restlessly about, seeking relief, but finding none.[1] In the intervals of the paroxysms there is a sense of soreness and discomfort, perhaps amounting to continued pain, or the relief may be more positive, if the concretion be small. Usually, after a number of paroxysms, lasting from a few hours to many days, suddenly all pain ceases at once. The calculus has dropped into the bladder, and the suffering is over. Instead of this happy termination, the stone, after having engaged in the upper end of the ureter, may drop back into the pelvis of the kidney. Relief of the severe pain follows, but the patient's condition is an unenviable one, for perhaps the stone is too large to pass. Again, the paroxysms of pain may extend over a long series of days or weeks, coming on, perhaps, at a certain hour every day, or at longer intervals. In one (personal) case, the paroxysms came every Sunday, in the afternoon, for several weeks. This periodicity may be so marked as to give rise to the idea of some malarial element in the case. It is needless to add that quinine does not control the paroxysms. In this way the symptoms may linger along indefinitely, tiring out both patient and surgeon.

A termination always to be feared is, impaction of the calculus in the ureter. In such cases, the patient will indicate some spot along the course of the ureter where he feels constant pain, increased by local pressure. The pain will be less severe than during the paroxysms, but it will be constant. A stone is most apt to halt near the outlet of the ureter into the bladder. If the ureter is blocked up almost entirely, the function of the kidney on that side will be interfered with. The ureter above the obstruction, and the pelvis of the kidney, will fill up with urine, subjecting the secreting structure of the kidney to pressure, and perhaps occasioning drowsiness, headache, with symptoms of mild uræmia. If the other kidney be diseased, or its ureter obstructed, these symptoms will be by so much the more certain to ensue. If the other kidney and ureter be sound, enough urine may trickle past the stone to prevent these symptoms from being marked. In such cases the ureter above the stone gradually dilates, as does also the pelvis of the kidney, pressing upon and causing the gradual atrophy of the kidney-substance, so that after death the ureter may be found as large as the small intestine, containing perhaps several stones, while the kidney is replaced by a fibrous sac, more or less distended with purulent fluid, inflamed or ulcerated; or perhaps by a mass of semi-solid pus (pyo-nephrosis), or hydro-nephrosis may come on. The effect upon the ureter at the point of impaction of the stone is to cause ulceration, with perhaps the growths of granulations which bleed easily, and may give rise to hæmaturia. Sometimes, after being lodged for a while, a stone will finally pass, but the ulceration of the ureter left behind by it may go on to the formation of stricture and the production of the same results as if the stone had remained.

[1] If the paroxysms be severe and long continued, more or less fever, with great thirst, hot skin, and quick pulse, results.

After a stone has finally entered the bladder, the symptoms cease. The constant desire to urinate is rarely aggravated by the presence of the small foreign body, although sometimes irritability is increased. Any thing which will pass the ureter will also pass the urethra, if the latter be not strictured. Such, indeed, is usually the case, and, after the cessation of the pains in an attack of kidney-colic, the urine should be carefully watched; for the little calculus, which caused so much distress in getting into the bladder, may reach the outer world without giving any evidence of its passage. It is always a satisfaction to find the stone, both to confirm the diagnosis, and to insure against the fear of subsequent stone in the bladder. Sometimes the stone is large enough to cause considerable pain in passing the urethra, or indeed it may become lodged there. Lastly and not uncommonly, the stone once in the bladder and the patient relieved, he recovers from his irritability, and forgets his pains, thinking himself well. In this dangerous state of unconcern he lives perhaps for years, the stone constantly growing by new accretions, but not occasioning much distress, until finally, from some new exciting cause (cold, exercise), or in the natural course of events, he suddenly breaks down with a sharp attack of acute cystitis, and upon search a stone of some size is found in the bladder.

Diagnosis.—Kidney-colic is not liable to be mistaken. In severe nephralgia from highly-acid urine or gravel, there may be similar paroxysms of pain, but the testicle is not so apt to be retracted, nor the paroxysm to be so severe. The passage of blood-clots or of hydatids through the ureter, as well as kidney-stone, occasions true colic. An inspection of what is passed by the urethra can alone clear up such cases, which are exceedingly rare. The patient's previous history or antecedents often furnish valuable presumptive evidence. An individual having once passed a stone, is always liable to have another one form, unless he regulates his life so as to avoid the causes of acid concentrated urine.

