

is a new application of this old principle which was known hundreds of years ago.

The beneficial results obtained by other men and myself in this comparatively large number of cases, showing that 87 per cent. of patients wearing the belt are helped by its use, demonstrate positively and conclusively that the belt method of treating whooping cough is of therapeutic value.

#### DISCUSSION.

DR. C. DOUGLAS, Detroit, said that when Dr. Kilmer's article appeared, he tried the treatment experimentally and found mothers much impressed with the beneficial results. Although some mothers would take the belt off, Dr. Douglas was much pleased to find that they all came back to it; not only that, but some of the children asked the mother to have the belt put back, saying the cough did not hurt so much with the belt on.

DR. G. H. CATTERMOLLE, Boulder, Colo., has not tried this belt, but for some time he has directed the mother to use pressure over the child's back and counter pressure over the abdomen. It does lessen the amount of vomiting. Dr. Cattermole thought the belt would be an improvement over his method.

DR. R. B. GILBERT, Louisville, Ky., has not tried the belt, simply because he was afraid of inducing hernia. The wearing of the ordinary belt that the nurse puts on the newborn infant often causes hernia if it is bound too tightly. This is apt to occur especially in the male infant. Therefore Dr. Gilbert still feels apprehensive about using the belt.

DR. C. G. KERLEY, New York City, endorsed the value of the belt as a therapeutic measure, although it is not a curative one. That is, it does not cure whooping cough, but its use makes it easier for the child to bear the disease and he goes through the attack much more satisfactorily as regards his general condition, because it often enables him to keep down his food. He commenced using the belt very much of a doubter, but has tried to give it a fair trial, and by noting the good results in preventing vomiting he came to believe in it. It showed conclusively that in a majority of cases the vomiting was relieved to a considerable degree. He thinks that it ought to be used more generally. He has used it for the last year in all cases of whooping cough, with satisfactory results. It is, he said, particularly beneficial in the case of little babies that can not take drugs. When these children vomit they lose their milk, and this is a serious matter to them. He has never seen a case of hernia follow its use.

DR. T. W. KILMER, New York City, stated that large children appreciate the belt; he has seen children cry for it. Hernia sometimes occurs during whooping cough, but, he said, it occurs more often in children who do not wear the supporting belt than in children who do. The belt is especially useful in young infants, and the pressure does give relief.

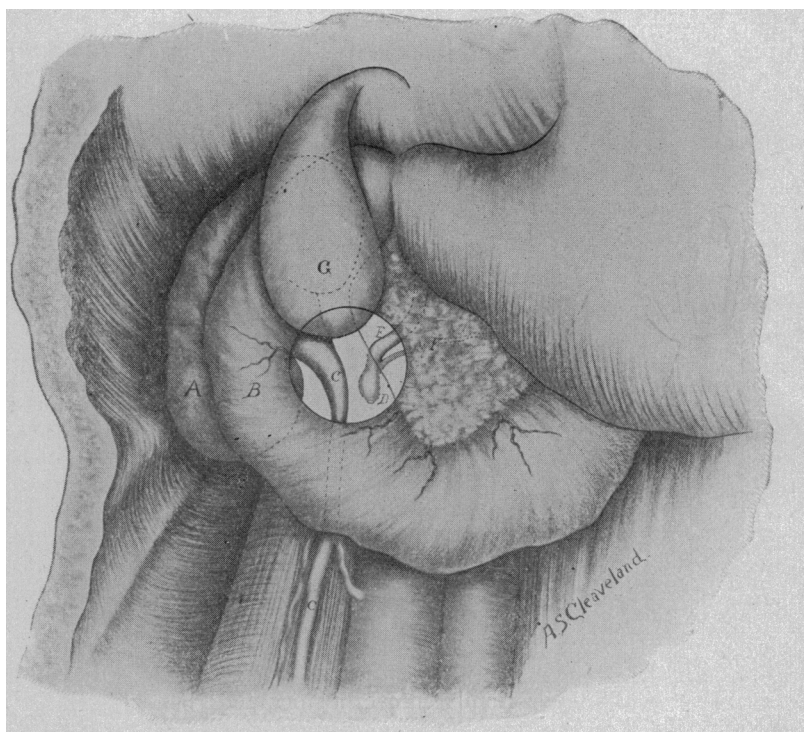
tempts at getting rid of this obstacle are attended by varying degrees of pain and followed by more or less serious results.

