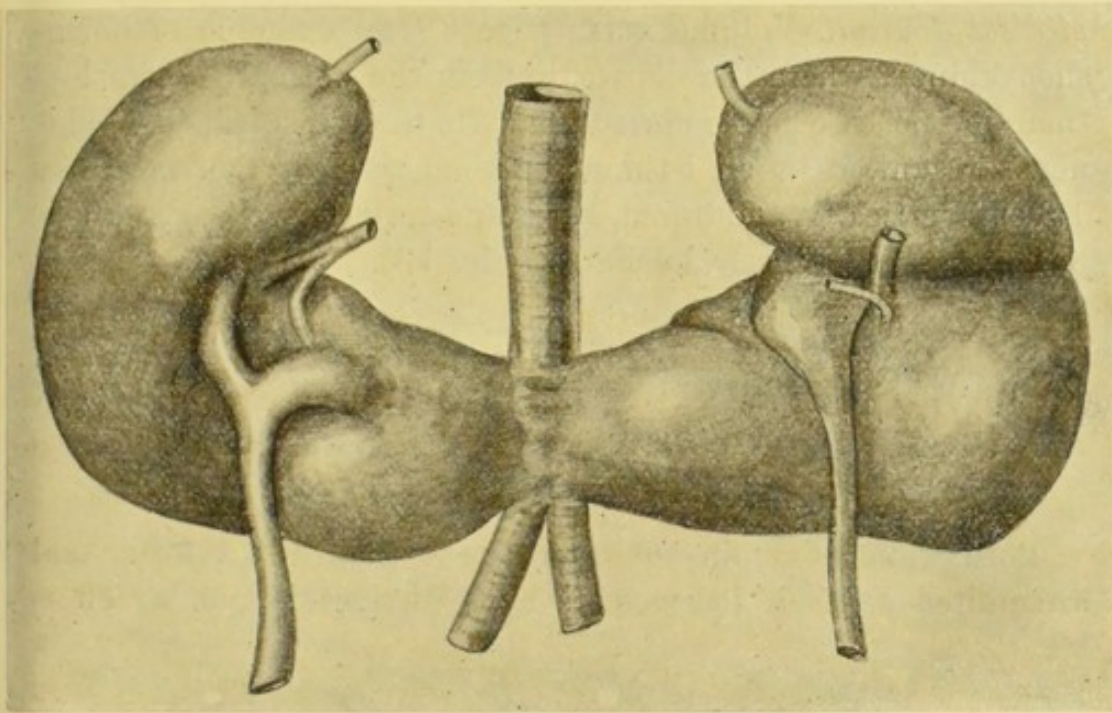


FIG. 12.

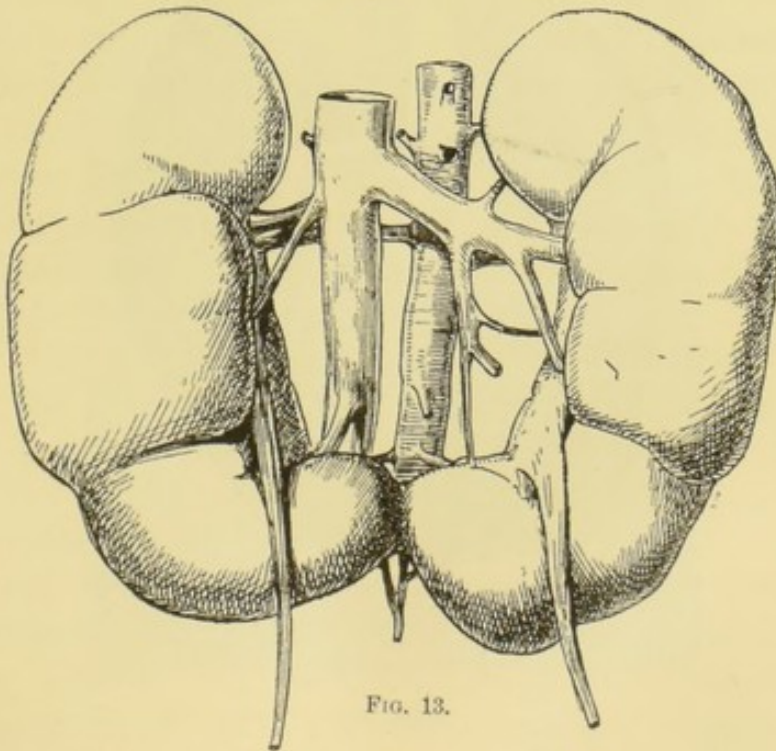


FIG. 13.