Treatment. — During the paroxysms, prolonged immersion of the whole body in very hot water, or the local use of dry cups and hot fomentations, may produce relaxation. If the pain become unbearable, ether by inhalation should be given, sufficient to moderate it. Kneading the course of the ureter is occasionally of service. A sudden change of position may sometimes dislodge a stone after it has become engaged in the orifice of a ureter; but, once engaged, it is better that it should pass. Opium or belladonna may be used by the rectum when the pains are protracted, and the attack promises to be a long one. It is of the first importance to promote a free secretion of urine, so as to act upon the stone from behind, by an abundance of liquid pressure. This is effected by warm drinks, half-drachm doses of acetate or citrate of potash every few hours, or half-ounce doses of infusion of digitalis, until free diuresis is produced. These means should be persisted in intelligently,

if the stone become impacted in the ureter. If the stone fail to reach the bladder, being retained in the kidney or impacted in the urethra, the solvent treatment for stone is applicable (*see* CALCULOUS PYELITIS). If the stone reach the bladder, but fail to escape through the urethra, diluents should be continued and the urine retained until the bladder is full, so that each act of urination may be accomplished in a full stream. If it still fail to pass, the lithotrite is the natural remedy. On no account should a nucleus for future vesical calculus be left behind.

After one attack of nephritic colic, the patient must be instructed in the proper course of life to follow in order to avoid the formation of another stone. The diet should be low and largely vegetable, and the use of all acoholic stimulants interdicted, especially the use of new fermented liquors. Plentiful out-door exercise should be taken, and the reaction of the urine be watched. Vichy water or some mild alkaline diuretic should be adopted as an habitual beverage to keep the urine abundant and diluted. The patient should also acquire a habit (Roberts) of taking a full draught of water between meals, and on retiring, so as to dilute the urine of fasting, which is normally concentrated and over-acid. The alkaline tide after taking food insures against the formation of stone during those periods.

PYELITIS, PYO-NEPHROSIS, AND PERI-NEPHRITIC ABSCESS.

PYELITIS is an inflammation of the pelvis and calices of the kidney. Like most other inflammations of the urinary passages, it is usually encountered in practice in the chronic form, undergoing perhaps from time to time acute exacerbations. The pathological appearances in the acute form are, a uniform redness of the mucous membrane, frequently dotted in a punctate manner with little ecchymotic spots, or perhaps with free blood on the surface of the membrane. There may be false membranes attached or blocking up a ureter, otherwise the fluid contained in the kidney is a mixture of urine, pus, blood, with more or less epithelium. In chronic pyelitis the membrane is thickened, tough, pale, bluish-gray, crossed by branching vessels. There may be spots of ulceration. Rayer[1] describes vesicles of the size of a pin's-head studding the mucous membrane in many chronic cases. Rarely the ulcers are covered by deposits of triple phosphates. Sometimes the surface of the membrane is distinctly granular. There are found, perhaps, within the pelvis of the kidney, cancerous or cheesy tubercular deposits, hydatids or other entozoa, kidney-stones incrusted or not with phosphates, etc.

Where there has been obstruction of the ureter, the condition known as *pyo-nephrosis* is liable to be encountered after death, namely atrophy, more or less complete, of the secreting or tubular portions of the kidney with dilatation of the pelvis and calices, the kidney being, perhaps,

[1] *Op. cit.*, vol. iii., p. 4.

replaced by a large pouched sac filled with semi-solid pus or pus and blood, with precipitated phosphates and urates. The septa between the pouches may be calcified or imperfectly ossified. Sometimes the pus is absolutely solid, and seems to be stratified, so that it can be removed in layers; often it is cheesy, with soft spots. Sometimes the pus collected in the kidney pelvis has ulcerated its way out, giving rise to peri-nephritic abscess. It may point externally, leaving behind a fistulous tract which usually remains permanent. Occasionally after pyelitis, the kidney atrophies instead of becoming pyo-nephrotic. Pyelitis is more often double than single. If it depend upon a cause acting on one side only (impacted stone), the other kidney may be healthy, although enlarged by conservative hypertrophy.

Pyelitis is usually entertained by some cause and the problem for treatment is not so much to remove the inflammation from the pelvis of the kidney, as it is to remove the cause which keeps it up.