The comparisons can be carried to the formation of these bodies, the symptoms produced by them and the pathologic conditions resulting therefrom. This fact makes a diagnosis sometimes exceedingly difficult when the right kidney is at fault, since the relational anatomy is so intimate and the nerve supply of the viscera involved is so complex and extensive.

#### CONDITIONS FAVORING CALCULUS FORMATION.

There seems to be an imperative law of our physical being which demands that all currents of secretion or excretion be unobstructed, and so long as these currents are not interfered with the functions are performed without discomfort and without any pathologic processes resulting, but the moment any obstruction occurs trouble immediately arises.

The source of the disturbance may be due to a normal



Relation of ampulla of Vater to the upper portion of ureter. A, kidney; B, duodenum; CC, ureter; D, ampulla of Vater; E, common duct; F, pancreatic duct; G, gall bladder.

constriction as in the case of the ureter, the caliber of which is nearly uniform throughout its entire length. It is slightly constricted, however, at about one and one-fourth inches below the renal pelvis; this would be slightly below the site where the descending duodenum crosses the anterior portion of the kidney. On the other hand, a perfectly normal right kidney possessed of the normal amount of mobility (three-fourths to one and one-half inches) could, if the direction of the motion be forward, produce a constriction if not an obstruction of the cystic, and perhaps the common duct, as will be seen later in considering relational anatomy.

Where the lumen of these canals are lessened there is first a hyperemia, then an extravasation of blood or serum that combines with the mineral matter of the secreted fluid and a nidus is formed that eventually becomes a calculus. In the case of the ureter, where the

#### A COMPARATIVE STUDY OF RENAL AND BILIARY DISEASE IN WHICH CALCULI FIGURE PROMINENTLY.

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There is a striking similarity between renal disease in which calculi figure prominently and in diseases of the liver or biliary tract in which gallstones are formed. The analogy goes beyond the fact that a hard and sometimes irregular mass has been formed by reason of perverted function in a soft canal or pouch, and that at-

constriction is normal, this congestion is produced in the opposite way, viz., by dilatation of the normal constriction. This may occur during the passage of an unusual amount of urine heavily laden with crystalline or amorphous material, or perhaps from a small calculus which has descended from the renal pelvis and become the source of the nidus. In either case extravasated albuminous substances from the blood, resulting from the hyperemia induced by the tissue being put on a stretch, combines with the mineral salts to form the calculus.

Renal calculi are produced by some damming back of the flow of urine into the pelvis of the kidney and by tension of the pouch, producing hyperemia and extravasation of the albuminous portion of the blood, the latter combining with the mineral salts as above described.

There is always an albuminous substance in these formations. This can readily be demonstrated by dissolving the stones by chemical action; after the inorganic substances have been wholly dissolved there remains an organic pulpy mass. The unorganized salts of kidney and ureteral stone are oxalic, phosphatic and uric. This albuminous material is the result of the hyperemia and is the element in the formation of calculi that promotes the cohesion.

Thus we find that a disturbance of the vasomotor supply of a part must precede the extravasation of the organic materials and that the presence of the organic substances seems to attract and cohere with the inorganic elements of the current.

This hyperemia is caused by the same agents that produce congestion elsewhere and may briefly be classified as thermic, traumatic or specific.

1. Variations of temperature, either heat or cold, local or general, have a potent influence on the vasomotor mechanism and produce the disturbances of a part possessing the lowest resistance.