On both sides an artery passes directly to the upper and convex aspect of the kidney, while the other arteries pass into the

kidney at the hilum. In the specimen the veins have not been preserved (Fig. 12).

Drs. Sutherland and Edington published in the *Glasgow Medical Journal*, Volume XLIX., page 89, an example of horse-shoe kidney, where the departure from the normal is even less than in the case just referred to. In their case the two kidneys are united by an isthmus of renal tissue which measures 1.3 cm. vertically, and 3 mm. antero-posteriorly. Both kidneys, however, are distinctly lobulated (Fig. 13).

#### CASE 15.

*Horse-shoe kidney with lobulation and complete fusion of both kidneys  
malformation of pelves, and anomalous distribution of bloodvessels.*

Both kidneys retain to some extent their renal form, and are united at their lower ends by a distinct lobule, which is

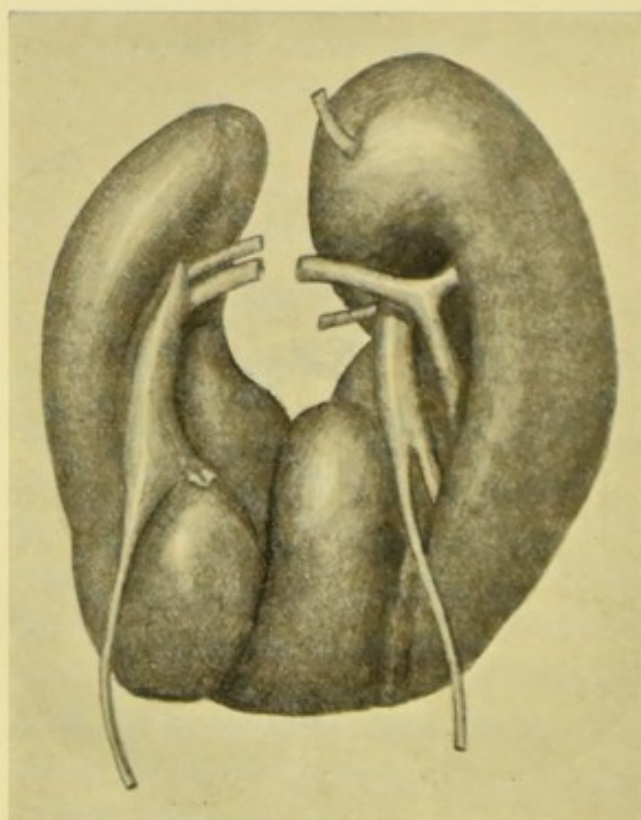


FIG. 14.

marked off by two deep grooves, on the right side the pelvis is not greatly malformed, but on the left it is abnormally small,



and is separated into two distinct branches, one passing to the upper, the other to the lower part of the organ. The right segment receives one artery, while the left is supplied by two, one entering at the hilum, the other close to the upper end of the kidney. Both renal veins pass out at the hilum (Fig. 14).

### CASE 16.

*Horse-shoe kidney with complete incorporation of the two organs. Lobulation of both segments, the ureters deformed, and anomalous distribution of the bloodvessels.<sup>1</sup>*

The two kidneys are completely united at their lower ends, and the whole renal mass although lobulated is, roughly speaking, uniform in diameter, and in this respect contrasts with the previous specimens.

When removed from the body the mass weighed  $15\frac{1}{2}$  ozs. The arteries, which are small in size, sprang direct from the aorta, and the veins passed to the vena cava direct. On the right side three arteries enter the kidney on its upper aspect, while the left segment is supplied by an artery which enters the deformed hilum on the right side. Three venous trunks unite to form one vein before the blood is emptied into the vena cava, while on the left side one vein only leaves the kidney from the hilum. On the right side the pelvis is divided into three distinct branches, which unite, at the lower limit of the horse-shoe, to form the right ureter. On the left side the pelvis is also segmented into three parts, forming roughly with the ureter the appearance of a St. Andrew's cross. The ureter passes downwards in a deep groove on the anterior aspect of the shoe-horse.

