evade pressure ; they must either become stretched or compressed. For that reason root-pains are the earliest and most constant symptom which you expect in spinal compression. The tumour grows and catches the roots. Next it displaces the cylinder of cerebro-spinal fluid. That does not produce very much in the way of symptoms. Then it squeezes through the fluid cylinder and compresses the spinal cord itself. When it does so, it produces venous engorgement below the level of the lesion. This venous engorgement causes exudation of blood below the level of the lesion, and consequently there is pigmentation of the fluid, and in the fluid, too, there occurs an excess of albumin, so great in some cases as to cause spontaneous coagulation. This is commonly described as Froin's syndrome—xanthochromia and spontaneous coagulation, a condition which is pathognomonic of spinal compression. It was present in both of these cases. Lastly, as the tumour grows, the cord itself becomes flattened out, and then we get signs of disease of the long tracts which run through the cord. So the symptomatology of the condition is quite easily understood.

(To be concluded.)

INTESTINAL OBSTRUCTION FROM GALL-STONE.

"GALL-STONE ILEUS."

A PITFALL FOR THE PRACTITIONER.

BY

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(Concluded from p. 73.)

TREATMENT.

AT one time enormous doses of belladonna were given with the intention of relieving the intestinal spasm, and in the hope that natural cure might be thus brought about. One reads of cases where stones have been voided, and the treatment has been given the credit. I was amused at the account of a case in which the attendant claimed that he had cured a case in which the patient passed a stone 3" $\times$ 1½", and another in which, after abdominal manipulation, a stone the size of a ping-pong ball was voided naturally. I suspect that in all these cases treatment has been a coincidence, and that but for the grace of God the patients might have suffered oblivion.

The most charitable and practical way to look at the matter is to say that in these days probably surgical intervention with all its risks is much safer than the other plans that have been popular from time to time. The form which intervention should take may admit of some discussion in the late cases. Sometimes an enterostomy has been performed above the stone, with the idea that the obstruction having been relieved, the stone would

safely pass on and lead to spontaneous cure, leaving only the intestinal fistula to be dealt with by a plastic operation (Fig. 12). The relief of the obstruction in this way removes the only stimulus to effort on the part of the intestine and destroys the last chance of the stone being propelled along the bowel. In the cases in which I have seen this carried out, the result has been disappointing and the patients have died, either as the result of continued exhaustion, or from peritonitis, or from the rupture of an ulcer (see Case 2 in appendix). The experiences of the treatment of this type of obstruction have confirmed what has been learnt from other cases of obturation, and I have now come to look upon enterostomy as only an adjunct in the treatment of obstruction and never as a method by itself.

I would say, therefore, that if a diagnosis of gall-stone obstruction is made, the best chance for the patient lies in early laparotomy for the purpose of searching for and removing the cause of that obstruction.

The question may arise as to where the operation should be carried out. Generally speaking, I am strongly of the opinion that operations should be performed in properly equipped institutions ; but I do think that there are many emergencies which have a better chance if they are not disturbed in the way that such removal may imply. Cases, for instance, under consideration are always elderly and sometimes gravely ill, and I believe that their chances are sometimes better if they are dealt with in their own homes. I am always thankful to have learnt a great part of my emergency surgery in the small industrial houses of Tyneside, and cannot be too grateful to my doctor friends who have so ably assisted me and seconded my efforts in every way. Very often these patients are actually regurgitating and vomiting intestinal material, and this may be a very grave complication when the question of anaesthesia arises. Under these circumstances it is usually better to empty the stomach before an anaesthetic is administered, or, if that is not done, the stomach tube should certainly be passed as soon as the patient is unconscious.

The question of the anaesthesia is very important. In the early stages there can usually be no valid objection to carefully-administered general anaesthesia, but if for any reason the patient has to be operated upon in the stage when toxæmia has supervened, then general anaesthesia should certainly be avoided. Local infiltration of the abdominal wall will nearly always suffice, and should unexpected complications be met with, general anaesthesia can be administered. The operation is always simple. It consists in opening the abdomen in the middle line below the umbilicus. In most of my cases a couple of fingers introduced into the peritoneum have almost at once encountered the piece of intestine containing the stone, and when it has not been so, a short search has soon disclosed its whereabouts. It is best to follow the collapsed intestine, and it is well to

remember that as it approaches the obstructed area it becomes reddened. Once the stone has been located, the piece of bowel containing it should be gently withdrawn from the abdomen. The searching of the peritoneal cavity and the withdrawal of the intestine may both be a little painful, so that they must be done with the greatest of gentleness. After the loop containing the stone is withdrawn, it should be surrounded

FIG. 12.