2. Traumatism of any degree necessitates repair and requires the well-known phenomena of increased circulation to the damaged area.

3. Specific organisms provoke disturbance of the circulation by one or more of the properties ascribed to the blood in its attitude toward bacteria, viz., agglutinating, bactericidal, bacteriolytic or phagocytic.

In calculi of the biliary tract the same general laws of formation pertain, but there exists a difference of chemical composition. Calculi of the biliary tract consist chiefly of bilirubin, usually combined with calcium, and cholesterin; the presence of a nidus in the biliary tract is determined by its size; if small, it no doubt passes out of the gall bladder after the subsidence of the acute inflammation and may be expelled into the duodenum; if its size prohibits this, it will remain a constant menace to the membrane tolerating it and constantly calling forth an extravasation of blood which again unites with the elements of the stagnated bile and forms layer on layer about the original nidus; thus is explained the growth of these bodies and the peculiar stratified appearance they present when sectioned.

In the cases presenting the numerous small calculi the same process as outlined probably obtains, and instead of forming layers on the original nidus the cohesion takes place anew each time, forming a small hard calculus.

No doubt the salt or combination of salts determine the multiplicity of stones also, as, for example, the large number of small stones usually show a composition of

bilirubin with calcium; their color ranges from a deep yellow to a decided brownish black, they are irregular in size and the outer surface is hard with a soft center.

The stones in which cholesterin is the whole or principal constituent are large, very hard, showing layer on layer when mixed with some calcium salts, and are either white or light in color. This substance is no doubt derived from the diseased mucosa of the gall bladder, as first suggested by Budd in 1845, supported by Bristowe in 1889, and indorsed and elaborated by Naunyn in 1892. Cholesterin calculi are very slowly soluble in normal bile; the other substances not at all.

The pathologic cause is identical in each system, the difference is only in composition.

#### RELATIONAL ANATOMY.

In the male the normal position of the kidney extends from the twelfth dorsal vertebra to the upper border of the fourth lumbar vertebra; in the female the position is about one-half inch lower. The right kidney is wholly covered by the liver laterally, the posterior parietal peritoneum only being interposed. Anterior to its middle position, on a plane with the pelvis of the right kidney, crosses the descending portion of the duodenum; one and one-fourth inches from the site where the duodenum crosses the pelvis is the ampulla of Vater, the common opening of the intestinal outlet of the duct of Wirsung and the common duct. Its lower margin is in contact for a variable extent with the right flexure of the colon.

Remembering now the normal constrictions in the ureter, viz., (a) one and one-half inches from the renal pelvis as the ureter flexes forward over the anterior portion of the psoas muscles, (b) at the level of the pelvic brim where flexion is downward crossing the bifurcation of the common iliac artery, and (c) as the ureter approaches the vesicle orifice, it becomes apparent that when the calculus is caught at the upper constriction or where the ureter flexes forward to cross the psoas muscle it is on or near a level with the opening of the ampulla of Vater.

The flexure of the ureter over the psoas muscle, the opening of the duct of Wirsung and the common bile duct into the ampulla of Vater, and the fundus of the gall bladder, are within an area of one and one-fourth inches diameter, or about the size of a silver dollar (see illustration). The duct of Wirsung comes from the left and is joined from above by the common duct at the level of the upper portion of the third vertebra, one and one-fourth to two inches to the right of the vertebral column.

The pelvis of the kidney is opposite the lower portion of the first lumbar about one-half inch to the right; directly in front of this point lies the surface of the liver as it dips forward, and on its under surface extending from behind forward on the same plane is the gall bladder lying in an obliquely transverse position, the fundus being the lowest point and in close proximity to the external abdominal wall as it emerges from the hepatic notch.

A right kidney normally movable would, if the displacement be sufficient and the direction of motion be forward, encroach on the pyloric end of the stomach and duodenum in its descending portion and compress the biliary duct which descends behind the pylorus and duodenum. Into the descending portion of the duodenum, which is about four inches long, the pancreatic and biliary secretions are emptied, usually through a common opening, viz., the ampulla of Vater.