As a rule the horse-shoe kidney rests on both sides of the spinal column, but lower down than normal, the isthmus generally crossing the vertebral column about the level of the bifurcation of the aorta. The band of union is almost always at the lower extremity, so that the concavity of the horse-shoe presents upwards. Cases, however, have been

<sup>1</sup> Royal Infirmary Museum, Series VII., No. 4.

recorded where the union was found to be at the upper, in place of the lower, ends of the organ. It has been already shown that the bond of union between the two segments may be slight, or may be very intimate. In the former, the blood-vessels, pelves, and ureters seldom depart much from the normal in their number or distribution; but when the binding of the two organs is very complete, the auxiliary struc-

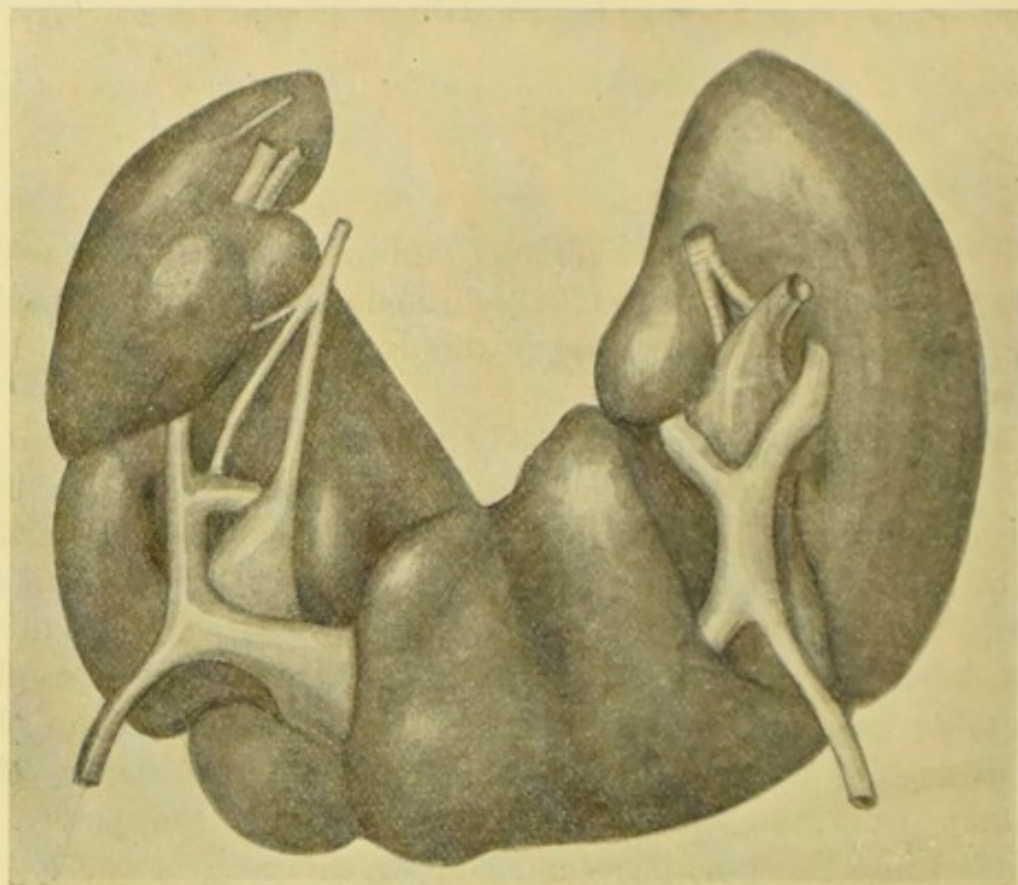


FIG. 15.

tures also are markedly anomalous. This circumstance may raise the question whether or not the anomalous distribution of vessels may be regarded as a cause of the malformation of the kidney. The pelvis may be divided into several separate cavities, which unite to form the ureter some distance from the hilum. Monquiot<sup>1</sup> publishes a case where a kidney was placed transversely across the lumbar vertebrae, and had four pelves, four ureters, and as many arteries and veins. Whatever the other deformities may be the ureters seldom

<sup>1</sup> *Journal des Savants*, 1878, Mai 16me.



pass behind the renal mass. Durham,<sup>1</sup> however, describes a case in which the ureters passed behind the organ. The united mass weighed  $13\frac{1}{2}$  ozs., and was formed by the union of the lower extremities. The structure of the kidney is described as normal.

Sutherland and Edington describe an interesting example of horse-shoe kidney, in a male child, where there was a pyonephrosis limited to the left segment. On this side the pelvis was greatly dilated, and there were cavities representing dilated calices, which largely replaced the renal tissue and still contained remains of pus. The left half of the isthmus showed a similiar lesion; the right side of the specimen and the corresponding portion of the isthmus were normal.