Causes.—Pyelitis is not an idiopathic disease. Of all the numerous causes which may occasion it, two are in constant action in the community, and furnish the bulk of the cases. These are—

1. Chronic prolonged obstruction to the free escape of urine from the bladder, and chronic inflammation of the latter organ.

2. The retention of kidney-stone, or, more rarely, its impaction in a ureter.

The first of these causes is constantly at work in stricture and prostatic hypertrophy. Here the bladder becomes inflamed, the damming back of the urine is felt by the kidneys, and their mucous membranes are kept constantly more or less congested, until finally, from some provocation, such as cold or retention, or the use of instruments in the bladder, an acuter phase of inflammation is set up in the latter organ, which is very prone to travel rapidly up the ureters and locate itself permanently in a chronic form upon the pelves of the kidneys. Here it remains in a subacute state, suffering occasional exacerbations of acuteness, and liable to become complicated by inflammation of the secreting structure of the kidney, attended by uræmic symptoms and speedy death. Pyelitis under these circumstances is mild in character, does not occasion any severe symptoms, and goes, for the most part, unnoticed by patient and surgeon. Its presence may always be inferred in old cases of obstructive prostatic and urethral disease, and it must be remembered that in these diseases danger to life is more to be apprehended from this than from any other quarter.

By far the most frequent cause of such pyelitis as manifests itself during life by positive symptoms referable to the kidney, is stone retained in the kidney. By the same mechanism as in the bladder will stone in the kidney sooner or later give rise to inflammation of the mucous membrane upon which it rests. Stone impacted in a ureter inevitably leads to the same result by distention of the pelvis of the kid-

ney with retained urine, and by the secondary decomposition of the fluid, the mechanism being similar to that causing cystitis with atony, from prolonged retention of urine. Hence any thing which will cause prolonged distention of the pelvis of the kidney, retention of urine, blood, entozoa, false membrane, etc., blocking up a ureter, is able to occasion pyelitis. Pressure of the pregnant uterus in the female probably acts in the same way, in inducing that fatal form of pyelitis attending lying-in women, even where there is no pyæmia.

Besides the above causes, a host of others may be enumerated as more rare. Thus, the irritating action upon the kidneys of turpentine, of constantly over-concentrated, over-acid urine; the existence of chronic forms of Bright's disease; the deposit of cancerous or tubercular matter in the walls of the kidney pelvis; foreign bodies other than stone; worms, hydatids, clots, etc. Pyelitis also attends certain diseases as a complication at times, the eruptive fevers, typhus, cholera, etc., and is found not infrequently with pyæmia and carbuncle.

Symptoms.—Pyelitis is usually attended by pain in the back, of the same character as that described in the section on *nephralgia*. This pain is made worse by pressure, and is usually confined to the affected side, although there may be pain over both kidneys when only one is diseased. When the affection depends on kidney-stone, usually there have been some attacks of nephritic colic more or less marked. Occasionally, however, the disease comes on in an insidious manner, with little or no pain in the back, what symptoms there are being referred to the bladder. Sometimes paroxysms of pain, resembling nephritic colic, are experienced where there is and has been no stone. Early in the disease the urine will usually be found to contain blood-disks, a little excess of mucus, with many small, round, oval, spindle-shaped, and irregular epithelial cells, such as abound in the pelvis of the kidney. There is a trace of albumen depending on the blood, and the urine reacts acid. As the disease advances the epithelial scales are replaced by pus-cells, not in clusters, but evenly distributed through the urine, giving it a uniform, turbid appearance when voided. The amount of pus steadily increases in quantity, the urine usually remaining strongly acid; on standing, this pus settles down into a dense, greenish, oily-looking deposit. Violent exercise increases the nephralgia and the amount of pus in the urine. Often the pus diminishes greatly in quantity for some days, and suddenly reappears in excess. This phenomenon is especially noticeable when the kidney has become sacculated. The pus retained in a sacculus accumulates there, until finally it bursts its barriers and reappears in quantity for a day or two, when it will again cease to flow abundantly, until the sacculus has had time to refill. The pain in the flank is often greater when the pus is not flowing, and any swelling existing there is apt to become more prominent. These variations in the amount of pus are less marked when both kidneys are affected. In rare cases there

may be no discharge of pus whatever, as when the ureter is absolutely occluded.