## URETERS AND BILIARY DUCTS COMPARED.

The gall bladder is a storage cyst for the product of the liver not immediately required. During the day or working hours of an individual when food is taken at regular intervals there is no accumulation of bile in the gall bladder, the product of the liver being demanded for immediate use in digestion, but at night the functioning liver stores its secretion in the gall bladder for emergency demands. One has only to observe carefully the amount of bile discharged through a tube during the convalescence of a patient where the gall bladder has been drained to prove this. During the first twenty-four or thirty-six hours after operation, and during the period when food is denied, the discharge of bile is greater during the daytime, but as food is permitted the discharge of bile is lessened during the day and increased at night.

During the day when the bile is discharged directly into the intestine there is an interesting periodicity noticed; the bile flows down the ducts, but is not immediately permitted to enter the intestine drop by drop as excreted, but is held in check at the ampulla of Vater by a valve-like action of the "papilla major;" here the bile current is joined by the pancreatic discharge, until a sufficient amount accumulates to exert the pressure required to permit its escape. This amount varies at different times and in different individuals from 1 c.c. to 4 c.c. (15 m. to 1 dram).

The discharge from the gall bladder is regulated by two elements of dynamics, first, the pressure of the cystic muscularis, and, second, the valve-like arrangement of the cystic duct, one compensating the other and permitting the bile to escape in proper amounts, the contractions of the gall bladder occurring synchronously with the contractions of the stomach during digestion.

A similar periodicity of discharge may be noted in regard to the ureters. Through a cystoscope the discharge of urine may be seen to occur at frequent intervals and of a relatively considerable amount at a time, instead of a continuous dribble, the ureter orifices closing tightly after the discharge and again opening suddenly, emitting a fine stream, sometimes with force sufficient to cause a perceptible swirl of the fluid contained in the bladder.

## FACTORS DETERMINING THE LOCATION OF CALCULI.

Urinary calculi may form in the pelvis of the kidney and assume such proportions that it is impossible for them to escape and, curiously enough, may cause no symptoms that would create any suspicion of their presence. A small stone just large enough to be denied entrance into the ureter will cause more definite and distressing symptoms than one much larger. The larger stone will not be shifted in its position so frequently and would not encroach on the pelvic ureteral opening.

After a urinary calculus has passed into the ureter there are three distinct points where its transit may be interrupted. These points have already been mentioned at length above:

1. At the psoas flexure, one and one-fourth to one and one-half inches below the kidney pelvis.
2. At the iliac flexure, on the level of pelvic brim.
3. At the vesical flexure near the union with bladder.

Of these regions the upper flexure is most frequently the site of a stone; 40.7 per cent. of the stones found in the ureter are found at this site. At the second flexure stones are found in 25 per cent. The lower flexure gives a percentage of 30.5 per cent., coming next in fre-

quency to the first flexure. Other portions of the ureter give 3.8 per cent. of the stones.

The following percentages in the location of calculi in the biliary tract are compiled from reports of the work done by men who see the largest number of cases and are only approximate. In more than one-half (54-58) per cent. of all cases of biliary calculi the stones are found in the gall bladder; stones in this locality are often complicated by stone in the cystic duct; this complication is noted in 12 per cent. of the cases, while stone in the common duct is associated with gall bladder stones in 10 per cent. Stone is found in the cystic duct alone in 6 per cent., while in the common duct alone it occurs a trifle more frequently, viz., 6.5 per cent.

