

Stones in the common duct and their surgical treatment : with remarks on the ball-valve action of floating choledochus-stones / by Christian Fenger.

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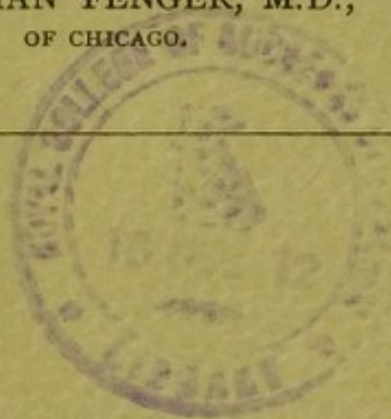
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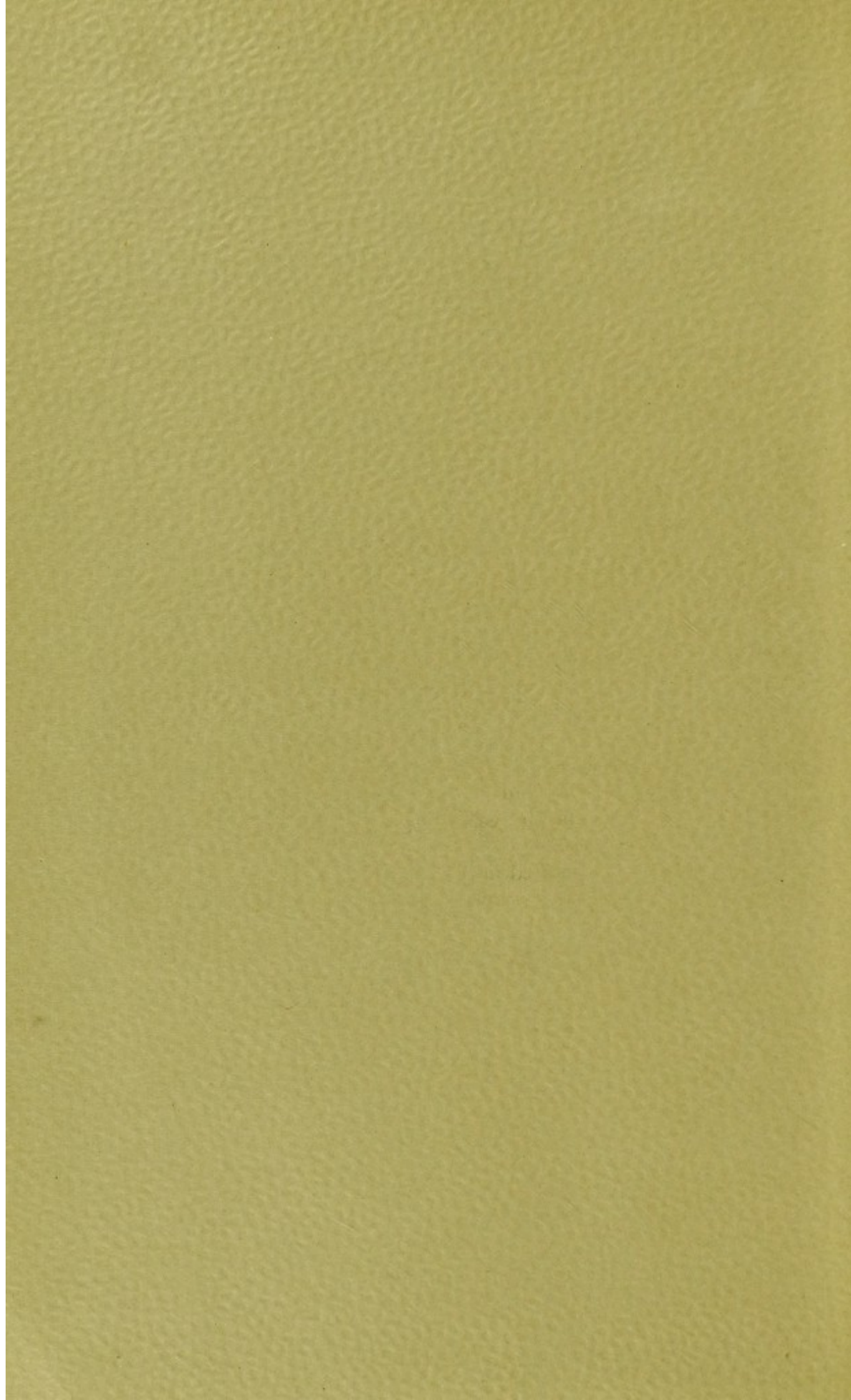
*With Remarks on the Ball-valve Action of Floating
Choledochus-stones.*

BY

CHRISTIAN FENGER, M.D.,
OF CHICAGO.



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STONES IN THE COMMON DUCT AND THEIR SURGICAL
TREATMENT.

WITH REMARKS ON THE BALL-VALVE ACTION OF FLOATING CHOLEDOCHUS-STONES.

BY CHRISTIAN FENGER, M.D.,
OF CHICAGO.

GALL-STONES in the common duct were found by Fiedler in only 2 out of 800 autopsies (Courvoisier). Schloth in 343 cases of cholelithiasis found stones in the common duct 9 times, that is, in 2.6 per cent. of the cases. Courvoisier found stones in the common duct in 10 out of 255 cases of cholelithiasis, or in 3.9 per cent. of the cases. Conradi found gall-stones in 2.6 per cent. of dead bodies; namely, 1.6 per cent. in men and 3.6 per cent. in women. In 97 cases of cholelithiasis he found stone in the gall-bladder alone in 82 cases, in the gall-bladder and common duct in 10 cases, and in the common duct alone in 5 cases; that is, he found stones in the common duct in nearly 15 per cent. of the cases of cholelithiasis.

As gall-stones, when located in the common duct, almost always give rise to serious disturbances, obstruction to the flow of bile and its consequences, while, when located in the gall-bladder or cystic duct, they cause little or no disturbance as long as no infection or inflammation occurs, it is obvious that although the cases of choledochus-stone are in the minority, varying from 2.6 per cent. to 15 per cent., this minority will make itself felt partly from the gravity of the symptoms caused, and partly from the dignity of the operation demanded for relief.

Operation for stone in the common duct is of comparatively recent origin. A number of different operative procedures have been employed, and are yet under discussion. The symptoms of stone in the common duct, in contradistinction to those of stone in the gall-bladder and cystic duct, have not hitherto been sufficiently differentiated. The surgical anatomy and pathology of the common duct and its surroundings have received little attention, as this region of the body has become a field of

¹ Read before the American Medical Association, 1895.

operation only within the last five years. I have had the opportunity of observing six cases of stone in the common duct during the past year, in five of which I operated, and in two obtained an autopsy. The material thus obtained I have used as a basis for the study of stones in the common duct, with especial reference to some points in the anatomy, symptoms, and operative treatment, which have either not been mentioned at all, or have received only slight attention in the brilliant and exhaustive monograph of Courvoisier. To this author we owe not only this monument in the pathology and surgery of the bile-ducts, but also choledochotomy, or, as he calls it, choledocholithotomy, the operation of choice for stones in the common duct.

I will first report the six cases in detail. When attempting to think over the plan of operation to be performed in a difficult or uncertain case, I have often derived great help from reading the reports in detail of similar cases. The greater the detail, the more valuable were they to me. The too common method of presenting a merely cursory report of a large number of cases is entirely valueless in this regard. For this reason I present in detail the reports of the following cases. The first case, in which no operation was performed, but in which an autopsy was made, furnished the material for the study of the pathological anatomy and the mechanism of ball-valve action in choledochus-stone. In order to avoid repetition, the most essential points in relation to these two subjects have been embodied in the report of the autopsy in this case and in the remarks thereon. The remainder of the cases furnished the material for symptomatology and treatment.

CASE I. Synopsis: Two years ago first attack of colic with icterus. Attacks more and more frequent with slight remittent icterus. Remittent pain every two or three days for three weeks, followed by fever, icterus gravis, and death. Autopsy revealed one small floating stone in the dilated common duct.

Mrs. G. E., aged thirty-one years, was admitted to the German Hospital in the service of Dr. Hessert, March 29, 1895. The mother of the patient died at the age of forty-two years from a trouble similar to that for which the patient entered the hospital. Nothing further of the family history of the patient could be ascertained.

As a child the patient was weakly; at the age of twelve years she began to menstruate; menstruation has always been regular and without pain. At about the age of eighteen years she began to have vomiting attacks at intervals of five or six weeks or less, especially after eating indigestible food. The vomitus consisted first of food and later on of brownish slime. The emetic efforts were exceedingly violent, as though "she could vomit up the abdominal viscera."

The patient always appeared healthy except after one of these attacks of vomiting, when she would lose in weight, but would afterward regain health and flesh rapidly. The attacks lasted one or two days, during which time she would vomit for perhaps five minutes at intervals of an hour. The vomitus was usually a brownish fluid. Each year there has

been a slight increase of the symptoms, and the vomiting has been more severe and frequent.

In 1883 the patient married. She has had seven children. Three or four days before her last confinement she had a very severe attack of vomiting, with intense pain in the lower part of the back and abdomen. Shortly after her confinement she had another attack of vomiting accompanied by intense pain in the epigastric region. A few hours after this attack began, the skin and the sclerotics were noticed for the first time to be icteric. This attack lasted for fourteen days, during which time the patient rapidly lost weight, losing altogether about sixty pounds. The attacks of vomiting finally recurred every two weeks. The pain in the abdomen, epigastric region, and back became constant, but the pain over the region of the gall-bladder occurred only every two or three days. On the day following each attack the skin was of a darker, icteric hue.

In February, 1895, the patient undertook the water-cure, which resulted in slight temporary improvement of her condition. About March 1st she was suddenly seized with severe pain in the "inguinal region" and lower lumbar region, accompanied by vomiting. The patient felt during this attack as if something had given way, whereupon the severe inguinal pain immediately ceased, but the pain in the back continued for several hours. Two days later she had another attack of pain which lasted for three weeks, with exacerbations of pain every two or three days in both hypochondriac regions. After the 17th of March the patient felt better, but every afternoon about 4 o'clock she was seized with a chill and fever. Upon March 24th, severe general headache began, which became constantly worse, until she lay in a stupor. Her condition became more grave, the stupor more profound, and she died on April 5th. For three days before she died there was no vomiting. The stools were very dark, greenish-brown, and without foul smell, but had a very peculiar mouldy odor. The patient had exceedingly severe and almost constant pain located over the left lobe and median line of the liver. The bowels moved twice during the three days before she died, and the urine was drawn off by catheter.