Morris<sup>2</sup> describes and illustrates a most unusual form of fused kidney, and one with which I am not familiar. The two kidneys lie together, as if the hilum of one kidney was placed against the outer convex aspect of the other. The following in his description of the specimen:

"The two kidneys formed an irregularly shaped mass which weighed 13 ozs., and was lying on the front of the promontory of the sacrum. It was not an ordinary horse-shoe, for the vessels and ureters were arranged most unusually. The central part of the mass was fissured by a sulcus, in which the ureter for the left kidney coursed downwards and the vein for the same upwards, passing into the vena cava just above the junction of the two iliacs. In the right half of the mass the ureters and vessels, instead of being situated centrally, were on its outer side; the ureter being in front of the vessels as in the left, and as is usual in fused kidneys. The arterial supply in each consisted of two or three arteries for each half of the mass about the size of radials derived from the common iliac arteries, and entered the lower part of each kidney. The suprarenal capsules were in their normal positions. The renal substance to the naked eye was healthy."

(b) *Sigmoid kidney.* Sigmoid kidney is an end to end fusion of the two organs. In this anomaly both kidneys occupy one side of the body only, but while the condition

<sup>1</sup> *Guy's Hospital Reports*, 1860, p. 407.

<sup>2</sup> *Surgical Diseases of the Kidney*, 1885, p. 96.



is unilateral it cannot be properly included under the term "single kidney."

The following specimen from the Museum of the Royal Hospital for Sick Children, given to me by Dr. Lewis R. Sutherland, illustrates very beautifully a typical sigmoid-kidney. I may quote his description of it in the *Glasgow Medical Journal* for February, 1898, p. 95:

"*Fusion of kidneys in a female child.* The fused mass, which measures 11.5 cm. in length, presents an elongated reniform outline, and is possibly formed by the superposition of one kidney on the other, as represented in the accompanying sketch (Fig. 16).

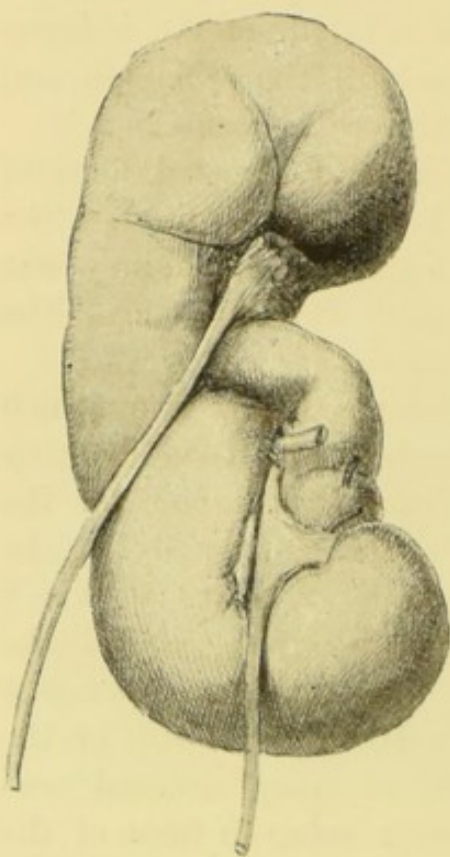


FIG. 16.

"The anterior surface of the mass is irregularly lobulated; the posterior surface is smooth. There are two distinct pelves, one above the other, each in its own hilum. The upper hilum presents antero-internally; the lower anteriorly.

"The ureters, which are of normal dimensions, pass downwards and outwards from the corresponding pelves, and lie in grooves on the anterior surface of the mass. The upper entered at the right, the lower at the left angle of the trigone. The bladder was normal. The vascular relations were not fully determined.

"The suprarenal bodies were normally disposed. An examination of the generative organs was not made. Microscopic examination of the fused mass shows normal renal tissue.

"The specimen was removed post mortem from a girl about 7 years of age. The mass occupied the right renal region, and was distinctly palpable in life (G.H.E.). There was no trace of renal tissue found on the left side.

"*Note.*—The appearances suggest an incomplete union of two kidneys—the smaller (lower part of the mass) representing



the left; the larger (upper part) the normally placed right kidney.

"From the relations of the lower ureter and pelvis inversion of the left kidney may possibly be inferred, as well as coalescence with the anterior surface of the inferior extremity of the right kidney. (Royal Hospital for Sick Children.)"