A large gall-stone lying loose in the ileum. The patient was a feeble woman of 65 who was very ill from obstruction. For this reason only an enterostomy was performed, but in spite of the relief thus afforded she gradually sunk and died 12 days later.

by gauze, preparatory to incision. I have usually found that the stone is so grasped by the intestine that its position cannot be easily altered without risk of damaging the bowel wall, and I have always made the incision directly over the calculus. Such incision should be made in the long axis of the gut on the antimesenteric border. As a rule, it need not be more than one inch in length, but there is no object in increasing the difficulty of extracting the stone by limiting the incision of the bowel wall. When of sufficient length, the stone can be very readily squeezed out, and will usually be accompanied by a good deal of mucous. The fingers of the assistant control any unwanted escape of intestinal contents. The incision is then sutured in the opposite direction, that is to say, the transverse axis of the bowel, so as to avoid diminishing its lumen.

The surgeon should take care that the closure is efficient without being too tedious. Personally, I rely on two continuous sutures, one through all the coats of the bowel to be hæmostatic and watertight, and the other a continuous Lembert. It is, next, wise to examine the bowel in the immediate vicinity for any further calculus, though I would certainly never make a prolonged search or eviscerate the patient for this purpose.

We ought to consider whether or not the gall-bladder region should be systematically examined. This step is really quite unnecessary. It only half-satisfies the curiosity of the surgeon and does not help the patient, because I am satisfied that it is seldom necessary to interfere with the gall-bladder region, and, if such is indicated, is much better done at a second operation. The after-history of my own patients, and indeed of most cases, shows that subsequent gall-stone trouble seldom occurs, and the fact that stones have escaped into the intestine shows that nature has provided a route for the evacuation of any small stones or debris that may be left. Of my six patients who survived, one has been so recently operated upon as to make the information of little value, one has not been able to trace, and in the others there has been no recurrence of any trouble which could be attributed to the gall-bladder region. In the after-treatment the less that is done the better. Purgatives must be avoided, and the only indication is to treat the toxæmia that may exist. The history of many cases shows that during this period a further obstruction due to stones may occur, and if this is suggested, the surgeon must not hesitate to reopen the abdomen, for the cure of the patient will again depend upon early interference.

APPENDIX OF CASES.

A. C. Age 72. Female. (Reg. No. 1,513, Case 1.) April 1908. Impaction of calculus in small intestine. Acute obstruction of three days' duration. Removal by operation. Recovery.

History.—On a Saturday morning at 2 A.M. the patient was seized with sudden pain over the umbilical region at 8 A.M. she began to vomit, and this continued at intervals until Tuesday night, when the patient was admitted to the Newcastle Infirmary. The vomiting was copious and frequent, and had a bad smell, and the patient described it as of a dark brown colour and with a taste like sulphur. The vomiting attacks persisted right up to the time of operation. The bowels were moved on Friday morning and again on Tuesday afternoon after some medicine, but no flatus was passed. The patient was seen by a doctor on Monday, who gave her some medicine, but it did not relieve her. Two years ago she had a similar attack which lasted a week; there was the pain, vomiting, and constipation, but at the end of that time diarrhoea came on, and her symptoms were relieved. The patient fancies that during that attack her eyes were rather yellow, but she did not notice any discoloration of the skin. There is no history of any other attacks, but the patient stated that she used to become unaccountably distended sometimes.