Very rarely stones are found in the gall bladder, hepatic, cystic and common ducts at the same time. Stones in the hepatic duct are seldom found alone or in association with stones in the gall bladder; however, they occasionally accompany stone in the common duct. The predominance of the gall bladder as a site of these bodies is easily explained by the anatomy of this cyst, the opening occurs in a constricted portion of the sac and its upper extremity. The location of the stone in the cystic duct is usually near the gall bladder. In the case of stone in the common duct it is interesting and instructive to note their location; in 14 per cent. of the cases they are located just below the junction of the cystic with hepatic duct at the beginning of the common duct, in 12 per cent. stone is found about one and one-half inches below the bifurcation, and in 10 per cent. stone is found in the retroduodenal portion of the common duct, and in 57 per cent. of all common duct stones their location was found to be in the ampulla of Vater, the narrowed portion of the papilla of the ampulla proving the obstruction that prevented their escape into the duodenum.

## ANALYSIS OF SYMPTOMS.

The provoking cause of symptoms in either the biliary or renal tract consequent on the presence of calculi may for convenience be classed under three heads: 1, Obstructive; 2, infective; 3, traumatic.

1. The symptoms occasioned by obstruction are due to the interrupted normal flow of the urine or the bile, as the case may be; in the case of stone in the kidney, obstruction is more commonly caused by a small calculus completely occluding the ureteral opening; in the gall bladder by a stone plugging in the neck of the gall bladder or becoming firmly encysted either in the cystic or common duct. In either locality there is a damming back of the secretion formed and a consequent stagnation.

2. Infection follows stagnation as a natural sequence and at first is local but rapidly invades the proximal and distal portions of the system involved and is made manifest according to the supply of lymphatic circulation; where lymphatic circulation is ample a prompt general disturbance is apparent, chills may occur, high temperature follow with pain and prostration. In the absence of lymphatic nodes, however, the physical symptoms may remain insignificant. This is particularly true of the gall bladder, which is very tensile and permits of absorption to equalize the supply, and since there are no lymphatic nodes in this site the entire process may be without any rise in temperature.

3. Traumatism is caused by the pressure of the calculus and is increased by the swollen and thickened sur-

rounding tissue which is due to the inflammation of the part.

In a recent paper Bovée<sup>1</sup> quotes the combined series of Cunningham and Morris relative to the site of the stone in each kidney as follows: Right kidney 119 cases, left kidney 98 cases, and both kidneys 11 cases. (Note the frequency of right kidney stone).

As a rule a diagnosis between kidney stone and gall-stone will not be difficult. The history of hematuria on exertion, a sharp lancing in the loin gravitating to the groin or bladder with abuminous urine, are typical symptoms of renal calculi, but there may occur a wide variation in these symptoms, and it is then that the differentiation is difficult.

A stone may exist a long time in a kidney without hematuria until some blow or strain followed by a sharp pain provokes it. When we consider the intimate relational anatomy of the renal and biliary system the surprise is not that errors occur in diagnosis but that they are not more frequent. Chills and subsequent rise of temperature are frequent in each condition, as is also vomiting and other disturbances of the gastrointestinal tract.

In calculus of the kidney or ureter the nausea and vomiting follow closely after or during the intense colic and is explained by the intimate relation existing between the pneumogastric nerve and the renal plexus. The same stomach disturbance is to be noted in gall-stone disease and occurs in a similar relation to the colicky seizures.

When the pain of renal or ureteral colic continues down the course of ureter into the groin or bladder the condition is not perplexing, but not infrequently the pain of the colic centers near the umbilicus or even higher, approximating the region of the gall bladder, then it is decidedly confusing.

Even the presence of a tumor palpable in the right upper abdominal quadrant is not positive indication of an enlarged gall bladder or a hydronephrotic right kidney, as its presence may be found in either.

Radiography was at first thought to be the element of diagnosis that would invariably clear the situation. Leonard<sup>2</sup> expresses himself in no doubtful terms of its value and, judging from his report of cases, his positive opinions are well founded. Hulst<sup>3</sup> and Mosely<sup>4</sup> are equally as enthusiastic but do not present such records of success. MacIntyre,<sup>5</sup> Abbe,<sup>6</sup> Davidson and Morton<sup>7</sup> have repeatedly succeeded in demonstrating and locating calculi in the kidney and confirmed their work by operation. On the other hand, Albarran, Guvon, Tuffier and Alexis Thompson express themselves frankly as to its uncertainty.

