small, pale, and granular. The amyloid change is first seen in the Malpighian tufts, and then involves the afferent and efferent vessels and the straight vessels. It may be confined entirely to them. In later stages of the disease the tubules are affected, chiefly the membrane, rarely, if ever, the cells themselves. In addition, the kidneys always show signs of diffuse nephritis. The Bowman's capsules are thickened, there may be glomerulitis, and the tubal epithelium is swollen, granular, and fatty.

Symptoms.—The renal features alone may not indicate the presence of this degeneration. Usually the associated condition gives a hint of the nature of the process. The urine, as a rule, shows important changes; the quantity is increased, and it is pale, clear, and of low specific gravity. The albumen is usually abundant, but it may be scanty, and in rare instances absent. Possibly the variations in the situation of the amyloid changes may account for this, since albumen is less likely to be present when the change is confined to the vasæ rectæ. In addition to ordinary albumen, globulin may be present. The tube-casts are variable, usually hyaline, often fatty or finely granular. Occasionally the amyloid reaction can be detected in the hyaline casts. Dropsy is present in many instances, particularly when there is much anæmia or profound cachexia. It is not, however, an invariable symptom, and there are cases in which it does not develop.

Increased arterial tension and cardiac hypertrophy are not usually present, except in those cases in which amyloid degeneration occurs in the secondary contracted kidney; under which circumstances there may be uræmia and retinal changes, which, as a rule, are not met with in other forms.

Diagnosis.—By the condition of the urine alone it is not possible to recognize amyloid changes in the kidney. Usually, however, there is no difficulty, since the Bright's disease comes on in association with syphilis, prolonged suppuration, disease of the bone, or tuberculosis, and there is evidence of enlargement of the liver and spleen. A suspicious circumstance is the existence of polyuria with a large amount of albumen in the urine, or when, in these constitutional affections, a large quantity of clear, pale urine is passed, even without the presence of albumen.

The prognosis depends rather on the condition with which the nephritis is associated. As a rule it is grave.

The treatment of the condition is that of chronic Bright's disease.

VIII. PYELITIS

(Consecutive Nephritis; Pyelonephritis; Pyonephrosis).

Definition.—Inflammation of the pelvis of the kidney and the conditions which result from it.

Etiology.—Pyelitis is induced by many causes, among which the following are the most important: (*a*) The irritation of calculi—a very

frequent cause. (*b*) Tubercle. (*c*) The infectious pyelitis which develops in typhoid fever, pneumonia, scarlet fever, diphtheria, small-pox, and other fevers. Here an acute inflammation of the pelvis of the kidney may occur, sometimes hæmorrhagic in character, more frequently diphtheritic. (*d*) The presence of decomposing urine, following pressure upon the ureter by tumors or bladder-disease. By far the most frequent form of pyelitis is that which is consecutive to cystitis, from whatever cause. In these cases the inflammation may not be confined to the pelvis, but pass to the kidney, inducing pyelonephritis. (*e*) Occasional causes are cancer, hydatids, the ova of certain parasites, and, according to some, the irritation of the saccharine urine of diabetes, and the irritation of turpentine or cubebs. (*f*) A primary pyelitis or pyelonephritis has been described as coming on after cold or overexertion, but such cases are extremely rare.

Morbid Anatomy.—In the early stages of pyelitis the mucous membrane is turbid, somewhat swollen, and may show ecchymoses. The urine in the pelvis is cloudy, and, on examination, numbers of epithelial cells are seen. In the form associated with the infectious fevers there is usually a grayish pseudo-membrane, either limited to an infundibulum or involving a great part of the pelvis.

In the calculous pyelitis there may be only slight turbidity of the membrane, which has been called by some catarrhal pyelitis. More commonly the mucosa is roughened, grayish in color, thick, and, on microscopical examination, the tissues are seen to be infiltrated with leucocytes. Under these circumstances there is almost always more or less dilatation of the calyces and flattening of the papillæ. Following this condition there may be (*a*) extension of the suppurative process to the kidney itself, forming a pyelonephritis; (*b*) a gradual dilatation of the calyces with atrophy of the kidney substance, and finally the production of the condition of pyonephrosis, in which the entire organ is represented by a sac of pus with or without a thin shell of renal tissue. (*c*) After the kidney structure has been destroyed by suppuration, and the obstruction at the orifice of the pelvis persists, the fluid portions may be absorbed, the pus becomes inspissated, so that the organ is represented by a series of sacculi containing grayish, putty-like masses, which may become impregnated with lime salts.

Tuberculous pyelitis, as already described, usually starts upon the apices of the pyramids, and may at first be limited in extent. Ultimately the condition produced may be similar to that of calculous pyelitis. Pyonephrosis is quite as frequent a sequence, while the final transformation of the pus into a putty-like material impregnated with salts, forming the so-called scrofulous kidney, is even commoner.