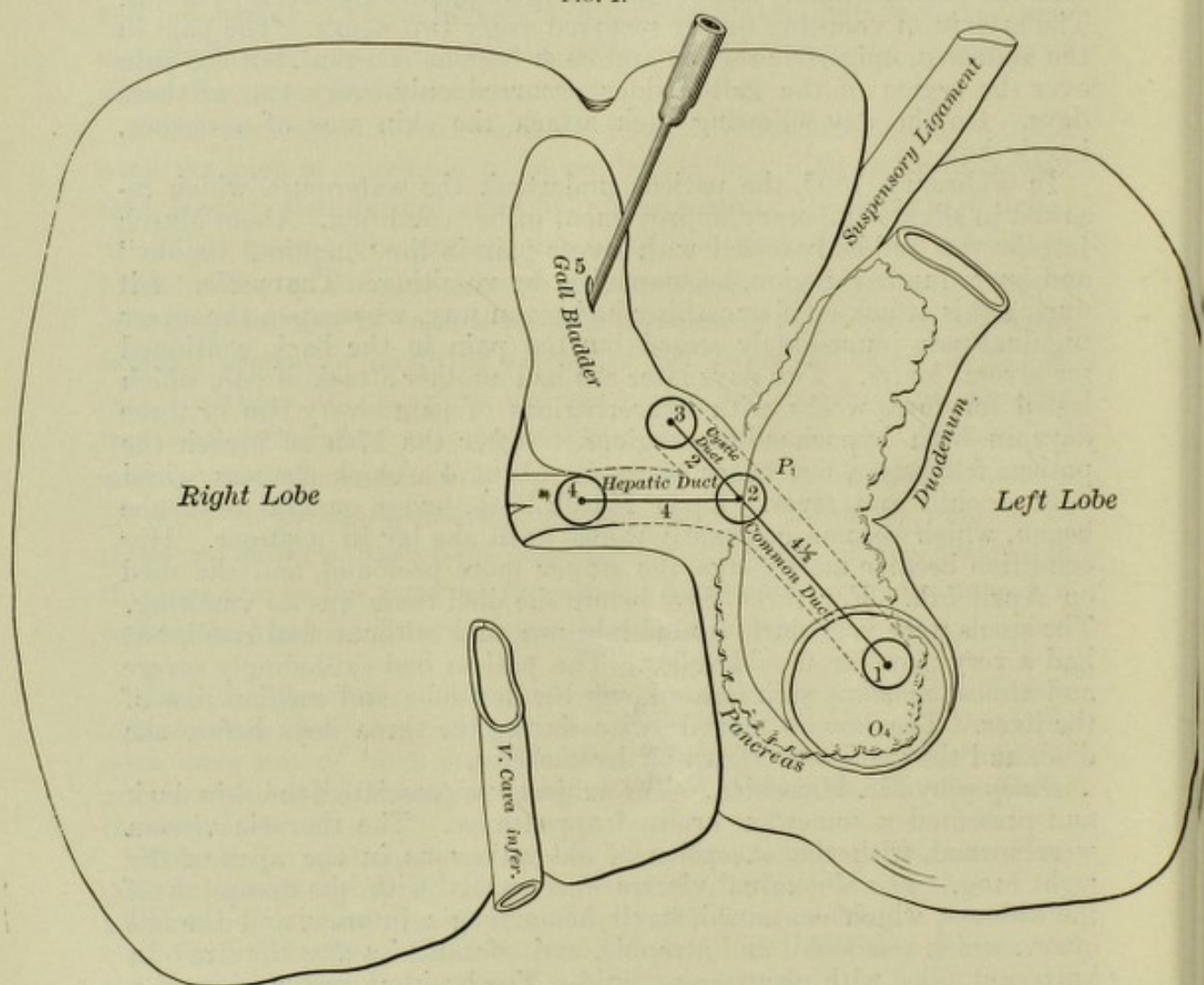
Autopsy by Dr. Haiselden. The subject was emaciated, the skin dark and presented a somewhat bronzed appearance. The thoracic viscera were normal, with the exception of old adhesions in the apex of the right lung. The abdominal viscera were normal with the exception of the kidneys, which contained small hemorrhagic infarcts, and the left ovary, which was small and atrophic, and contained a cyst the size of a butternut, filled with clear serous fluid. The brain on section showed a large quantity of fluid in the ventricles. The liver, gall-bladder, pancreas, and duodenum which was ligated above and below the pancreas, were removed entire.

The liver was flabby and a dirty brown in color. Upon cross-section the surface was a dirty brownish-yellow; the tissue was soft and friable, so that the finger could be easily pushed into it (acute yellow atrophy).

The gall-bladder was empty, atrophied, and small, so that it did not extend to the incisura hepatis. When a glass tube was inserted into the gall-bladder and the latter inflated with air, the air filled first the gall-bladder, then passed down into the cystic duct, then into the common duct, and then entered and distended the duodenum. No stones could be felt in the gall-bladder or in the cystic duct.

In the common duct a small round stone, 1 centimetre in diameter was felt; it was movable—that is, it could be pushed or dislodged with the finger from the duodenal end of the common duct into the hepatic duct. It could be pushed up into the hilus at “4” (Fig. 1); was more superficially located at “2” at the border of the duodenum; from this point it passed downward behind the duodenum to “1.” The horizontal portion of the canal was 4 to $4\frac{1}{2}$ centimetres long, and the oblique portion $4\frac{1}{2}$ to 5 centimetres long. The lower portion of the duct was

FIG. 1.



surrounded by pancreas-tissue, and the stone was stopped at the lower end of the head of the pancreas on the middle of the posterior surface of the duodenum.

REMARKS. The cause of death was cholæmia or icterus gravis. The opening from the common duct into the duodenum was not completely closed, as air could be inflated, and as the duodenum contained greenish fluid feces. The cystic duct was open to air-inflation, and the gall-bladder contained a dirty green fluid, together with yellowish-green gravel.

The stone acted as a “ball-valve,” and caused icterus, when it lay close to the opening of the common duct into the duodenum, by stopping

the passage of bile into the duodenum. The stone was freely movable in the common and hepatic ducts. The stone was not grasped tightly by the common duct, as Courvoisier states. The wall of the common and hepatic ducts was not thickened, but the ducts were considerably dilated. There was neither pus nor inflammation in or around the duct, nor cholangitis. The stone was probably the cause of the emptiness and atrophy of the gall-bladder and of the cystic duct.

That the small gall-stone, 1 centimetre in diameter, freely movable, floating or swimming in the ductus choledochus, cystic and hepatic ducts might have caused complete stoppage of the flow of bile by acting like the ball in a ball-valve was proved by the following experiment:

The duodenum was opened opposite the diverticulum of Vater, and the papilla, on which the opening from the duodenum into the diverticulum was found, was seen to be of normal size and shape, and the duodenal mucosa and wall in normal condition. A silver probe passed readily from the duodenum into the common duct, and when it was pushed down toward the end of the common duct grated against the stone. A silver probe passed down from the gall-bladder into the common duct passed easily through the latter into the duodenum. It is comparatively easy to pass a probe through a dilated common duct, but it is not until search has been made by pushing and sliding the mucous membrane of the duodenum that the exit of the duct is found; because the dilated duct, just above the canal through the wall of the duodenum, forms a pouch or pocket in which the probe is caught until the narrow exit is found. There was no stenosis of the duodenal opening of the common duct, but the common, cystic, and hepatic ducts were all dilated.

A canula was now inserted in the gall-bladder (see Fig. 1), through which glycerin, which has about the same consistency as bile, was injected until first the gall-bladder, then the cystic, then the common, and finally the hepatic duct were filled and distended.

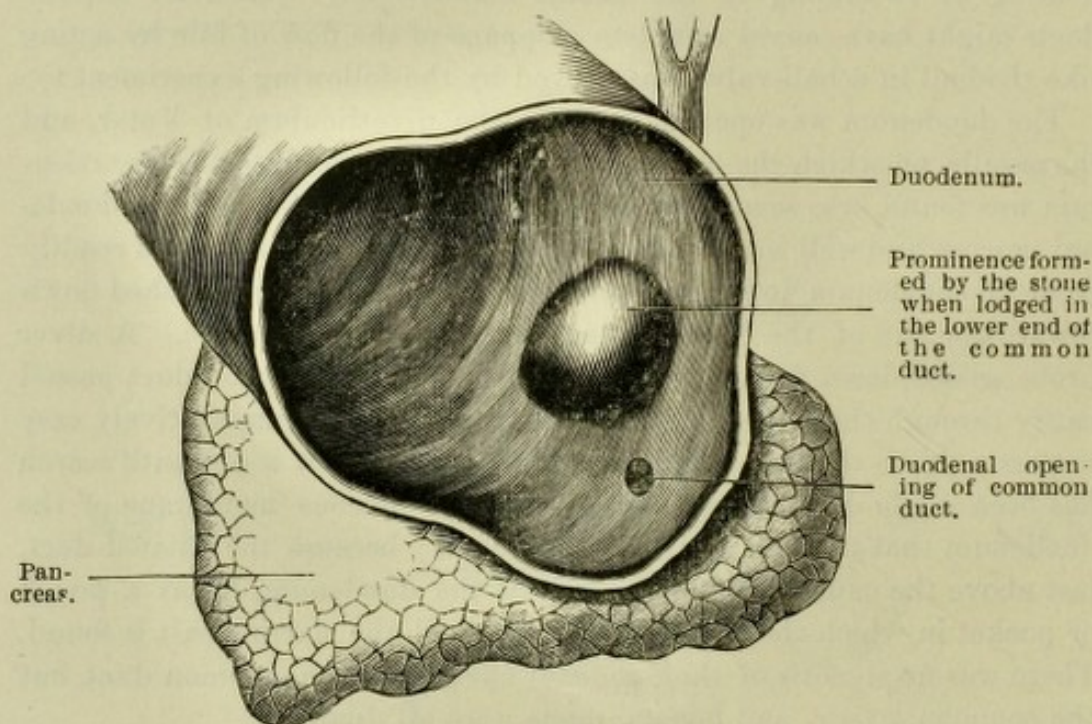
When the stone was now placed in any of the ducts or in any place with the exception of the lower end of the common duct, the glycerin would flow out in a continuous stream through the opening into the duodenum.