Almost precisely similar specimens are described by Dr. G. Broesike of Berlin,<sup>1</sup> and by Dr. A. Birmingham.<sup>2</sup>

Sigmoid kidney may be regarded as intermediate between horse-shoe kidney and disc-shaped kidney. The first mentioned fusion is very complete, while in the latter only the lower extremities of the organs are united. They differ also in the circumstance that the disc-shaped kidney and the horse-shoe kidney are most frequently placed in the middle line, while in sigmoid kidney one kidney is transferred to the opposite side where it is joined to the lower or inner part of the opposite organ. Probably sigmoid kidney is the rarest form of fusion.

(c) *Disc-shaped kidney.* Disc-shaped kidney is applied to those instances where incorporation of the two organs is very complete, as for example in the following cases—an illustration of which has been given to me by Drs. Sutherland and Edington:

"*Fusion of kidneys in a male infant. Hypospadias. Umbilical hernia sac.* The kidneys form a mass of approximately reniform outline, measuring 6.5 cm. vertically, 3 cm. laterally, and 2.5 cm. antero-posteriorly. The anterior surface shows distinct lobulation; the posterior surface is smooth (Fig. 17).

"The hilum faces anteriorly or antero-internally, a small amount of renal substance being situated towards the middle line behind. Emerging from the hilum are two distinct simple pelves, one above the other. This is corroborated on making a section of the mass. The lower ureter passes to the right side of the trigone, and is crossed anteriorly by the upper ureter on its course to the left side of the trigone.

"There are three sets of renal arteries: (1) an upper, entering the upper end of the hilum; (2) a lower, entering the lower

<sup>1</sup> Virchow's *Archiv.*, November, 1884.

<sup>2</sup> *Dublin Journal of Medical Science*, Vol. xc., p. 47.



end of the hilum; and (3) a third vessel supplying the intermediate parts. Branches 1 and 3 arise from the lateral aspect of the aorta, one above the other at the crossing of the renal vein. Branch 2 arises from the anterior aspect of the aorta to the right and below the origin of the inferior mesenteric artery. The renal vein is formed mainly by

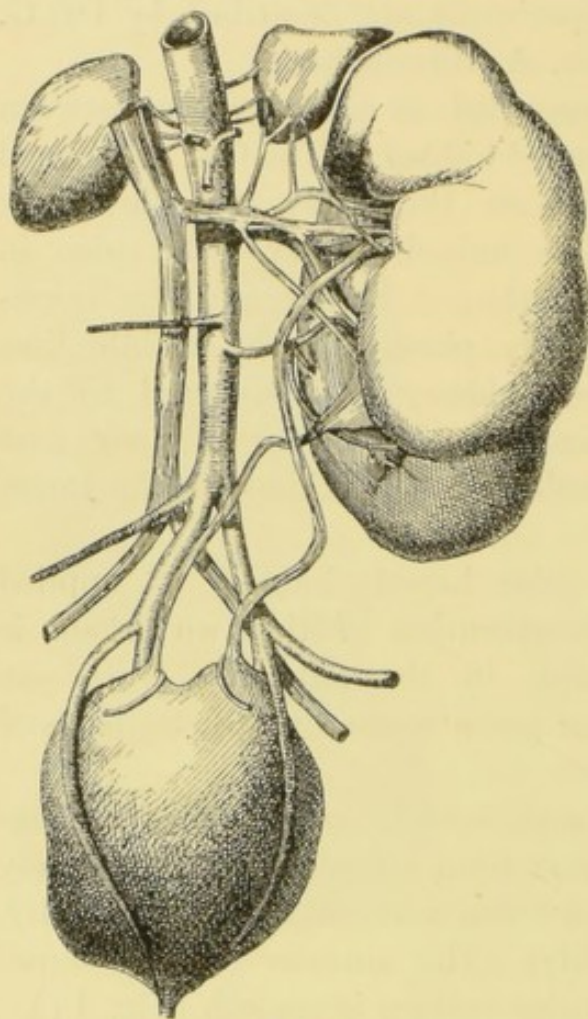


FIG. 17.

three tributaries emerging from the upper and middle portions of the hilum. It crosses the aorta in the normal situation of the left renal vein. There is entire absence of corresponding renal vessels on the right side.

"The specimen shows further the obliterated hypogastric arteries, and a portion of persisting urachus likewise obliterated. The bladder is normal (shown turned downwards and forwards in the figure).

"The specimen was removed post mortem from a male infant, aged 2 months who died of acute broncho-pneumonia.