When seen late on Tuesday night this patient was found to be a stout woman in quite good general condition, and obviously suffering from obstruction, for the vomited matter was undoubtedly intestinal in character. The abdomen was quite flaccid, and there were no physical signs pointing to the cause. A diagnosis of gall-stone ileus was arrived at by exclusion, and the patient was admitted to the Infirmary for operation. This was carried out in the early hours of the morning. On account of the frequent vomiting local infiltration anaesthesia was employed. The abdominal cavity was opened by an incision in the middle line below the umbilicus, a little cloudy yellow fluid escaping. The finger was introduced, and on feeling towards the pelvis a mass in the small intestine was at once detected. This piece of bowel was drawn outside the abdomen. The rounded mass was impacted in the bowel, which was distended and slightly inflamed above it, but collapsed below. On

incising the gut directly over the mass, a gall-stone was found. The wound in the intestine was closed and the abdominal wall resutured. During the operation the patient only complained of the discomfort of lying on the table, and not of pain. The next day she vomited four times, but afterwards recovery was uneventful. The calculus measured $1\frac{1}{2} \times 1$ ", and weighed 113 gr. (Fig. 13). It had originally been faceted, but the corners were rounded off and the faceted surfaces were not smooth, suggesting

that it had not been in contact with its fellows for some long time.

The history suggests that in the attack of two years previously the distended gall-bladder had leaked into the bowel, thus explaining the relief of symptoms and the attack of diarrhoea which accompanied the cure. At this time the other faceted stones may have escaped into the bowel, leaving the larger stone which slowly entered the lumen of the bowel by the process of ulceration which has been described.

This patient died 12 years later from bronchitis, and without at any time suffering from a return of abdominal pain.

M. M. Age 70. Female. (Reg. No. 1,744, Case 2.) August, 1908. Impaction of calculus in ileum. Acute obstruction of seven days' duration. Toxæmia. Enterostomy. Death.

History.—About 14 years previously she had a severe abdominal illness, which laid her up for five or six weeks; at that time she was given up, but gradually got better. There was jaundice, and she passed several gall-stones which were like peas. For several months recently she had complained of sudden pains in the upper abdomen, for which she had to lie down for a few hours. She was said to be "bothered with the wind," though the bowels were regular. There was no diarrhoea, and she did not pass blood. A month ago, after one of these attacks, gall-stones were voided. At the same time an abscess between the breasts formed and burst. Exactly seven days before admission to hospital she was suddenly seized with a much more severe pain, which made her cry out and vomit. The vomiting had continued ever since; on one occasion she brought up two basinfuls of green material; the vomited matters have become offensive. Since the onset of the attack the bowels have not been properly moved, and she has become progressively weaker.

On admission this patient was exceedingly ill. The pulse was 140 and small. The face was grey and sunken, and the hands had a tendency to be cold; the tongue was thickly furred and very dry; and there was almost constant vomiting of intestinal contents. The abdomen was not much distended, but intestinal coils could be felt contracting in the right iliac fossa. There was nothing to be made out on pelvic examination, and there was no external hernia. In the light of the history a diagnosis of gall-stone obstruction was suggested. Operation under eucaïne anaesthesia—an incision was made in the right iliac fossa and a loop of very distended small intestine was opened, large quantities of fluid fæces escaping. A mass could be felt in the pelvis,

but was not interfered with, as the condition was desperate. The patient went on fairly well for about three days. During this time the hands remained cold and the pulse continued to be very quick and feeble, but towards the end of the time she was obviously picking up, the tongue becoming moist and the vomiting ceasing. Then, without warning, she had a sudden severe attack of pain, after which the condition became rapidly worse, and death soon followed.

At the necropsy the peritoneal cavity was found to be full of pus. A stercoral ulcer in the small intestine 2 ft. above the enterostomy opening had leaked, in spite of the fact that it was covered by adherent omentum. A large gall-stone was found impacted 18" beyond the enterostomy opening, and had evidently been the cause of the obstruction. This point on measurement proved to be 8 ft. below the duodenojejunal junction. The intestine above the enterostomy was distended, and its walls were sodden, while the mucous membrane was thickly studded with ulcers lying between the valvulæ conniventes, and it was one of these ulcers which had given way. The intestine immediately above the stone was much thickened, but not very distended, while below the stone it was very much collapsed. At the site of the impaction of the stone there was no ulceration of the mucous membrane. There were many adhesions between the gall-bladder, the hepatic flexure of the colon, and the duodenum, and a hole was found between the gall-bladder and the duodenum about $1\frac{1}{2}$ " beyond the pylorus. It had a ragged, sloughy edge, and would just admit the tip of the fore-finger, but did not appear large enough for the transit of the stone, which was found in the intestine. The gall-bladder was shrivelled and did not contain any other stones. The calculus measured 1×1 ", and weighed 273 gr. (Fig. 14).