When the stone was made to slide down as far as it would pass into the common duct, namely, into the cul-de-sac or pouch just above the duodenal opening (Fig. 2), the flow of glycerin into the duodenum ceased, and a further injection through the canula into the gall-bladder made the duct and the gall-bladder more tense and full, but not a drop of the glycerin entered the duodenum.

When I now dislodged the stone a little, pushing it up out of the pouch by pressing slightly on the prominence which it formed in the duodenum, $\frac{1}{2}$ cm. above the opening, the glycerin immediately began to flow into the duodenum. This flow would continue until I again pushed the stone back into its former position. I repeated this experiment a number of

times, and always with the same result, namely, that the flow of glycerin would cease entirely as soon as the stone came down into the cul-de-sac immediately behind the opening of the duct into the duodenum. I therefore considered that the "ball-valve" mechanism as effected by the small round stone in the pouch at the lower end of the common duct, behind the normal duodenal end, was the sole cause of the stoppage of the flow of bile, of the retention of bile, and of the icterus.

FIG. 2.



Exact measurements of the distances which the stone could be moved in the respective ducts gave the following results, as shown in Fig. 1:

(a) *Common Duct.* From the cul-de-sac, the lowest point to which the stone could be forced, up to the junction of the hepatic and cystic ducts, was 4.5 cm.

(b) *Cystic Duct.* The lower part of cystic duct was 2 cm. long; that is, the stone could be pushed up into the duct to this distance. Its direction was in a line with the common duct, an oblique line directed from above anteriorly, and the right, downward, backward, and to the left, forming an angle of 45° with the horizontal and vertical lines, respectively.

(c) *Hepatic Duct.* The stone could be moved in the hepatic duct a distance of 4 cm. in an almost horizontal direction from left to right (see Fig. 1). When the stone was lodged in the right end of the duct, or was pushed or made to slide as far to the right as possible, it disappeared from the surface down into the liver, so that only its upper or anterior surface could be felt, and even this was attended with consid-

erable difficulty. The point at which it descended into the liver was 1 cm. to the left of the medial or left border of the right lobe (in the horizontal branch of the "H" in the hilus, 1 cm. from its right end). The hepatic duct, having a horizontal direction, thus formed an angle of about 45° with the cystic duct, and an angle of about 135° with the common duct.

The passage of bile back into the cystic duct and the gall-bladder was free when the entire system of gall-bladder and ducts was filled with glycerin, and when the stone was free in the middle of the common duct.

The ball-valve action of the stone in the cystic duct, whereby the filling of the gall-bladder with bile was prevented, was demonstrated in the following manner:—

The gall-bladder was opened at "5," Fig. 1. The stone was made to slide up into the cystic duct until it lodged at "3." Glycerin mixed with white lead, so as to look milky white, was injected through a canula inserted from the duodenum, through the duodenal opening, into the common duct for a distance of 1 to $1\frac{1}{2}$ inches. The common and hepatic ducts filled slowly until the place of lodgment of the stone in the cystic duct was reached, but here the fluid was stopped and did not pass up into the gall-bladder. When the stone was made to slide down into the common duct, the fluid flowed up into and out of the gall-bladder at "5." This experiment was repeated several times with identical results; the stone acted as does the ball in the ball-valve, and prevented the passage of the fluid into the gall-bladder.

During this experiment, while the common duct was distended with the fluid, the hepatic duct also became distended, and the glycerin-emulsion escaped from the cut surface of the right lobe, from the right border of which pieces had been removed for microscopic examination. This escape of the fluid from the distal branches of the bile-ducts of the liver proved that the larger hepatic ducts and the smaller bile-duct were permeable. The prevention of regurgitation of bile from the common duct into the gall-bladder by ball-valve action of the stone in or near the cystic duct explains why the gall-bladder is found small and empty in cases of movable stone in the common duct. When the stone has been lodged in the cystic duct at "3," and the gall-bladder has been empty for a considerable time, possibly for months, the latter naturally retracts and loses its power of distention, its elasticity, so that it cannot be filled to its normal capacity, even if the passage becomes free later on by occasional dislodgment of the stone.

It is impossible to demonstrate the ball-valve action of a choledochus-stone on animals or even in normal biliary passages. The proof of this action requires a system of biliary passages altered by the presence of a cholodochus-stone in the manner here described. The experiment un-

dertaken with this specimen proved conclusively, and to the satisfaction and conviction of those present, the ball-valve action described above.

The bearing of the effect of this ball-valve action on the symptoms and course of cases of choledochus-stone is obvious. Its action is dual:—

(a) It causes intermittent attacks of retention of bile and icterus when the stone is lodged immediately above the duodenal opening of the common duct.

(b) It causes atrophy and shrinkage of the gall-bladder when the stone is lodged in or immediately below the cystic duct.

The ease with which a comparatively small stone is dislodged and floats around in the dilated canal; namely, the common, cystic, and hepatic ducts, is remarkable; it requires only a very slight touch with the finger or sound outside of the duct to push the stone from one place to another. As the stone has about the same specific gravity as the bile, it moves upon the slightest contraction of the wall, or when currents of bile act upon its surface. Thus, movements of the body which cause movements of the liver, duodenum, or transverse colon may cause movements of the stone from one place to another.

The specific gravity of the human bile is 1.030. Although the choledochus-stones, as, for instance, in three of my cases, float in the bile, they sink in water. The specific gravity of gall-stones thus lies between 1.000 and 1.030.

The direction of the large bile-ducts is almost horizontal when the body is erect. If the specific gravity of the stone plays any part in causing its dislodgment, it might be possible to dislodge it from its position behind the duodenal opening of the common duct, where it causes biliary colic and icterus. I therefore think it might be well to place the patient suffering from this condition, for a time but not constantly, on the right side, or on the stomach.

Ball-valve action was observed by Courvoisier in the cystic duct in two cases of his own, and in one case of Socin's during operation for gall-stone, but neither Courvoisier nor any other author has, to my knowledge, observed this phenomenon in the common duct.

Courvoisier describes his observation as follows (*loc. cit.*, page 18): "A peculiarly strange condition is the following: The more or less round, spherical stone is situated in a dilated portion of the cystic duct in such a manner that it is not immovably grasped by the wall of the duct, but so that it can be moved or moves only a short distance in a proximal and distal direction. If we now make pressure on the fundus of the gall-bladder, its contents will press the stone firmly down into the duct, causing it to close the duct hermetically like a ball-valve, so that not a drop can pass out. The bile, however, from the hepatic duct (Why not from the common duct?—F.) can yet enter the gall-bladder as long as no great tension exists here. This peculiar condition, which plays a part

in the genesis of certain ectasias of the gall-bladder, I have myself observed in two cases during cholecystectomy and also in an analogous case of Socin's."

Neither Courvoisier nor any other author seems to have observed the ball-valve action of floating stones in the common duct. While this condition in the cystic duct is comparatively rare, and is of little practical importance, as it could cause dilatation of the gall-bladder only, I have reason to believe that the floating stone with ball-valve action is the condition ordinarily found in the common duct, and is of great practical importance, as it explains the causation of the remittent icterus and of the multiple slight attacks of icterus and colic. It has also a scientific importance, as it explains the atrophy of the gall-bladder, which takes place in the way I have described above.

CASE II. First attack of biliary colic two years ago followed by icterus; second attack, October, 1894, followed by frequent lighter attacks; loss of weight, 15 pounds in ten weeks; slight icterus; no tumor of gall-bladder; operation; adhesions to atrophic gall-bladder; choledochotomy; one stone, 2 cm. in diameter, removed; no leakage of bile; recovery; gained 50 pounds in three months.

Mrs. C. L., married, aged forty-two years, was admitted to the German Hospital, January 3, 1895. Family history good; patient began to menstruate when sixteen years of age; has always been regular; flow has been excessive and each period accompanied by backache and nausea; no leucorrhœa, no pain on urination. She was married when twenty years of age, has six living children, and has had two miscarriages, both of which occurred after the birth of the third child and within one year of each other.

Twenty-two years ago the patient began to have pain in the epigastric region after eating food difficult of digestion, or after drinking cold water. For the ten years following she was obliged to be very careful in eating.

The present illness began in 1892, when a sudden attack of intense pain over the lower ribs on the right side and in the stomach occurred. The pain persisted for twenty-four hours and then subsided, only to return with greater severity. These attacks occurred at frequent intervals for three weeks, during which time the patient was confined to her bed. Her physician, Dr. Illingworth, attributed the attacks to gall-stones and noticed that the patient was somewhat icteric. Since this time the patient has never felt entirely well; she frequently feels weak, and has severe backache and heaviness in the epigastric region, more marked after eating.

The next severe attack occurred October 8, 1894, when the patient had vertigo and pain in the right side, which gradually became more severe and was accompanied by vomiting. The pain began in the region of the gall-bladder, and soon extended to the epigastrium.

The bowels moved regularly, but the movements were grayish-black. Since that time the stools have been grayish and foul-smelling. Since the beginning of this attack the patient has had frequent recurrences of the pain, which would always begin on the right side over the lower costal cartilages, and would soon radiate to the stomach. The attack

lasted ordinarily from noon until 10 P.M., and was relieved by morphine. Her sleep has been much disturbed since the attack.

The patient did not notice any icterus until after the pain had commenced, when the skin became "as yellow as wax." There was also an intolerable itching of the skin. After this attack the patient remained in bed for about five weeks. For the two weeks following she had constant pain in the right hypochondriac region and stomach. On January 1, 1895, pain commenced in the back, and the patient felt chilly. A few hours later she had very severe shooting pains in the right side and stomach, and these attacks recurred at frequent intervals for three days. On the fourth day she felt somewhat better, and was up and around, and the next day she entered the hospital, since which time she has had no pain.

The patient has a fair appetite when not in pain, the tongue is not usually coated, but at this time was slightly furred. She states she has lost fifteen pounds in weight since October 15, 1894. Examination of urine showed no abnormality.

Upon examination the patient was found to be rather poorly nourished, the icterus was disappearing, but a slight trace of yellow remained in the conjunctiva. Upon percussion the liver was found to be of normal dimensions. On palpation the liver was felt below the border of the ribs for about one and one-half or two inches, but the border was not distinct. There was some tenderness upon pressure in the region of the gall-bladder, but no tumor nor hardness could be felt in this place. The urine was apparently normal; the last two stools were yellow from bile-coloring.