The pyelitis consecutive to cystitis is usually bilateral, and the kidney is apt to be involved, forming the so-called *surgical kidney*—acute suppurative nephritis. There are lines of suppuration extending along the pyramids, or small abscesses in the cortex, often just beneath the capsule;

or there may be wedge-shaped abscesses. The pus organisms either pass up the tubules or, as Steven has shown, pass by the lymphatics.

Symptoms.—The forms associated with the fevers rarely cause any symptoms, even when the process is extensive. In mild grades there is pain in the back or there may be tenderness on deep pressure on the affected side. The urine is turbid, contains a few mucous and pus cells, and occasionally blood-corpuscles. The urine is acid, and there may be a trace of albumen.

Before the condition of pyuria is established there may be attacks of pain on the affected side (not amounting to the severe agony of renal colic), rigors, high fever, and sweats. Under these circumstances the urine, which may have been clear, becomes turbid or smoky from the presence of blood, and may contain large numbers of mucus cells and transitional epithelium. These cases are not common, but I have twice had opportunity of studying such attacks for a prolonged period. In one patient the occurrence of the rigor and fever could sometimes be predicted from the change in the condition of the urine. Such cases occur, I believe, in association with calculi in the pelvis.

The statement is not infrequently made that the epithelium in the urine in pyelitis is distinctive and characteristic. This is erroneous, as may be readily demonstrated by comparing scrapings of the mucosa of the pelvis and of the bladder. In both the epithelium belongs to what is called the transitional variety, and in both regions the same conical, fusiform and irregular cells with long tails are found.

When the pyelitis, whether calculous or tuberculous, has become chronic and suppurative, the symptoms are:

(1) *Pyuria.*—The pus is in variable amount, and may be intermittent. Thus, as is often the case when only one kidney is involved, the ureter may be temporarily blocked, normal urine is passed for a time, and then there is a sudden outflow of the pent-up pus and the urine becomes purulent. Coincident with this retention, a tumor mass may be felt on the side affected. The pus has the ordinary characters, but the transitional epithelium is not so abundant at this stage and comes from the bladder or from the pelvis of the healthy side. Occasionally in rapidly advancing pyelonephritis portions of the kidney tissue, particularly of the apices of the pyramids, may slough away and appear in the urine; or, as in a remarkable specimen shown to me by Tyson, solid cheesy moulds of the calyces are passed. Casts from the kidney tubules are sometimes present. The reaction of the urine is at first acid, and may remain so even when the pus is passed in large quantities. If it remains any time in the bladder or if cystitis exists it becomes ammoniacal. Micturition may be very frequent and irritability of the bladder may be present.

(2) Intermittent fever associated with rigors is usually present in cases of suppurative pyelitis. The chills may recur at regular intervals, and the cases are often mistaken for malaria. Owen-Rees called attention to the frequent occurrence of these rigors, which form a characteristic feature of both calculous and tuberculous pyelitis. Ultimately the fever assumes a hectic type and the rigors may cease.

(3) The general condition of the patient usually indicates prolonged suppuration. There is more or less wasting with anæmia and a progressive failure of health. Secondary abscesses may develop and the clinical picture becomes that of pyæmia. In some instances, particularly of tuberculous pyelitis, the clinical course may resemble that of typhoid fever. There are instances of pyuria recurring, at intervals, for many years without impairment of the bodily vigor.

(4) Physical examination in chronic pyelitis usually reveals tenderness on the affected side or a definite swelling, which may vary much in size and ultimately attain large dimensions if the kidney becomes enormously distended, as in pyonephrosis.

(5) Occasionally nervous symptoms, which may be associated with dyspnœa, supervene, or the termination may be by coma, not unlike that of diabetes. These have been attributed to the absorption of the decomposing materials in the urine, and has been called ammoniæmia. A form of paraplegia has been described in connection with some cases of abscess of the kidney, but whether due to a myelitis or to a peripheral neuritis has not yet been determined.

In suppurative nephritis or surgical kidney following cystitis, the patient complains of pain in the back, the fever becomes high, irregular, and associated with chills, and in acute cases a typhoid state develops in which death occurs.

Diagnosis.—Between the tuberculous and the calculous forms of pyelitis it may be difficult or impossible to distinguish, except by the detection of tubercle bacilli in the pus. This has been done on several occasions, but many slides must be examined, for the bacilli are usually scanty. From perinephric abscess pyonephrosis is distinguished by the more definite character of the tumor, the absence of œdematous swelling in the lumbar region, and, most important of all, the history of the case. The urine, too, in perinephric abscess may be free from pus. There are cases, however, in which it is difficult indeed to make a satisfactory diagnosis. A patient whom I saw with Fussell had had cystitis through her pregnancy, subsequently pus in the urine for several months, and then a large fluctuating abscess developed in the right lumbar region. It did not seem possible, either before or during the operation, to determine whether the case was a simple pyonephrosis or whether there had been a perinephric abscess caused by the pyelitis.