Chills of varying duration and intensity are often present, especially if the kidney is sacculated and contains large amounts of pus. These rigors may assume the quotidian or tertian type, and recur with great regularity, especially in the evening.

One symptom of pyelitis is very liable to lead to error of diagnosis, especially if the pain in the back has not been prominent and no tumor exists in the flank. This symptom is frequent micturition. The irritating properties of the pus in the urine stimulate the bladder to repeated contractions, and many a case of pyelitis has been treated as chronic cystitis, powerful injections being thrown into the bladder in the vain hope of controlling the formation of pus, which is supposed to have its origin there. The bowels usually act irregularly, diarrhœa and constipation alternating with each other, due to inflammatory adhesions between the dilated kidney and the colon, or to the mere mechanical pressure of a distended pyo-nephrotic kidney upon the large intestine passing over it. When the kidney becomes dilated and sacculated by the pressure of accumulated pus, a tumor is formed, which is tender on pressure, sometimes affording a feel of deep fluctuation, more or less perceptible to sight and touch, according to its size, sometimes becoming appreciably smaller after a free discharge of pus in the urine. The position usually occupied by such a tumor is in the flank between the last ribs and crest of the ilium. On the right side the transverse colon may separate the tumor from the liver, but this diagnostic sign may be absent, from inflammatory adhesions having taken place between the coverings of the two glands. The tumor formed by a pyo-nephrotic kidney is occasionally large enough to extend across the middle line of the abdomen.

As the disease advances the patient becomes cachectic, pale, and debilitated. Hectic fever may set in and close the scene, the patient being worn out by constant suppuration, or poisoned by the urea, which cannot find an exit through his altered kidneys. Ulceration of the pelvis of the kidney may occur, especially if it contain stone, and, through an opening thus made, pus and urine may infiltrate the tissues, forming peri-nephritic abscess. This points in the back or under Poupart's ligament (simulating psoas abscess), or opens into the bladder or pleural cavity, into the lung, or, more commonly, into the intestine—rarely into the peritoneal cavity. A distended, sacculated, pyo-nephrotic kidney in the same way may contract inflammatory adhesions to all the surrounding tissues, and finally break and burrow in any of the above directions. The tumor subsides rapidly when the pent-up matter has found an outlet, but, unless the calculus or other offending body escapes, or is extracted through the opening, a permanent fistula is pretty sure to remain. When such an abscess breaks into the bladder, bowel, or lungs, the

subsidence of the tumor is attended by a copious discharge of pus at the anus, urethra, or mouth. After the abscess has discharged itself and remained fistulous for a time, in some favorable cases, it may gradually shrivel and dry up, owing to total atrophy of the kidney, and in such cases, if the other kidney be healthy, the patient recovers completely.

Peri-nephritic abscess does not necessarily depend for its origin upon antecedent kidney-disease. It may come on as the result of fatigue, and a straining exertion of the muscles about the kidney-region, from cold or other cause. Three exceedingly interesting examples of peri-nephritic abscess, not caused by or attended with any kidney-disease, are reported by Dr. H. J. Bowditch, in a paper read before the Boston Society for Medical Observations, May 4, 1868. In each of these there was a distinct tumor in the right loin, with the usual train of symptoms, chills, hectic, etc.; in each there was pulmonary and pleuritic complication, with discharge of pus by the mouth, the matter having made its way up along the sheath of the psoas muscle into the pleural cavity; and in each there was marked relief of all symptoms, and ultimate recovery after a timely opening into the tumor, which was made in two of the cases before fluctuation could be distinctly felt. In two of the cases the kidney was recognized by the exploring finger free in the cavity of the abscess, but neither microscopic nor chemical test applied to the urine revealed the presence of kidney-disease. These cases demonstrate the advantage of early opening for peri-nephritic abscess.

Instead of breaking externally, a pyo-nephrotic kidney, after its secreting substance has become atrophied, may consolidate into a hard, cheesy mass, and cease to give trouble. One perfectly good kidney is sufficient for life. Unfortunately, the disease is most often double.