The patient was prepared for operation in the usual manner and anaesthetized with ether. Upon palpation in narcosis I thought I could feel a rounded resistance in the region of the gall-bladder. With the assistance of Drs. Bernauer, Brown, and Haiselden, and in the presence of Drs. Illingworth, Hecht, and Goldspohn, I operated on January 5, 1895, in the following manner:—

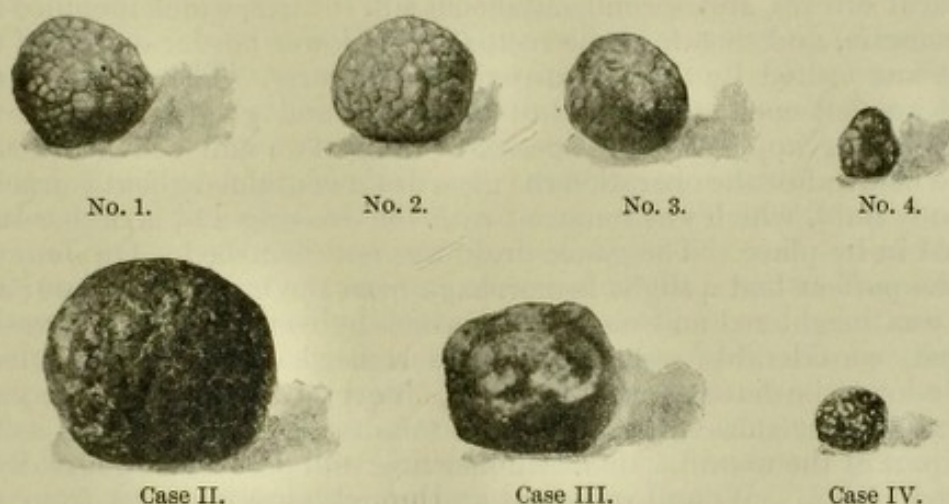
A lateral longitudinal incision was made 10 cm. in length along the outer border of the right rectus muscle through the parietal peritoneum, whereupon I felt a rounded tumor which I thought to be the gall-bladder, but which proved to be the obtuse, rounded border of the quadrate lobe. The anterior border of the liver was rounded and not sharp. The liver was bluish, smooth, and on the upper surface of the convex right lobe there was a whitish, rounded spot 3 mm. in diameter, not prominent upon the surface, and not hard. The incisuræ between the anterior and right lobes, and between the left and anterior lobes were marked. In the grooves between the quadrate lobe and the right lobe—that is, the groove for the gall-bladder, no gall-bladder could be seen or felt, but the groove was filled with adhesions to the transverse colon.

By blunt separation and division between ligatures I now loosened the transverse colon, but still the gall-bladder did not come into view. The pyloric portion of the stomach was found to be adherent to the lower surface of the liver, and the liver was held up toward the ribs by the second and third fingers of an assistant.

Large, flat sponges were now packed in the abdomen around the field of operation and the wound was held open by retractors. Upon loosening the adhesions of the pyloric portion of the stomach I found a small, empty gall-bladder 4 cm. long and 1 cm. broad, whitish, extending

from below the border of the liver 4 to 5 cm. backward to the hilus. The duodenum was pulled upward and to the left away from the lower surface of the atrophied gall-bladder. Blunt dissection with the fingers and Kocher's sound finally permitted me to feel partly through the duodenum, and partly behind it, a nodular mass in the hilus of the liver, consisting of soft, almost immovable glands, and a hard, rounded, movable mass, which was a large gall-stone, and a little nearer to the median line, another semisolid mass, which was the head of the pancreas. As I was uncertain whether the whole mass was carcinoma or gall-stone, and in order to gain further operating space, the abdominal wound was prolonged downward and below the umbilicus, making an incision in all 12 to 15 cm. in length. The colon and omentum were now held down, the stomach held to the right, the liver pushed up, and the duodenum separated from the gall-bladder so that I could get a finger in behind the nodular mass. With the index and third fingers I could now push the mass out into the field of operation. I could not distinguish the hepatic artery, vena porta, or common duct, but I could see large swollen

FIG. 3.



glands the size of almonds. I now explored for the stone with a straight needle, the mass being held forward by my left third finger in the foramen of Winslow, and the stone held firmly in position against the wall of the common duct, whereupon the needle pushed against it gave forth a grating sound.

A longitudinal incision 2 cm. long was now made at the left border of the mass through the loose layer of the hepatico-duodenal ligament, the soft mass of glands and the whitish wall of the common duct, which was 2 mm. thick, to the surface of the stone. The stone, which was rounded, 2 cm. in diameter, finely nodular, and weighed 5 grammes (see Fig. 3), was removed, and my finger then passed readily into the common duct, which had formed a pouch for the stone large enough to admit the finger. One or two drachms of clear yellow bile escaped.

After thorough sponging the ductus choledochus was explored by a curved metal sound, which passed easily upward for 10 to 12 cm., but detected no other stones. I did not, however, succeed in passing the probe into the duodenum through the ductus choledochus, either downward or toward the median line. The wall of the ductus choledochus

was thickened from hypertrophy of the muscularis, grayish-red, but not hard or friable. There was no carcinoma. The inner wall of the surface of the dilated ductus choledochus, where the stone was located, was whitish-red, the mucosa normal; neither carcinoma nor ulcer was found. The hilus glands, surrounding the ducts, were enlarged, soft, and reddish from inflammatory swelling.

As bile had already passed down into the bowel, as was seen from the bilary coloring of the last two stools, I desisted from further search for an opening into the duodenum, and proceeded to close the wound in the bile-duct by a double row of extra-mucous silk sutures, as follows:—

First, five sutures through the muscularis of the duct; second, five sutures through the glands and tissues of the hepatico-duodenal ligament. This second series of sutures covered the deeper row. No bile escaped after the first row of sutures had been inserted. I now proceeded to close the field of operation. The bleeding points in the duodenum and elsewhere were first ligated and a Mikulicz drain applied. A glass tube was inserted to the bottom of the wound, and iodoform-gauze packed in over the sutured duct. The upper half of the abdominal wound over the ribs and the liver was united by step sutures; first, separate buried peritoneal sutures, and, second, cutaneous silk sutures, which included the skin, muscles, and sheath of the rectus. The lower border or end of the wound was united by three transperitoneal sutures. The middle of the wound was left open on account of the gauze and glass drain and the usual dressing applied. The operation lasted two and one-half hours.

Five hours after the operation the glass drain contained about $\frac{1}{2}$ drachm of bloody fluid, which was removed with the dressing and a rubber tube inserted in its place. The gauze drain was not disturbed. On *January 10th* the patient had a slight hemorrhage from the mouth and nose; the blood was bright red and was not preceded by cough. *13th*. Dressing changed, considerable serous discharge somewhat tinged with blood. Faint odor to be detected in the wound. Very little tenderness on pressure except over gauze drain, and some soreness along the stitches in the upper part of the wound. *15th*. Rubber tube and part of the gauze drain removed. *16th*. Wound redressed and more gauze removed from the abdomen. *17th*. More gauze removed and also two stitches. *20th*. Wound dressed and repacked, stitches removed. *February 3d*. The granulations forced out the packing from the wound. The wound was closed until only a sinus about the diameter of the little finger remained. Patient complained of moderate, constant pain on the right side under the lower ribs upon deep inspiration. *9th*. The sinus now is about two inches in depth, but is very narrow with very little discharge. *March 10th*. The sinus entirely closed. *April 10th*. The patient has gained about 50 pounds in weight, looks very strong, and says she feels entirely well.

REMARKS. *Hemorrhagic Diathesis*. Hemorrhage from the nose and mouth occurred on *January 10th*, five days after the operation, and on the eighth day the dressings were tinged with blood. The hemorrhagic diathesis is well known in icterus gravis and is also found in the icterus from gall-stone. It is a grave complication, and Courvoisier found 58 cases, in most of which operation was not performed, and in which the hemorrhage was severe and often fatal. He collected six cases in which hemorrhage from the wound of operation in the gall-bladder had a fatal

termination. He warns us to search the history of the patient and make careful examination all over the body in order to ascertain whether or not a predisposition to hemorrhage exists, either from the mucous membranes or in the subcutaneous tissues; and in case the patient presents this symptom to abstain from operation, which is likely to prove fatal on account of the uncontrollable hemorrhage from the wound of operation or from other organs.

In some cases, however, in which no symptoms of hemorrhage pre-existed, the operation has been followed by fatal hemorrhage, not from the operation-wound, but from other portions of the body. It seems almost as if the operation brings into active existence a latent hemorrhagic condition. Mermann reports that Czerny lost 7 patients out of 43 upon whom he operated for diseases of the biliary tracts. Three of the seven deaths were caused by cholæmic secondary hemorrhage, which in one case occurred from the intestine, entirely independent of the wound of operation.

CASE III. First attack of biliary colic five years ago; after third attack frequent slighter attacks of pain and icterus for four months; one year ago, fourth attack with icterus, followed by frequent slighter attacks at intervals of ten days; five months later, cholecystotomy, with no relief; loss of weight, 50 pounds; slight icterus; mucous gall-bladder fistula; chole-dochotomy; removal of one stone, one and one-half centimetres in diameter; no leakage of bile; recovery; gained 20 pounds in three months.

Mrs. R., aged forty years, was admitted to the German Hospital February 10, 1895. Family history good; patient began menstruating at twelve years, always regular, no pain, moderate flow. At age of twenty years had an attack of acute gastro-enteritis with vomiting and diarrhoea, but without pain or icterus. She married at twenty-three years, and has had five children and one miscarriage, the latter probably due to a concurrent attack of measles.

Her present illness began suddenly about five years ago with cramps in the stomach, accompanied by constipation, and vomiting of green, slimy matter. The pain in the stomach lasted about two hours and did not recur for about six months, when a second attack occurred, lasting two to three hours. Since that time she has had similar attacks at irregular intervals. Until 1892 there was no icterus. At this time the patient had attacks of pain in the region of the stomach and gall-bladder occurring at very frequent intervals and sometimes lasting all night. Icterus was present, which persisted for about four months, but afterward disappeared.

In the winter of 1893 the patient, who had been ill in the interim, had another attack, not so severe as the former ones and without icterus, but the stools were gray. The patient was confined to her bed for about a week and then felt better, until April, 1894, when the attacks again recurred every three or four days, with pain in the region of the stomach and gall-bladder, but most severe in the lower dorsal region. About two days after each attack the urine was brown, the icterus intense, and the stools gray. The icterus varied in intensity with the severity of the pain. After a few weeks the attacks occurred only every ten days, but

continued during the entire summer. In September, 1894, Dr. Wiener operated, making a right lateral incision, and removed one stone about the size of a hazelnut from the gall-bladder. Patient remained in bed for five weeks after the operation. She obtained no relief from the operation, and all the symptoms returned.