R. B. Age 63. Male. (Reg. No. 5,280, Case 3.) December, 1912. Impaction of calculus in small intestine. Sub-acute obstruction of nine days' duration. Bowel growth suspected. Removal of stone by operation. Recovery.

History.—On a Saturday a week before admission this patient was very well, and attended a football match. He went to bed at 11 and slept until about 3 A.M., when he was awakened with a feeling of sickness. He vomited, which relieved the small amount of pain from which he suffered. From this time and up to his admission he had constantly recurring discomfort in the upper abdomen, with nausea and vomiting which temporarily relieved him. The bowels were never moved from the time of the onset, nor did he pass flatus, though he was not troubled with wind. Medicine and enemata were both without result. He felt as if there were an obstruction, and as the week wore on it seemed to move a little lower down. He does not remember ever having an abdominal illness except perhaps once or twice a bilious attack, and in 40 years he never drew sick benefit until this illness. Not troubled with indigestion and never had "windy spasms" or jaundice.

On admittance he was found to be a very healthy-looking old man in good condition, but rather toxic. Temp. 98° . Pulse 80. Tongue a little dirty. There was some general distension of the abdomen, but this was not very marked. No growth or mass or tender area to be felt. There was no external hernia and nothing to be felt per rectum, nor could anything abnormal be seen with the sigmoidoscope. There was no result from a hospital enema, but poultices gave some relief to the abdominal discomfort. Forty-eight hours after admission it was decided to operate because the patient still had discomfort, and there had been no action of the bowels and no passage of flatus. Though not in pain, he readily agreed.

It was proposed to make a preliminary cæcostomy for a supposed growth in the large bowel beyond. An oblique incision was therefore made over the caecal region, but the latter was not distended, though there was a small amount of free fluid in the peritoneum. The incision was enlarged, and with the hand the whole of the colon was palpated, but no growth could be felt. A hard mass was felt about the position of the hepatic flexure, but on further investigation this was made out to be adhesions about the gall-bladder. The importance of this finding was not appreciated

at this stage. As no growth could be found in the large bowel, the hand was passed into the pelvis among the small intestines, when a hard body was at once found. On withdrawing this it proved to be something inside a loop of small intestine. The bowel was fairly tightly contracted on this body, and was neither distended above nor unduly contracted below, but just looked as if a foreign body were being grasped in its passage through the bowel. The body was firm but could be crushed to some extent between the fingers. As the site of impaction—though not clearly determined—was a considerable distance from the ileo-cæcal valve, no attempt was made to push the body on into the cæcum, nor was it broken up for fear of damage to the intestine. The gut was incised in its long axis, what proved to be a gall-stone removed, and the opening closed in the transverse axis. The abdomen was closed with through and through silkworm sutures. The patient stood the operation perfectly well, he was never sick afterwards, and flatus very soon passed naturally and the bowels moved of their own accord. Recovery was quite satisfactory, and for some time he was known to be well. Unfortunately, the later after-history could not be obtained.

The mass removed had all the appearance of a single large gall-stone undergoing a process of disintegration by maceration. On analysis it proved to be a bilirubin-calcium stone. Bile constituents and calcium were detected, but no cholesterin was found.

M. M. Age 70. Female. (Reg. No. 11,790, Case 6.) April, 1919. Gall-stone impacted in pelvic colon. Acute obstruction of four days' duration. Removal of stone by operation. Recovery.

History.—Five years previously patient had what was said to be "chill on the liver." It began with pain during the night, and she was laid up for two weeks. The same sort of illness recurred two years later, and this time was followed by jaundice. The present illness began four days before she came under my observation, when she was suddenly seized with great pain at the pit of the stomach with sickness. From this time there had been recurring spasms attended with vomiting. She had not been able to take food, and there had been absolute constipation.