Osgood<sup>8</sup> observes that in cases which show a shadow a calculus can unquestionably be demonstrated, but that all cases of calculus do not show a shadow, hence the mere absence of shadow in suspicious cases is not conclusive proof that calculi do not exist.

It is my experience that the more uric acid or urates entering the composition of calculi the less likely are they to give a satisfactory shadow.

Morris<sup>9</sup> did some original work along this line by

demonstrating the shadow value of the different stones outside of the body; oxalate of lime gave a shadow deeper than bone from a three-minute exposure, which became very faint on exposure for eighteen minutes; phosphate of lime gave a dark shadow; uric acid stone a very faint shadow, and the biliary stones also gave a faint shadow.

The cystoscope is valuable in determining whether both ureters are emitting the fine jets of urine. Catheterization of the ureters or the passage of Kelly's wax-tipped bougies will usually detect a stone in the ureter or kidney pelvis, but such ureteral exploration should not be attempted, however, until after the urine and bladder are known to be sterile; otherwise extended infection would surely follow. The segregator determines only the activity of each kidney or the patency of each ureter and demonstrates the presence or absence of blood in either.

Carl Beck<sup>10</sup> states that biliary stones of pure cholesterolin show a faint shadow and comments on the difficulty of securing satisfactory results in gall-stones by reason of the density of the liver, which acts as a curtain. Respiratory movements and the flushing of gall-stones with bile also served as elements unsatisfactory to the x-ray diagnosis of gallstones.

To recapitulate briefly we observe that:

1. Kidney stone usually is found in the pelvis of the kidney and the frequency of the right kidney is 119 to 98 in the left.

2. Ureteral stone is found in 40.7 per cent., or in nearly one-half, of the cases at the upper flexure of the flexure.

3. More than half of the gallstones found in the common duct are located in the ampulla of Vater.

4. Both of these regions are connected with the pneumogastric distribution through the renal plexus, and this explains the nausea and vomiting during the acute seizures.

5. The pelvis of the kidney, the usual site of kidney stone; the flexure of the ureter, the location of 40.7 per cent. of all ureteral stone; the fundus of the gall bladder, the site of gallstone in more than half of all cases; the descending common duct, the distal portion of the duct of Wirsung; the ampulla of Vater, which is in the location of 57 per cent. of all common-duct stone; and the descending portion of duodenum, are all contained in space covered by a silver dollar, between the end of the ninth rib and the umbilicus (see illustration).

6. The pain of a kidney or ureteral stone does not always radiate to the groin or bladder, but is sometimes more evident about or above the umbilicus.

It is obvious then that disturbance of any of these structures may produce symptoms of pathology in the adjacent structures.

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10. N. Y. Med. Jour., Sept. 8, 1906.

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#### Local Reduction of Sensation of Pain by Electric Current.—

Winkler has been testing Leduc's intermittent electric current and the analgesia it induces. Leduc's communication on the subject of the "electric sleep" and anesthesia were described in these columns April 6, 1907, page 1221. Winkler has found the analgesia so pronounced that he uses it in electrolytic depilation. He has found static electricity extremely useful in reducing itching, but it does not reduce the sensation of pain like Leduc's intermittent current. He gives an illustration of his apparatus in the *Monatshefte f. prakt. Derm.*, Sept. 15, 1907.

1. Am. Jour. Med. Sciences, November, 1906.

2. Ann of Surg., xxxiii, xxv, February, 1900, and April, 1907.

3. Am. Med., Dec. 24, 1904.

4. N. Y. Med. Jour., March 7, 1903.

5. Glasgow Lancet, July, 1896.

6. Ann. of Surg., August, 1899.

7. Lancet, June 4, 1898.

8. Ann. of Surg., June, 1907.

9. Lancet, November 14, 1896.