Present condition. Patient was anæmic, rather poorly nourished; had lost about fifty pounds in weight in the last five months. The skin and sclerotics were slightly icteric, stools clay-colored, heart and lungs negative; pressure over the lower border of the liver and the median line caused considerable local pain and also pain in the back.

There was a longitudinal cicatrix 7 cm. long along the border of the rectus muscle over the gall-bladder, and a small fistulous opening from which a clear, viscid mucus exuded, a few drops at a time, which, upon examination, was shown to contain pus-corpuscles.

On February 21st, I operated with the assistance of Drs. Bernauer, Brown, Haiselden, and Gottschalk, in the presence of physicians from the Polyclinic. Ether was the anæsthetic. The fistula, which was 5 cm. in depth, was scraped and closed with a silk continuous pouch-suture. An incision was made around the fistulous opening 1 cm. therefrom. The incision was then carried up above the border of the ribs and down through the old cicatrix. The peritoneal cavity was opened 5 cm. below the fistula, and, guided by the finger in the abdomen, the fistula was excised and left connected with the gall-bladder. The right lobe was an elongated corset-lobe. The transverse colon and pylorus were adherent to the gall-bladder and hilus. These adhesions were broken up, and palpation showed the gall-bladder to be contracted and empty, containing no stone, nor could a stone be felt below the gall-bladder in the cystic duct. The adhesions were now loosened from the anterior surface of the hepatico-duodenal ligament, and its free right border, the entrance to the foramen of Winslow, isolated so that the index-finger of the left hand could pass into the foramen along the posterior surface of the hepatico-duodenal ligament. Upon palpating the ligament of the liver down to the duodenum I could feel a movable rounded stone the size of a hazelnut, which would slip away from my fingers up to and into the hilus of the liver. By passing the finger high up on the posterior surface of the hepatico-duodenal ligament I could feel the stone in the hilus and could move it down, forward, and to the median line as far as the border of the duodenum and even a little behind its right border. The stone could move in the dilated ductus choledochus for 6 or 8 cm. I could fix the stone between the index-finger on the posterior surface of the hepatico-duodenal ligament and the thumb on its anterior surface, and push the stone against the wall of the ductus choledochus at the right free border of the hepatico-duodenal ligament. Upon pressing the stone against the wall of the duct in this place I could see the enlarged white stone shining through the dark-red peritoneal covering of the ligament. I could feel the hepatic artery across the median line about 2 cm. from the free border of the ligament, and to the right of the hepatic artery I could see a bluish band running longitudinally in the ligament from the hilus of the liver to the left of the duodenum; this was probably a branch of the vena porta.

The abdomen was packed with large, flat sponges, one between the right

lobe of the liver and the diaphragm, one over the pylorus and stomach, and one over the upper surface of the transverse colon and omentum.

Fixing the stone against the anterior surface of the hepatico-duodenal ligament close to the duodenum, 1 cm. from the entrance to the foramen of Winslow, I made a longitudinal incision 1 to 2 cm. long down to the surface of the stone (see Fig. 5), which was then lifted out with a sharp spoon, as I wished to avoid crushing the stone; a moderate flow of light-yellow, transparent bile followed.

An assistant now held the liver up against the diaphragm with both hands, one on the right lobe and the gall-bladder, and the other on the left lobe. This hand also pushed the stomach upward and to the left. Another assistant with two fingers of the hand held down the transverse colon. Thus I obtained space for suturing the longitudinal wound in the duct. The duct was now explored by probe, elastic bougie, and finger. The probe and elastic bougie passed up 8 or 10 cm. into the hilus of the liver, and down 4 or 5 cm. behind, but not into the duodenum. The dilated duct easily admitted my little, third, or index-finger to a distance of 5 cm. upward into the hilus, where no stone could be felt, and 4 cm. downward behind the duodenum into a pocket which ended blindly like the finger of a glove.

The wound in the ductus choledochus was closed by, first, a row of six mucosa sutures (the ends of which were left long) through the muscularis and mucosa, which was smooth and pale yellow from bile, and, second, an outer row of Lembert serosa sutures $\frac{1}{2}$ cm. from the first row, taking in 2 to 4 mm. of the serosa. After six of these sutures had been inserted there was a flow of bile from the lower corner of the wound. The ends of the inner row of sutures were cut short and four additional Lembert sutures applied, after which the flow of bile ceased, and I considered the canal hermetically closed.

The skin and abdominal wall over the fistula into the gall-bladder and down to the surface of the liver were now excised. The fistula was narrow; a silver probe was passed down 5 cm., but a bougie or elastic catheter 2 mm. in diameter could not be passed down until I had dilated with Lister's forceps. The catheter was left in and the border of the fistula united to the skin. The toilet of the abdomen was performed as usual. The drainage consisted of, first, a Mikulicz drain of iodoform-gauze surrounding a glass tube, over and upon the sutures of the ductus choledochus to the hilus of the liver; iodoform-gauze was packed over the pylorus and down on the duodenum; second, an iodoform-gauze strip along the gall-bladder or fistula out of which a few drops of clear, transparent bile escaped.

The wound was now united by a row of silk sutures through the whole abdominal wall.

The operation occupied two hours; the patient was in good condition at its close; pulse 110.

Five and one-half hours after the operation no fluid was found in the tube, which was, therefore, removed. The patient has no pain upon high percussion over the abdomen, but complains of pain in the stomach. *February 22d.* The patient feels weak and passed gas by the anus; complains of pain in the wound; has vomited dark-green matter, the vomiting of which causes an intense burning to the throat and mouth. *28th.* Wound dressed. Wound in good condition and apparently no bile. Packing removed and replaced. *March 3d.* Wound dressed; a

portion of the packing removed from the wound. Considerable sensitiveness on pressure over the lower part of the wound apparently caused by a tight suture, which was removed. Pain ceased immediately after dressing. 8th. Stitches removed, considerable pain on pressure along lower border of wound. Small drainage-tube in the gall-bladder was removed and sinus packed. No bile on dressings. 12th. The icterus has almost entirely disappeared. Patient feeling well. All of the gauze removed. The entire index-finger can be introduced into the wound leading to the duct. Very slight amount of discharge, consisting principally of blood, which followed the removal of the gauze packing. April 20th. The patient has gained seven pounds in weight since operation; is very much stronger. The sinus is small and closing in rapidly, and the discharge slight. The patient gained twenty pounds in weight in three months after the operation, and is now in perfect health.

REMARKS. The opening of the ductus choledochus was 1 cm. above and to the right of the duodenum, and was 2 to 3 cm. long. When the stone was removed it was found that the wall was not thickened, and clear yellow bile flowed out. The probe and elastic bougie could be passed upward in the hilus of the liver 10 cm. and down behind the duodenum 5 cm., but it may be that the bougie was flexed in the duct.

The ductus choledochus was so dilated that it would admit the little and even the third finger easily. The wall was smooth; no more stones could be felt. The finger could be passed 5 cm. up to the hilus without reaching the upper end. The finger passed downward behind the duodenum, entered a pocket 2 to 3 cm. deep, with a smooth wall, in which I could feel no stone, and through which neither finger, flexible sound, nor elastic bougie could be passed into the intestine—exactly the same conditions as in the previous case.

Six mucous sutures were first inserted, and then ten sero-muscular, buried sutures, because of the clear, light-yellow bile which exuded all the time between the sutures first introduced.

A probe passed through the gall-bladder was arrested somewhere in the cystic duct; it did not go down into the ductus choledochus. I could feel no more stones in the ductus choledochus, cystic duct, or the gall-bladder. At first nothing but a clear watery fluid passed out of the gall-bladder, but later there was a discharge of bile. A small drain was passed into the gall-bladder, the end of which was united to the skin. A Mikulicz drain was inserted down to the sutured wound in the ductus choledochus. The operation lasted two hours. I could see the yellow-spotted stone shining through the wall of the duct when pressed against it by two fingers behind the hepatico-duodenal ligament and the thumb on its anterior surface. The stone moved easily for 6 to 8 cm. in the ductus choledochus, from the hilus of the liver down to the pocket behind the duodenum. Sometimes it slipped up out of reach into the hilus of the liver, but could be brought down again by pushing

the fingers behind the hepatico-duodenal ligament high up into the hilus of the liver. The stone could also be pushed down near the duodenum and to the right free border of the hepatico-duodenal ligament, the fingers being in the foramen of Winslow.

I thought that I could see the vena porta as a blue band about 1 cm. broad, and that I punctured it with the needle; but the bleeding stopped as soon as the sutures were tied. Hereafter in operations of this character I shall employ fine, curved, round-pointed needles and fine silk. The ends of the inner sutures should be kept long in order to make traction on the wound when the outer sutures are introduced. Straight needles cannot be used, as the bottom of the wound is deep and the operating-space narrow. The liver must be held up by both the index and third fingers of an assistant.

It is not necessary to find the opening into the duodenum, and this is often impossible; it could not be found in either of my two cases. The icterus was intermittent, and there was no inflammation of the wall of the duct. The choledochus stone could be moved for 8 or 10 cm. and obstructed the flow of bile like a ball-valve.

CASE IV. Biliary colic and icterus two years ago; frequent attacks of indigestion and pain in cardiac region for two years without icterus; then second severe attack with icterus; later very frequent slight attacks twice a week; fever; loss in weight, 25 pounds in twelve days; slight icterus; no tumor in region of gall-bladder; operation; extensive adhesions over atrophied and empty gall-bladder; choledochotomy; removal of four stones; recovery; gained 40 pounds in forty days.

H. J. W., American; weight, 140 pounds; height, five feet eleven inches; married; occupation, dial-maker. Family history good; no trace of hereditary disease. For the past two years the patient has been working in the baking-room of the dial department of a watch factory, where the heat is so intense that it can be endured for a few minutes only, and the men are obliged to work in relays. For eight years previously he had worked in the dial department. Patient's habits are good, he lives a simple life, smokes an occasional cigar, and at rare intervals drinks a glass of beer. So far as he knows he has not been exposed to accidents or contagion in any form. With the exception of the ordinary illnesses of childhood he has always been well until three years ago, when he had a very severe attack of typhoid fever, from which he recovered, however, without complications.