Prognosis.—The prognosis of pyelitis depends upon its cause. The milder cases, occurring with stricture or prostatic disease, cease to be troublesome after successful treatment of the latter. The forms occurring with fevers, pleurisy, and zymotic diseases, often get well quickly, if the primary disease spares the patient. In pyæmia and carbuncle, the complication aggravates the prognosis. Depending upon local cancer or tubercle, the affection does not get well. With hydatids or calculus it is severe, but not necessarily fatal. Double pyelitis is generally fatal. Where there is pyo-nephrosis the chances of recovery are not great, but with one sound kidney there is always hope. Autopsies have revealed wasted, withered sacs, perhaps clasping a stone, or a mass of hard, concrete pus, whose existence had never been suspected during life. Discharge of the pus by other than the natural channel is often speedily fatal, except in favorable cases where the opening occurs through the loins.

Treatment.—When pyelitis depends upon bladder, prostatic, or urethral disease, its treatment is identical with that of its cause. The same is true of cancer, tubercle, etc. In fever, zymotic, or scorbutic disease,

the main malady must be treated, care being exercised to prevent the urine from becoming too acid, and concentrated. Where it is attended with considerable hæmorrhage, tannin, gallic acid, acetate of lead, opium, ergot, or other styptics, may be advantageously tried.

During an acute attack of pyelitis, with great pain, high fever, frequent urination of bloody purulent matter, wet cups over the kidney, hot baths, hot local fomentations, warm diluent drinks, and opium to allay pain and spasms, are the main features of treatment. In chronic cases, however, such as are not infrequently met with in practice, where there is reason to suspect kidney-stone, and where constant suppuration is wearing out the patient, the surgeon's duty lies in putting him into the best possible hygienic conditions, giving him the advantage of rest, country air, and a sustaining diet, with such tonics as iron, quinine, and cod-liver oil. Roberts speaks highly of large doses of muriated tincture of iron. Alkaline diluents will sometimes diminish the amount of pus, by making the urine less concentrated. Wine is often serviceable, and in some cases the mineral acids improve the digestion, increase the strength, and better the condition of the urine. The vegetable astringents, alum, and the terebinthinates, are occasionally useful as stimulants to the mucous membrane in chronic cases.

If there is reason to suspect kidney-stone, *the solvent treatment* should be persistently employed—unless, of course, there is pyo-nephrosis with a palpable tumor, and reason to believe that the secreting portion of the kidney is atrophied to such an extent that but little urine escapes through it. An excellent essay on the solvent treatment of calculus is given by Roberts.[1] A kidney-stone may be presumed to be composed of uric acid, or oxalate of lime. For the former the solvent treatment may be hopefully employed, and it will do no harm in the latter instance. Where, however, from the previous passage of oxalate of lime calculi, or the presence in the urine of a considerable number of crystals of the same, there is reason to believe that the concretion is formed of this substance, or where, from kidney-ulceration, the stone is covered with a layer of the secondary (mixed) phosphates, little can be expected from the solvent treatment.

The best method of carrying out this treatment consists in the steady administration of citrate or acetate of potash. The citrate is preferable in doses, for an adult, of not less than forty to sixty grains, well diluted in water. This quantity should be given every three or four hours. On account of the impurity of the citrate of potash, as ordinarily found in the shops, Roberts's plan is to prepare it directly by the combination of citric acid with bicarbonate of potash, as in the following formula:

℞.	Potass. bicarb.,	ʒ xij.
	Acid. citric.,	ʒ viij. gr. xxiv.
	Aquæ ad.,	℥ xij.
	M.	

[1] "Urinary and Renal Diseases," second American edition, 1872, p. 298.

This prescription yields ʒ j of citrate of potash to the fluid-ounce. The dose for an adult is from six to eight fluid-drachms, diluted with three or four ounces of water. This treatment should be persisted in steadily for months, or until the symptoms yield. If the stomach tire at the constant administration of alkali, the treatment may be intermitted, to be subsequently resumed. Vegetable bitters and tonics may be administered at the same time.

When there is pyo-nephrosis, with sacculation of the kidney and a tumor which can be felt in the flank, two courses of treatment are open:

1. The general treatment by tonics, astringents, and hygiene, keeping up the patient's strength in every way, and encouraging him to wait for final atrophy of the kidney and desiccation of the pus, using all the means suggested above for chronic pyelitis, with continued suppuration.