"The 'fused kidney' occupied the left side. There was entire absence of kidney on the right side. The right suprarenal body, however, was present, as shown in preparation, but markedly flattened out on the under surface of the diaphragm. The left suprarenal body occupied its normal position. Both suprarenal bodies were supplied by vessels arising directly from the aorta, the left receiving in addition two twigs from the highest renal artery. The left suprarenal vein emptied into the left renal vein, the right suprarenal vein directly into the inferior vena cava. Microscopic examination shows a normal



structure. The vasa deferentia, vesiculae seminales, and testes were normal. There was fairly well-marked hypospadias. There was also a small umbilical hernia sac.

"*Note.*—The relations of the ureters to one another, and the origin of the lowest renal artery, are compatible with the possibility of the lower half of the mass, having occupied a position to the right of the median line. (Royal Hospital for Sick Children.)"

#### C. VARIATIONS IN THE PELVIS, URETERS, AND BLOODVESSELS.

Malformation of the pelvis and ureters is fairly common, but these are generally of little importance.

The pelvis and upper two inches of the ureter are very frequently abnormal in cases of misplaced or malformed kidney, but even where the kidney is normal in position and in form the ureters may be deformed. These abnormalities have been already fully illustrated in the foregoing cases, in some of which the pelvis has been seen to be double or in several divisions, each of which may have a separate connection with the ureter.

The ureter may be double only for a short distance in its upper part, but in rare instances it has been found so throughout its whole course. We have seen a double ureter extending to within two inches, and cases have been described where it has extended to within one inch of the bladder.

Mr. John Wood<sup>1</sup> describes such a case. He says: "That in a male subject four ureters were discovered emerging from the hilum of each kidney, they united after proceeding about four inches towards the bladder forming a pelvis from which sprang the ureter proper. On section of one kidney the hilum was found occupied by a quantity of fat and connective tissue, embedded in which the ureters could be traced to the infundibula communicating with the calices and pyramids; thus there was no pelvis within the hilum, but the calices united to form infundibula of which these ureters seemed to form a continua-

<sup>1</sup>*Transactions of the Pathological Society, London, Vol. VII., p. 261.*



tion, and they became united in a pelvis some distance from the kidney."

Cases also have been described by Thomson, Coen, Richmond, Longé, Féré, Josso.

It may be safely said that no abdominal arteries are more irregular in their distribution than are those which supply the kidneys. They may vary in number, in their source of origin, or in the mode in which they enter the kidney. Cases have been recorded where both renal arteries have originated from a common stem arising from the front of the aorta, or the renal blood supply may be augmented by branches from the internal, external, or common iliacs, from the suprarenal artery, from the hepatic artery, or from the middle sacral.

The mode of entrance of the arteries also varies. They may pierce the kidney at the hilum, or may enter at any part of its surface, but most commonly abnormal vessels are found at the upper extremity of the organ. Again, the renal arteries may give off branches to the diaphragm, to the ascending colon, to the liver, or to the pancreas.

These irregularities in source, number, and distribution are well known, and have been fully described by Professor McAlister.<sup>1</sup>

Professor Joseph Coats showed a specimen at the Glasgow Pathological and Clinical Society,<sup>2</sup> which has some bearing upon the subject we are now considering. The specimen was one of hydronephrosis, where constriction of the ureter was caused by the pressure of an abnormal renal artery.

Professor Coats says, "The kidney has been supplied by two principal arteries. This artery has four branches, three of which pass into the kidney along the anterior border of the pelvis, whilst the fourth has passed rather downwards and backwards. In its passage this artery has encountered the ureter, and has crossed the latter shortly before its insertion into the apex of the pelvis. There is a deep groove produced by the artery, beneath which the ureter passes. The two rounded bulgings which here conceal the parts are, respectively, the dilated first part of the ureter and the apex of the pelvis. The

<sup>1</sup>*Journal of Anatomy and Physiology*, Vol. xvii., p. 250.

<sup>2</sup>*Transactions*, Vol. iii., p. 277.



dilated piece of ureter could be brought out by pulling on the ureter, and it was then seen that, at the place where the artery crossed the ureter, the wall of the latter was greatly thinned, the muscular coat being apparently destroyed."

We placed in the museum of the Royal Infirmary a peculiar abnormality of the kidney associated with a malformation of one ureter. The left kidney is about two inches longer than normal, and is divided by a deep groove into two distinct parts, the upper the larger, and the lower the smaller part, are each provided with a distinct pelvis and ureter, but the ureters join about two inches from the lower border of the organ.