The present illness commenced in August, 1893, when the patient had a sudden attack of pain in the region of the gall-bladder, accompanied by chills, fever, very intense pain, and marked jaundice. The jaundice gradually passed away, but from that time until February 5, 1895, he had frequent attacks of what he supposed to be indigestion or gastralgia, which were always sudden in onset, attended by severe pain, occasionally nausea, no vomiting, sometimes by chills and fever, and apparently independent of the food taken or the time of day. On February 5th, while at work, he was suddenly seized with severe pain in the region of the gall-bladder, chills, fever, but no vomiting. Within twenty-four hours intense jaundice appeared and marked constipation.

He was seen by Dr. Webster on February 17th, and at that time, although enormous amounts of cathartics had been taken, his bowels had not moved for ten days. The jaundice was intense, the pain not severe, temperature 101° , tongue coated, a bad taste in the mouth, no vomiting, occasional sweats, urine limited in quantity and containing a large amount of bile. The patient lost about twenty-five pounds in weight in the twelve days intervening between the attack and the time he was seen by Dr. Webster, and averaged two attacks a week, which were preceded by a vague uneasiness, and were always accompanied by a chill, temperature as high as $102\frac{1}{4}^{\circ}$, pulse 60, sweating, marked increase in the intensity of the jaundice, increase of bile in the urine, and very light stools. The pain persisted from a few minutes to an hour or more, was always quite severe, and the patient learned from experience that relief was more quickly obtained when he lay on his abdomen.

In the intervals between the attacks the jaundice faded, but did not disappear entirely; the urine became lighter in color, but always contained bile; the feces were darker. Itching of the skin was annoying and constant.

Present condition. Inspection shows a fairly nourished body. Jaundice well marked, though not so intense as at any time since February 5th; stools light colored, but very much darker than during or a day subsequent to the attacks. Urine normal in amount, specific gravity 1020; no albumin, sugar, or casts; urea 0.017 per cent., strongly acid, and contains bile. Blood contains 78 per cent. hæmoglobin; pulse in sitting posture 60. Heart normal; respiratory system normal. Nervous system—the patient is cheerful and hopeful, although the characteristic despondency has been present, but without great melancholia, nausea, or severe manifestations of nervous perturbation. Digestive system—tongue is less coated than previously, bad taste in the mouth, worse during attacks. Appetite—can eat but simple, light food at intervals between attacks. Slight eructations, considerable nausea but very little vomiting, but none during the last few days. The bowels have moved under small doses of sodium phosphate. Patient has never had piles nor bloody stools. There is no enlargement of glands, the liver is normal in size, and there is no apparent enlargement of the gall-bladder.

On April 14th, I operated at Mercy Hospital, in the presence of Drs. Morgan, Roler, Raymond, Webster, Billings, Andrews, Black, and Thiel. Upon inspection the patient was rather lean, skin of yellowish tint, but not exactly icteric; conjunctiva slightly yellowish. Ether was the anæsthetic, and was given by Dr. Weir.

Operation. A lateral longitudinal incision, 18 to 20 cm. in length, was made at the outer border of the right rectus muscle from above the border of the ribs to below the umbilicus. After packing with flat sponges the parietal peritoneum was sutured to the skin. Upon examination I found that the liver was drawn or extended more to the right than normal, so that the suspensory ligament of the liver and part of the left lobe presented in the middle of the lateral wound. The wall of the stomach presented below the liver; the groove for the gall-bladder was situated to the right of the wound and could not be brought into view without extending the field of operation to the right, and therefore a transverse incision, 6 to 8 cm. in length, became necessary. I could now reach the groove for the gall-bladder—the incisura between the right and the anterior lobe. At this point was found a cord-like adhe-

sive band, 1½ cm. broad and 8 mm. thick, binding the liver to the abdominal wall, which was probably the cause of the abnormal position and retention of the liver. This band was cut after double ligation and transfixion.

The gall-bladder could not be seen, as the incisura was filled with omentum, the wall of the stomach and the lesser curvature of its pyloric portion, which was at this point adherent to the liver and omentum.

The division of the omentum between double ligatures did not bring the gall bladder into view, but exposed the transverse colon. The division of the ligamentum hepatico-gastricum made it possible to push the stomach to the left, there to be retained by a flat sponge. The loosening of the colon by division of the ligamentum gastro-colicum finally brought the gall-bladder into view. It was empty, contracted, 2 cm. broad and 4 cm. long, and whitish. Upon blunt dissection backward with the finger and Kocher's sound, the hilus of the liver with the foramen of Winslow were laid bare, and also the bile-ducts and descending portion of the duodenum.

I could now feel a movable stone at this point, and could insert the index and third fingers into the foramen of Winslow behind the hepatico-duodenal ligament, and grasp between these two fingers and my thumb the vena porta and bile-ducts. With the fingers of my right hand I pushed the duodenum to the left and could feel two movable stones which glided from right to left in the common duct with absolute ease and freedom. They could be dislodged to the left down behind the duodenum and then could be pushed upward and to the right into the hilus of the liver. A slightly enlarged lymph-gland lay on the anterior surface of the common duct. The vena porta could not be seen. After packing with more sponges the first stone was now pushed down to the left and fixed in position against the anterior wall of the common duct close to the right border of the duodenum. An incision, 1 cm. long, longitudinal to the axis of the common duct, was now made on the upper aspect of its anterior surface down to the stone, whose yellowish-white nodulated surfaces presented in the wound. Transparent light-yellow bile flowed out of the incision, from which Dr. Black took cultures, but which he found to be sterile. A round stone (see Fig. 3, No. 1) was lifted and pressed out of the opening with the help of Kocher's sound, which was passed into the duct behind it. This stone was globular and 14 mm. in diameter. A second stone of the same size and shape was now removed; also a third stone a little smaller, probably 12 mm. in diameter.

I now explored the common duct with my little finger, which passed down behind the duodenum 2 cm. into a smooth cul-de-sac in which I could feel no stone. I then passed the finger upward for 2 cm., when it was grasped rather tightly by the walls of the duct, but here also no stone could be felt. A silver probe was now passed first downward, which did not enter the duodenum, and then upward for 8 cm., not into the gall-bladder, but into the hepatic duct. On withdrawing it I felt a grating as of a stone, and manipulation between the fingers of the contents of the hepatico-duodenal ligament brought forth a fourth stone smaller than the preceding, globular, about 6 mm. in diameter.

An elastic olive-pointed bougie, No. 10, American, was now passed into the common duct, first downward, when it entered the duodenum and could easily be passed down its entire length; then upward about

10 cm. into the liver, but not into the gall-bladder. The wall of the common duct was normal, but was rather thinner than usual.

The wound in the common duct was now sutured, first by mucous membrane sutures; the mucosa was reddish-grayish white, soft, with longitudinal folds. It was held with forceps, three silk sutures applied, upon the knotting of which the flow of bile almost ceased; second, the sero-muscular sutures which took in 4 mm. of the outer layer of the wall with its covering-layer of hepatico-duodenal ligament. Five sutures were first applied, but the flow of bile was rather increased than diminished, and bile was seen to come out of the needle-punctures. Two or three more sutures were applied obliquely and transversely to the others in the axis of the common duct, but even then the oozing of the bile did not completely stop. As I considered that when the pressure on the ducts and the liver which, was being held up with some difficulty by two assistants, was relieved, the flow of bile would stop, I resolved to close the wound.

Boric-acid gauze was packed in the hilus of the liver over the common duct, the six large abdominal sponges removed and one large clean sponge spread over the abdominal contents behind the wound in the abdominal wall.

The abdominal wound was closed by suture of the divided muscles in the transverse wound with buried silk sutures, and then by heavy trans-peritoneal sutures through the entire wall to the skin.

A rubber drainage-tube 1 cm. in diameter was passed up to the wound in the common duct; borated gauze packed in above the surface of the tube on to the hilus of the liver and also below the surface of the tube, and the abdominal wound left open for 4 to 5 cm. The wound was then dressed in the usual way.

The operation lasted an hour and a half; the pulse became better and stronger during the latter part of the operation.

The next day the outside dressings were removed and were found to be thoroughly saturated with bile, probably 10 to 12 ounces, and renewed.

On *April 17th* the wound was again dressed. The deeper layers of the dressing were soaked with bile, but probably not more than 2 or 3 ounces. The wound looked well. *18th.* The bowels moved spontaneously, the feces were ochre-brown in color. *20th.* There was very little discharge of bile until the patient was turned on the right side, when the dressing became soaked in about half an hour with probably 3 or 4 ounces of a greenish-yellow fluid. *21st.* When the patient was turned on the right side the discharge again became profuse, and soon assumed a fermentative odor. When the wound was redressed, the discharge in the upper layers of the dressing had a sour, fermentative odor, but the dressings next to the wound were sweet, the discharge resembled warm digesting milk, but was not of an intestinal character. The packing was now removed, and the wound found to be in healthy, granulating condition. A little stitch-necrosis was present. The superficial stitches were removed, the wound washed with a saturated solution of boric acid, and repacked lightly. *22d.* After an enema of magnesium sulphate, the bowel-movement was of a dark greenish color. *23d.* The wound was redressed; about half an ounce of discharge was found on the proximal dressing, very slightly sour in odor, and chylous in appearance. The drainage-tube was removed and found

plugged at the bottom with a mass of pressure-necrosis material. The tube was not replaced. The wound was irrigated with warm saturated solution of boric acid and lightly repacked with borated gauze. 25th. The wound was redressed; about 3 ounces of discharge of the same chylous appearance as before, but with a great admixture of bile, appeared on the dressing. Upon removal of the dressing 3 or 4 drachms of odorless pure bile floated down on the surface. Streak and stab cultures were made from both the chylous-like discharge and from the bile, both of which were negative.

On April 28th Prof. W. E. Morgan made the following report:

"The patient still discharges through the wound and from the duct a quantity of the chylous-appearing fluid, and for the past two days a considerable quantity of bile also, 2 to 3 ounces in twenty-four hours. As it occurred to me that the fluid might possibly be pancreatic in origin, I subjected some of it to a physiologic chemist for examination, and enclose his report. The discharge in question certainly comes from within the duct, and not from the surface of the wound, for I have been able at the last two dressings to watch its accumulation in the deepest part of the wound. At first, it looks like a coarse emulsion of fat in water, then slowly separates into two layers, the deeper one milky in appearance, the upper one like clear bile. I would naturally think the oily portion would be lighter in specific gravity, but perhaps the admixture of mucus may make the deep layer heavier; it certainly is more adherent. The patient is doing well."

Report of chemical examination of the discharge by Dr. Charles H. Miller:

"Source: liquids obtained by washing out the dressing.