Condition on admission.—When seen at the end of this four days' illness she looked quite well, was perfectly clear mentally, and gave an accurate account of her illness. The tongue was clean and moist and the pulse was just 100. The abdomen was not distended, nor was there any suggestion of enlarged coils of gut. There was a little tenderness over the right iliac fossa, but no mass could be felt there or elsewhere. The hernial sites were negative, and nothing could be made out on rectal examination. My notes do not say whether or not I made a diagnosis of the cause of the obstruction.

Operation.—Under general anaesthesia the abdomen was opened, and a large stone was found tightly impacted in the upper part of the pelvic colon. The bowel over the stone was much thinned and damaged, that above was a little distended and thickened, and the bowel below was contracted. The stone could not be moved from its position, and had to be extirpated by direct incision over it. The wound in the bowel was made in the longitudinal direction and sutured in the transverse. The small intestine was not distended. On palpating the gall-bladder it was found to contain stones, but it did not appear to be adherent to surrounding viscera. The stone removed was quadrilateral, becoming rounded, and measured $\frac{1}{2}$ " $\times$ $\frac{3}{4}$ ".

The patient made an uninterrupted recovery, and has had no further attacks of abdominal pain.

Mrs. M. M. Age 74. (Reg. No. 15,779, Case 7.) January, 1924. Gall-stone impacted in small intestine. Acute obstruction of three days' duration. Removal by operation. Recovery.

History.—For four or five years she had been troubled every three months with severe attacks of gall-stone colic. The attacks were relieved by morphia, and on one occasion several small stones were passed. The patient was considered to be too old for operation. The present illness began three days before operation, and was at first considered

to be a recurrence of the gall-stone trouble. But the pain was different, and was lower in the abdomen, and the bowels could not be got to act. There was intermittent colic and vomiting with remissions. A diagnosis of gall-stone ileus was made.

Operation.—Under general anaesthetic the abdomen was opened below the umbilicus and a calculus found tightly impacted in the small intestine. It was removed by direct incision, the gut being stitched in the opposite direction. The patient made an uninterrupted recovery, and was alive and quite well twelve months later. There had been no recurrence of the previous attacks.

Additional Case.

Because of the many unusual features of interest, I append the notes of a last case which I only encountered in the post-mortem room. It is not, however,

Fig. 15.

Specimens from a case where a gall-stone had become impacted above an inflammatory mass in the sigmoid, the result of sacculitis. The calculus ulcerated through the bowel wall and was found free in the recto-vesical pouch. A, Portion of pelvic colon and rectum removed after death; X, hole through which the gall-stone escaped; B, a longitudinal section showing some of the sacculi; C, gall-stone found in the recto-vesical pouch.

unique, for gall-stones have several times been found impacted above a previously existing obstruction in the bowel, whether due to new growth or some other cause.

This patient, a man of 57, was sent into hospital late one night in June, 1902, with a diagnosis of gall-stones, and retention of urine, further complicated by injury to the intestines from an attempt to empty the bladder by suprapubic tapping. The following history was obtained. He was working up to seven days before admission, when he was seized with sudden abdominal pain, and had symptoms of intestinal obstruction with vomiting. For some little time he had experienced difficulty with micturition, and during this illness he had retention. His doctor tried to pass a catheter, but was not successful in drawing off urine. A suprapubic trochar was therefore used, but only faeces came out.

On admission the man was very ill, with signs of general peritonitis. Per rectum a hard mass could be felt. He was never considered to be in a fit state for operation, and death occurred about 48 hours after admission.

Necropsy.—General septic peritonitis, the abdomen being full of liquid faeces. The trochar opening in the belly corresponded with two holes in a loop of small intestine.

lying just above the pubes, and intestinal contents were issuing from these holes. A large gall-stone ($1\frac{1}{2} \times 1'$) was found lying free in the recto-vesical pouch. There was a large mass of carcinoma in the rectum (1st part), and just above this a ragged hole in the wall of the bowel, from which the stone had evidently escaped. The gall-bladder was small and contracted, and the hepatic flexure of the colon and the duodenum were adherent to it. There were holes between both colon and duodenum and gall-bladder, and a gall-stone in the latter projected slightly into both parts of the bowel. No other stone was found in any part of the bowel. The liver was enlarged and markedly cirrhotic.