Suppurative pyelitis and cystitis are frequently confounded. I have known three instances of the former in which perineal section was performed on the supposition of the existence of an intractable cystitis. The two conditions may, of course, coexist and prove puzzling, but the history, the acid character of the pus in many instances, the less frequent

occurrence of ammoniacal decomposition, the local signs in one lumbar region, and the absence of pain in the bladder should be sufficient to differentiate the affections. In women, by catheterization of the ureters, it may be definitely determined whether the pus comes from the kidneys or from the bladder.

Prognosis.—Cases coming on during the fevers usually recover. Tuberculous pyelitis may terminate favorably by inspissation of the pus and conversion into a putty-like substance with deposition of lime salts. When pyonephrosis develops the dangers are increased. Perforation may occur, the patient may be worn out by the hectic fever, or amyloid disease may develop.

Treatment.—In mild cases fluids should be taken freely, particularly the alkaline mineral waters, to which the citrate of potash may be added.

The treatment of the calculous form will be considered later. Practically there are no remedies which have much influence upon the pyuria. Astringents in no way control the discharge, nor have I seen the slightest benefit from buchu, copaiba, sandal-wood oil, or uva ursi. Tonics should be given, a nourishing diet, and milk and butter-milk may be taken freely. When the tumor has formed or even before it is perceptible, if the symptoms are serious and severe, the kidney should be explored, and, if necessary, nephrotomy should be performed.

IX. HYDRONEPHROSIS.

Definition.—Dilatation of the pelvis and calyces of the kidney with atrophy of its substance, caused by the accumulation of non-purulent fluids the result of obstruction.

Etiology.—The condition may be congenital, owing to some abnormality in the ureter or urethra. The tumor produced may be large enough to retard labor. Sometimes it is associated with other malformations. There is a condition of moderate dilatation, apparently congenital, which is not connected with any obstruction in the ducts. A case of the kind was shown at the Philadelphia Pathological Society by Daland.

In some instances there has been contraction or twisting of the ureter, or it has been inserted into the kidney at an acute angle or at a high level. In adult life the condition may be due to lodgement of a calculus, or to a cicatricial stricture following ulcer.

New growths, such as tubercle or cancer, occasionally induce hydronephrosis. More commonly, pressure upon the ureter from without, particularly tumors of the ovaries and uterus. Occasionally cicatricial bands compress the ureter. Obstruction within the bladder may result from cancer, from hypertrophy of the prostate with cystitis, and in the urethra from stricture. It is stated that slight grades of hydronephrosis have been found in patients with excessive polyuria.

In whatever way produced, when the ureter is blocked the secretion accumulates in the pelvis and infundibula. Sometimes acute inflammation follows, but more commonly the slow, gradual pressure causes atrophy of the papillæ with gradual distention and wasting of the organ. In acquired cases from pressure, even when dilatation is extreme, there may usually be seen a thin layer of renal structure. In the most extreme stages the kidney is represented by a large cyst, which may perhaps show on its inner surface imperfect septa. The fluid is thin and yellowish in color, and contains traces of urinary salts, urea, uric acid, and sometimes albumen. The secretion may be turbid from admixture with small quantities of pus.

Total occlusion does not always lead to a hydronephrosis, but may be followed by atrophy of the kidney. It appears that when the obstruction is intermittent or not complete the greatest dilatation is apt to follow. The sac may be enormous, and cause an abdominal tumor of the largest size. The condition has even been mistaken for ascites. Enlargement of the other kidney may compensate for the defect. Hypertrophy of the left side of the heart usually follows.

Symptoms.—When small, it may not be noticed. The congenital cases when bilateral usually prove fatal within a few days; when unilateral, the tumor may not be noticed for some time. It increases progressively and has all the characters of a tumor in the renal region. In adult life many of the cases, due to pressure by tumors, as in cancer of the uterus and enlargement of the prostate, etc., give rise to no symptoms.

There are remarkable instances of *intermittent* hydronephrosis in which the tumor suddenly disappears with the discharge of a large quantity of clear fluid. The sac gradually refills, and the process may be repeated for years. In these cases the obstruction is unilateral; a cicatricial stricture exists, or a valve is present in the ureter, or the ureter enters the upper part of the pelvis.

The examination of the abdomen shows, in unilateral hydronephrosis, a tumor occupying the renal region. When of moderate size it is readily recognized, but when large it may be confounded with ovarian or other tumors. In young children it may be mistaken for sarcoma of the kidney or of the retroperitoneal glands, the common causes of abdominal tumor in early life. Aspiration alone would enable us to differentiate between hydronephrosis and tumor. The large hydronephrotic sac is frequently mistaken for ovarian tumor. The latter is, as a rule, more mobile, and rarely fills the deeper portion of the lumbar region so thoroughly. The ascending colon can often be detected passing over the renal tumor, and examination per vaginam, particularly under ether, will give important indications as to the condition of the ovaries. In doubtful cases the sac should be aspirated. The fluid of the renal cyst is clear, or turbid from the presence of cell elements, rarely colloid in character; the specific gravity is low; albumen and traces of urea and uric acid are usually present; and the epithelial elements in it may be similar to those found in the pel-