"A. *External Dressings*. The dressings were colored green from the dried discharge, which had ascended highest from more perfect capillary attraction. On washing, obtained 350 c.c. green liquid of neutral reaction with a specific gravity of 1.016, which contains a considerable quantity of bile, traces of serum-albumin, and practically nothing else.

"B. *Internal Dressings*. The internal dressings, especially those used for packing the wound, yielded 200 c.c. of a yellowish-white, creamy liquid of slightly acid reaction, due to lactic acid. Specific gravity, 1.023. On standing, this gave a heavy white precipitate containing pus-corpuscles (Donné's test). The supernatant liquid is strongly albuminous, and contains mainly serum-albumin with a small amount of peptone.

"Bile was present in small quantity; chlorides; phosphates, as salts of the alkali; urea, in minute traces only; fat, traces only; blood, in minute traces only (guaiac test); sugar was not present.

"The results of the approximate analysis would indicate that the liquid is a mixture of lymph and bile containing large numbers of pus-corpuscles. The examination was made twenty hours after the liquid was obtained. The trace of acidity is attributed to bacterial decomposition after removal from the body."

On November 9, 1895, I received the following report from Dr. Webster:

"In reply to your inquiry regarding my brother's health, I am pleased to write you that he gained forty pounds in weight in forty days after leaving the hospital, and has not missed one hour's work since recovery."

REMARKS. The operating-space was small and the application of sutures in the common duct difficult. For this purpose small, rounded, curved needles are necessary. If the wall of the duct is thin or normal, it is not easy to close the duct hermetically.

The liver was normal in color, little if any enlarged, and its borders were not rounded. On the upper surface of the right lobe I could feel numerous (fifty or more) small superficial, hard or resistant nodules from the size of a pin's head to that of a split pea. They could be seen as slight prominences over the surface of the liver. The liver-tissue was perhaps a trifle darker than normal, but neither whitish, yellowish, nor green. When I felt these nodules before I had found the stone in the common duct, I feared they were malignant metastatic tumors in the liver, due to a primary tumor somewhere around the hilus; but their large number, uniformly small size, and color made me consider them peripheral dilatations of the small bile-ducts. This was made certain by finding stones in the common duct. The nodules were not distributed all over the liver, none could be found on the lower surface; they were limited to a territory the size of the palm of the hand on the convex surface of the right lobe, and each was almost in contact with the others. My belief is that a large branch of the hepatic duct had been occluded by a stone, possibly by the smaller one (No. 4), or a stone which I did not discover. It may thus be well, as was done in this case, to pass an elastic bougie or probe and attempt to dislodge a stone situated higher up in the larger ducts of the liver. The increased flow of bile toward the end of the operation, at the time of incision and suture of the common duct, may have been due to the successive evacuation of a distended and overburdened territory of peripheral bile-ducts, and it is more than likely that the creamy fluid so abundantly discharged in the early part of the after-treatment was the contents of these dilated peripheral bile-ducts, which contained not bile, but an acholic serous fluid.

The peculiar nodulated condition found in the lower right half of the upper surface of the right lobe of the liver was due to dilatation of the distal ends of the bile-ducts. Courvoisier mentions one case in the literature, in which the superficial branches of the bile-ducts presented a varicosed appearance (*loc. cit.*, p. 56), and four cases in which the superficial terminal bile-ducts were transformed into small cysts the size of a cherry, protruding from the convex surface of the liver. It is natural that large quantities of bile should be evacuated even during the operation, after the opening of the common duct, and that the flow of bile should be considerable for several days thereafter. In such cases it might be advisable not to close the common duct entirely so that evacuation of bile might be permitted through the wound.

Another remarkable phenomenon observed in this case was the dis-

charge of large quantities of a milky fluid which did not contain bile-pigments, and which was characteristic of the acholic condition. Courvoisier found in the literature ten cases of hydrops of the biliary ducts, which were filled with a watery, colorless, or slightly mucoid fluid which did not possess any of the characteristics of bile. In these ten cases the entire system of the biliary tract, possibly with the exception of the gall-bladder, was filled with a hydropic fluid of this nature. In none of these ten cases was the obstruction due to stone, but to tumors within or outside of the common duct, or to obliteration of the duct in one case. He explains the acholia by assuming that cessation of the secretion of bile may under certain circumstances be caused by high pressure on the liver-cells due to the stagnation of bile behind the obstruction. In this case the acholia was partial, and was caused by a stone, probably a small stone, which was at last removed and dislodged by introduction of the probe high up through the hepatic duct into one of its branches. This phenomenon is remarkable in both these respects, as it is the only observation of the kind on record.

As the patient has had no disturbing symptoms up to the present time, eight months after the operation, and as the acholic territory became entirely empty shortly after the operation, it is not likely that a stone which had not been removed could have caused the localized dilatation of the ducts, nor that the acholic fluid could have come from any other territory than that of the dilated ducts. Prof. Morgan thought that the fluid might be pancreatic, from division of the pancreatic duct during the operation; but the incision in the common duct was nearly an inch from the pancreatic duct, and the fluid was shown to be non-pancreatic by the chemical examination made by Dr. Miller and reported above.

When it is impossible to close the common duct by suture so that no bile escapes, thorough drainage is important, namely, a rubber drain up to the sutured wound in the duct, carefully packing gauze around it, not only in the hilus, but out toward the stomach to the left, toward the flexure of the colon to the right, and to the transverse colon downward. This packing should be done before the closure of the abdominal wall is commenced, while the liver is still being held up by the assistants so that the nooks and corners to be packed may be clearly seen; a sufficiently large opening should also be left in the abdominal wound to allow free exit for the bile, through the tube and packing.

CASE V. *Six attacks of biliary colic since December, 1894, the later ones followed by icterus; frequent short attacks of pain in epigastrium; slight icterus; loss of weight, 23 pounds; no tumor in region of gall-bladder; diagnosis, stone in common duct; operation; adhesions to gall-bladder; enlarged glands in hilus; no stone found; change of diagnosis to malignant tumor in head of pancreas; cholecystenterostomy with*

Murphy button; death on fourth day, probably from cholæmia; autopsy, no malignant tumor; small gall-stone size of a cherry-stone found in diverticulum of Vater.

P. W., railroad-clerk, aged twenty-five years, was admitted to Emergency Hospital, May 18, 1895. Family history negative, with the exception of his paternal grandfather, who, in the course of an illness of three weeks, during which he was much jaundiced and had excruciating pain in the region of the liver, passed a number of gall-stones.

The patient had the ordinary diseases of childhood, and has had two attacks of gonorrhœa. He also had typhoid fever five years ago. He seldom drinks liquor, never to excess; uses tobacco sparingly; has a good appetite, and no cough. Has never suffered from any accident; is generally constipated.

The present illness commenced in December, 1894, when he was awakened early one morning by a slight, dull aching pain in the epigastric region. The pain continued quite severe in character, notwithstanding a warm compress, for about nine hours, when it suddenly disappeared. This time he did not notice that he was jaundiced. The character of the pain in this attack was somewhat paroxysmal. Each paroxysm would last from ten to fifteen minutes and would be followed by an interval of from half an hour to an hour and a half. The second attack occurred about the last of February, 1895. It commenced early one morning. The pain gradually increased in severity, and then suddenly disappeared exactly as in the former attack. This attack lasted about twelve hours, but for six or seven days afterward he felt more or less ill, and his appetite was poor. He did not notice any jaundice. The pain was localized in the epigastric region in a territory about three inches in diameter. The third attack occurred on March 28th. In the morning of that day he had a disagreeable feeling accompanied by fleeting pains in the epigastric region. In the afternoon he felt cold and chilly, but had no distinct chill. About 3.30 P.M. the pain began to increase rapidly in severity and soon became intense. After about fifteen minutes it suddenly disappeared. About two hours later he had another paroxysm, but not so severe as the first. This attack was not accompanied by jaundice. Three days later, while he was on his way home, he vomited three times on the train and perspired profusely. He had no pain, but had three very loose movements of the bowels. The next day he did not feel well, but had no pain.

The following day the fourth attack seized him and persisted for two hours and a half, but was not so severe as the former attack. During this attack he was not jaundiced, but his face was discolored. The day after this attack he was decidedly jaundiced, and the urine was very dark. He had painful attacks once or twice during the day. During the succeeding ten days he had an attack of pain every day, which lasted from half an hour to two hours, at the end of which time it would suddenly disappear. The jaundice was noticeable for about a week after its appearance. At the end of this period of ten days the pain continued in a less severe form for about five days. On April 19th he had a very severe attack which lasted about three hours, and for two weeks thereafter had less severe attacks of pain each day. The pain was always included in a space in the epigastric region, about three inches in diameter.

During the two weeks preceding his admission to the hospital he had

three attacks of pain. The first two were not severe, but the last attack, which occurred on May 14th, lasted for twelve hours. For the first four hours of this time it was not especially severe, but from this time on there was constant pain of varying intensity. He vomited three times during this attack, while the pain was at the maximum, and the vomiting was followed by a cessation of pain for about half an hour. He was distinctly jaundiced after this attack.

The character and intensity of the pain were varied by the patient's position. If he lay on either side or on his stomach, the pain was increased. When he would lie on the back, with the right thigh flexed to a right-angle, and the left leg drawn up and thrown across the right thigh, or with both thighs flexed as much as possible, or when he would sit up in bed and draw the knees up to the chin, the pain was less severe. The patient never tried to stand erect.

After the third attack the urine became very dark and continued so for about ten days. After the next attack the duskiess of the urine continued for about five days. On May 14th it again became very dark, and has remained so up to the present time. On May 17th he had another slight attack, which lasted only two or three minutes. During the attacks of pain pressure of any kind was intolerable, and any noise or jarring in or around the room seemed to increase the pain; pressure during the free intervals, however, was not attended by pain.

The patient's usual weight is 165 pounds, but on April 15th he weighed only 142 pounds, a loss in weight of 23 pounds.

No stones have ever been found in the feces.

Diagnosis before operation. As the patient had had six distinct attacks of gall-stone colic, increasing in severity and duration, and increasing also in frequency; as the pain was located in the epigastric region, and not in the region of the gall-bladder; as icterus of medium degree followed the later attacks; as marked emaciation (a loss in weight of 23 pounds) was present; and as there was an absence of tumor or pain in the region of the gall-bladder, I made a diagnosis of floating gall-stones in the common duct, feeling certain that this was a typical case, as all the characteristic symptoms were present. I therefore advised operation.