The specimen from this case was put aside labelled "Carcinoma Rectum with impaction of gall-stone and escape of gall-stone by ulceration." Amid an abounding wealth of pathological material it was neglected until the year 1908 when I was especially interested in this question of gall-stone ileus. On re-examination I found that the supposed growth was simply inflammatory thickening associated with a typical diverticulitis, as is well shown in the illustration (Fig. 15).

ULTRA-VIOLET LIGHT.

ITS PROPERTIES AND THERAPEUTIC USES.*

(ABSTRACT.)

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In a brief talk such as this it is not possible for me to cover the whole field of light therapy, but I shall endeavour to place before you as concisely as possible what I consider to be the main principles underlying the subject.

In order that we may appreciate fully the therapeutic values and limitations of such an agent as ultra-violet light it is essential that we should first understand something of its nature and of its physical and biological properties.

Ultra-violet radiation is of the same nature as light—i.e., visible light—X rays, gamma rays of radium and Hertzian (wireless) waves. These are *all* due to electro-magnetic disturbance of the ether—which disturbance is transmitted in the form of waves. The velocity of transmission is the same in each case—namely, the velocity of light (186,000 miles per sec. or 300,000 km. per sec.)—but the wave-lengths differ widely, ranging from the long waves of wireless telephony of 20 km. in length or more down to the heat waves and the infra-red rays—i.e., those rays just above the red end of the visible spectrum—followed by one octave of what we appreciate as visible light (an octave being so called because the waves at one end are twice the length of those at the other), then three octaves of ultra-violet light gradually merging into the X rays, of which there are 14 octaves, and, finally, the extremely short waves of radium.

As all these rays travel at the same velocity, it follows that the short waves repeat themselves much more frequently than the long—i.e., the frequency is greater. The frequency of a gamma ray is indicated by a figure stretching to 21 units, and that of wireless wave by five figures only.

Hertzian waves	..	..	20 km.
Heat waves—infra-red	..	..	8000 Au.
Visible light	..	..	7900–3800 Au.
Ultra-violet light	..	..	4000–1000 Au.
X rays	..	..	12–0.15 Au.
Radium rays	..	..	0.1–0.015 Au.

(Au = 1 ten-millioneth of a mm.)

It may be of interest to consider briefly the steps by which this long series of waves has been built up. Newton made the first discovery when he named the colours of the visible spectrum in 1666, and for over 100 years these were the only rays known, until Herschell announced the existence of the infra-red in 1800. Shortly after this, in 1801, the first mention was made of ultra-violet rays by Ritter, who noted the effect produced upon silver chloride by the violet end of the spectrum. Maxwell, in 1868, stated that there were rays beyond the infra-red, and Hertz shortly afterwards discovered how to generate them. Then in 1895 came the great discovery of X rays by Rontgen, leaving a gap between these and the ultra-violet, which was finally filled by Millikan as recently as 1921. The gamma rays were brought into use by the discovery of radium by Becquerel and the Curies in 1896 and after. Even now fresh discoveries are being made, and as recently as last year Prof. Millikan has stated that there are rays capable of penetrating 6 feet of lead.

The band of radiation which we make use of in our work extends from 4000–1500 A.U. approximately—the various wave-lengths being determined by analysis through quartz and fluorite prisms. These rays obey the same laws as light rays—namely, they are transmitted in straight lines in a uniform medium—they are capable of reflection and refraction, and they can be polarised. Again, the intensity of radiation on a given surface varies inversely as the square of the distance from the source—that is, the radiation falling on a surface at two-feet distance is one-quarter of that falling on the same surface at one-foot distance from the source of radiation. This is of great importance.

The natural source of ultra-violet light is, of course, the sun, but the pure sunlight contains only half an octave of this kind, and we have, therefore, to resort to artificial means to produce the rays in greater quantity. The use of sunlight as against that of ultra-violet light has been somewhat aptly compared to the use of crude drugs and their synthetic products, for instance, opium and morphia.

When we consider that only a fraction of the sun's radiation ever reaches the earth's surface, and that of this fraction only 75 per cent. on a clear day reaches an altitude of 18,000 feet, and 50 per cent. reaches sea level (according to Leonard Hill), it is seen that systematic heliotherapy is

* A Post-Graduate Lecture delivered at the Westminster Hospital on Sept. 24th, 1926.