2. The operation of opening, or even removing the kidney.

It may often be questionable which method should be adopted. The first has been successful, and may, perhaps, often be so, when only one kidney is involved, when the tumor formed by the distended kidney is not inordinately large, and the general health does not suffer very greatly from the continued suppuration; or, again, when pyo-nephrosis exists, and the kidney is already almost wholly atrophied. On the other hand, this first course must necessarily be pursued when there is reason to believe that both kidneys are implicated, or when the patient's general health is so lowered by the continued suppuration that an extensive operation would probably prove fatal. In certain cases, however, an operation is advisable; where, for instance, there is reason to believe that calculus is the origin of the pyo-nephrosis, and that only one kidney is diseased, and where the general health is good. More particularly is an operation called for when the tumor is very large, and has approached reasonably near the surface, or when there is peri-nephritic suppuration, for, in such cases, by a timely opening, perforation of the pleura, peritonæum, or intestine, may be averted.

If operative interference be decided upon, it is proper to begin with an exploration. This is best made with the aspirator. The exploring trocar is thrust into the most prominent part of the swelling posteriorly, where there seems a natural tendency to point. There is no fear of wounding the peritonæum if the back or flank be perforated, as the kidney is an extra-peritoneal organ. After the matter has been evacuated, search may be made in the cavity with the canula for any calculus which might occupy it. If none be found it is not possible to state that the disease is not of calculous origin; nor, if calculous matter be found, can the converse of this proposition be affirmed with absolute certainty. In Dr. Peters's case (p. 379) the abscess was punctured with the aspirator, pus evacuated, and finally, on withdrawing the instrument, a fragment of stone was found impacted in its extremity; yet, after the kidney had been extracted, the case proved to be one not of calculous pyelitis, but

of inflammatory (cheesy) pyelo-nephritis. The patient had pseudo-tubercular epididymitis, with fistula, and pseudo-tubercle of both vasa deferentia and vesiculæ seminales. As a rule, however, if stony matter can be felt, calculous pyelitis may be safely diagnosticated, and an operation rationally undertaken for its relief. If no stone be discovered, but a quantity of pus be evacuated, the operation may be repeated at intervals, to the great relief of the patient. Should stone be found, or even strongly suspected, if the patient's general condition will warrant an operation, nephrotomy should be performed. This consists in cutting down upon the most prominent portion of the tumor posteriorly, or making the same incision as for ablation, opening the sac of the abscess, or sacculated pelvis, turning out the pus it contains and extracting the stone, if there be one. The wound is to be dressed open, to allow all pus and urine to drain freely away. There is rarely any occasion, in simple pyelitis, for ablation of the kidney. With pyo-nephrosis this may sometimes be necessary, but even here, as a rule, it is as well to make a free posterior opening to allow pus and urine to escape, and give the bladder rest.

Extra-renal abscesses should always be opened early, even if no attempt be made to perforate the pelvis of the kidney. The opening, in these cases, should be kept fistulous, and after a time a stone may appear, and be extracted through the fistula. A great number of cases where renal and extra-renal abscesses have been opened, and (often) stone extracted therefrom, to the great relief of the patient, are quoted by Rayer,[1] among which are remarkable, as examples probably of pure nephrotomy for calculus where there was no renal tumor, two cases, both terminating successfully. The first is Paré's case of the archer of Meudon, condemned to death, who had suffered from kidney-stone, where vivisection was made, the peritonæum and probably the kidney opened —nothing is said, however, of the extraction of stone. The patient recovered. The other is the celebrated case of Hobson, who, having kidney-colic severely and frequently, but no tumor, induced Marchetti, a surgeon of Padua, to cut him. The operation was performed, the pelvis of the kidney opened, and two or three little stones extracted. Prompt recovery followed, and after a time the patient's wife extracted a stone from the fistula as large as a date-stone. After this the patient never had any more kidney-pains. Ten years subsequently the fistula was still open, and a probe was passed by Dr. Bernard into the pelvis of the kidney. The patient was in full health, and proposed, on the following day, to take a horseback-ride of forty or fifty miles.

Nearly all authorities are of accord as to the propriety of a speedy opening of extra-renal abscesses; but where the abscess is renal, and it becomes a question of true nephrotomy, i. e., cutting into the substance or opening the pelvis of the kidney, there is great diversity of opinion.

[1] *Op. cit.*, vol. iii., p. 206, *et seq*