Operation. After the usual preparations the operation was performed on May 10th. The patient was anesthetized by ether, an incision was made over the gall-bladder, extending downward from the lower border of the costal arch to the level of the umbilicus through the skin and superficial fascia. The rectus muscle was then separated by blunt dissection, and an opening made in the peritoneum, which was enlarged to the limits of the wound. The peritoneum was sutured to the skin, and the intestines protected by large flat sponges. The wound was now enlarged upward to the costal cartilages and downward to half an inch below the umbilicus. Extensive adhesions existed between the liver and the surrounding organs. These adhesions were loosened with considerable difficulty by blunt dissection or division between ligatures, and the common duct, artery, and vein could be felt by the examining finger passed through the foramen of Winslow. Careful palpation of the common and cystic ducts was negative, as no stones could be felt. The liver was then palpated, and hard, round nodules were found on its surface, which felt like dilated hepatic ducts. The head of the pancreas was enlarged, and I was inclined to attribute to this fact the symptom of jaundice due

to pressure upon the common duct. Some enlarged lymphatic glands were found, one as large as a horse-chestnut. One of these glands was removed for examination. To determine the patency of the common duct, a flexible sound was passed down through an incision into the gall-bladder, through the cystic duct into the common duct, and finally into the duodenum.

I now made a diagnosis, which afterward proved to be erroneous, of malignant disease of the head of the pancreas. I therefore attached the gall-bladder to the jejunum by means of a medium-sized Murphy button. This procedure was attended with extreme difficulty on account of the small calibre of the atrophied gall-bladder. The abdomen was then thoroughly cleansed, and two strips of gauze inserted, one above and the other below the point of anastomosis. The abdominal wound was closed with interrupted sutures, which were passed through the entire wall. One of these sutures was placed, but not tied. The ordinary dressings were now applied. The operation occupied two hours.

Twenty-four hours after the operation the temperature began to rise, and four days later reached 104° , attended with vomiting, pain, a dry tongue, with no tympanites. The patient died on the fourth day.

Autopsy. Upon opening the abdomen no diffused peritonitis was found; the gauze in the hilus was adherent to the surrounding intestines and stained with bile. There was no leakage from, or peritonic exudate around, the cholecystenterostomy. The liver, together with the stomach, duodenum, pancreas, and a loop of jejunum at the site of the anastomosis, was removed entire.

The liver was of normal size and appearance; the atrophied gall-bladder was united with the jejunum by a perfectly tight agglutination at the place of anastomosis.

Careful palpation of the hepatico-duodenal ligament failed to detect any stone or dilatation of the common duct. The pancreas was normal on palpation, and its head did not now appear enlarged, nor were any nodules nor abnormally hard territories to be felt in it.

I now opened the duodenum by a longitudinal incision over the head of the pancreas in order to examine the duodenal opening of the common duct. The inner surface of the duodenum appeared normal, and presented the usual transverse folds. On the inner surface of the posterior wall of the duodenum at the point where it crossed the head of the pancreas, I could now see a small, round polypus, one centimetre in diameter, movable freely from side to side, but less movable in a vertical direction; it was covered with mucosa, and was attached to the duodenum posteriorly by a broad base. I supposed this to be a small submucous lipoma or fibroma, protruding like a polypus into the lumen of the intestine. Upon closer examination, however, I found on its convex surface, near the upper end, the opening into the common duct. A sound passed easily from this opening into the duct, which appeared of about normal calibre. On passing the sound through the opening in the duodenal mucosa I felt a slight grating as from a stone at the location of the supposed polypus. I now made an incision from the opening downward through the mucosa covering the polypus, and found a gall-stone the size of a cherry-stone (see Fig. 5) in the supposed polypus, which was thus shown to be the diverticulum of Vater dilated downward so as to form a small pouch wherein the stone was contained. There was ample room over the stone to allow the passage of a bougie No. 14, French scale, in

the common duct, as had been done during the operation. No other stones were found in the common duct, cystic duct, or gall-bladder.

Microscopic examination of the liver showed a slight degree of fat-infiltration of the liver-cells, most of which contained one or more oil-globules, not large enough, however, to fill the entire liver-cells, the contour of which could almost always be recognized. The branches of the hepatic vein at the centre of the acini were somewhat dilated. The smallest bile-ducts could be seen to be not dilated, and to have normal epithelium. Around the periacinous branches of the vena porta there was slight infiltration with leucocytes, but this did not extend from the paravascular spaces out into the acini between the rows of the liver-cells.

It was thus seen that a slight degree of beginning interstitial hepatitis and a medium or slight degree of fat-infiltration were the only abnormal conditions to be found in the liver.

REMARKS. As I found the gall-bladder small, empty, and retracted, surrounded by the usual characteristic adhesions, I confidently expected to find a stone in the common duct, and was greatly surprised to find no stone upon palpation of the hepatico-duodenal ligament. The large lymph-glands in the ligament were soft; this might have been from inflammation, as in case of choledochus stones, but might also occur as a result of sarcoma. As I now found the head of the pancreas unusually large and firm, I changed my diagnosis, and thought of a tumor—a carcinoma or sarcoma—in the head of the pancreas, which had caused the intermittent paroxysms by compression of the common duct in its course through the head of the pancreas. I therefore opened the gall-bladder, first, to determine the patency of the common duct, and, second, to establish a cholecystenterostomy. As the flexible olive-pointed bougie passed easily down into the duodenum, I thought that no stone could be present, and that the bougie might have passed by a tumor in the head of the pancreas large enough to make compression of the common duct. I resolved upon cholecystenterostomy, because I expected the tumor in the head of the pancreas to increase in size and gradually to cause more compression.

The stone, covered with the soft wall of the diverticulum of Vater, was so small as to escape detection even after the duodenum was opened at the autopsy. If I had used a metallic instead of a flexible sound, I might possibly have detected the stone by the grating sensation at the location of the diverticulum of Vater. Had this been the case, I would have been able to remove the stone either from the ordinary incision in the common duct or from the duodenum, after incising the latter.

The small stone found in this case had a rather roughened, crystalline surface, with sharp, jagged points, or rather wavy ridges, like a fine saw. It imparted a feeling of grating or scratching when rubbed over the skin of the dorsum of the hand. It is possible that this stone would

cause more destruction of epithelium and subsequent inflammation than the smooth stones found in Case IV.

The hard, swollen condition of the pancreas, and especially of the head of the pancreas, led me to believe during the operation that a malignant tumor existed, which had caused the biliary obstruction, and this so much the more as I was unable to detect the small stone in the diverticulum of Vater. The autopsy demonstrated that the stone was present, and that no tumor of the pancreas existed; consequently the swelling or enlargement of the pancreas, which I felt during the operation, must have been of an inflammatory nature. This is in conformity with the considerable inflammatory swelling of the lymph-gland, the size of a small walnut, in the hepatico-duodenal ligament, on the anterior surface of the common duct. Although I had in other cases found swellings of the lymph-glands in this location, as a symptom of the inflammation which probably caused the adhesion between the biliary tract from the gall-bladder to the end of the common duct, on the one hand, and all the movable adjacent organs—the omentum, stomach, transverse colon, abdominal wall, and duodenum—on the other, I had not before observed any marked inflammatory swelling of the pancreas.

Similar observations have recently been reported by Riedel in a communication made before the Section of Surgery of the Convention of Naturalists in Lubeck on September 19, 1895. Riedel found inflammatory changes in the pancreas following gall-stone disease, which caused so considerable a swelling as to give the impression of a large pancreatic tumor. The author mentioned two cases in which these apparent tumors disappeared entirely, and a third case in which the autopsy demonstrated the simple inflammatory character of the tumefaction.

CASE VI. Tuberculosis of knee and shoulder for which resections were made; last operation three years ago; two years ago, pain in epigastric region; May, 1895, pain over liver; July, 1895, pain in epigastric region, with icterus; August, 1895, third attack, medium degree of icterus, emaciation; loss of weight, 53 pounds in seven months; no tumor in region of gall-bladder; choledochotomy; two large stones and one small stone removed; cholecystotomy; one stone removed; recovery; gained 38 pounds in two months.

Miss A. E. D., aged twenty-four years, was admitted to Passavant Memorial Hospital, October 5, 1895. Family history negative. Patient had the ordinary diseases of childhood; she began to menstruate at the age of sixteen years, and has always been regular. She was reared at the breast, and has never used cow's milk to any extent.

In 1887 I operated upon her first, making a resection of the right knee-joint on account of tuberculosis. A second operation was performed six months later. Six months after this I operated upon her for tuberculosis of the right shoulder-joint, and since that time I have twice

operated upon the right shoulder, the last operation being performed three years ago.

Her present illness began in 1893, when she had severe epigastric pain of a dull, aching character. The pain persisted for about a week, but she remained in bed for a week after this. The pain was accompanied by vomiting-attacks, which recurred twice a day. The patient thinks that she was given emetics, for the vomiting attacks always gave relief, which continued until she took solid food, when the pain would recur, to be relieved by another attack of vomiting. During the second week of this illness she had no attacks of vomiting. At this time she had no trouble with her bowels, and was not jaundiced, although she thinks her skin was a little darker than usual after the attack. During the last two years she has had slight attacks of pain, which were usually followed by slight darkening of the skin.

In May, 1895, she had a severe attack, which began suddenly, with dull pain, increased on deep respiration, in the right side, in the region of the costal arch, over the liver. This pain continued until the latter part of June, but was not attended by vomiting. The pain then grew worse, and became so severe that on July 1st she was obliged to take to her bed. Two days later the attacks of vomiting recurred. She vomited continually for two weeks upon the slightest provocation, even the ingestion of a few drops of water would cause an attack. At this time vomiting gave no relief from the pain. The pain had now extended until the epigastric, hypochondriac, and lumbar regions were included, and these parts were sore and tender to the touch.

On July 6th she had jaundice for the first time, and this has persisted up to the present time. She improved slightly, so that she was able to be up and around about July 20th; but on August 5th she had a third and very severe attack, localized in the epigastric region, but without pain in the sides, except at the maximum of the attack. Forced vomiting gave her immediate relief, and up to this time she always nauseates herself before she vomits. This third attack lasted for about two weeks. Since that time she has had occasional pain, but no continued attack. Solid food always causes or increases the pain. During the attacks there is great tenderness in the epigastrium, but this tenderness disappears with the pain.

There has been a marked diminution of weight. In February, 1895, she weighed 133 pounds; in October, seven months later, she weighed only 80 pounds, a loss of weight of 53 pounds.

Upon examination the patient was found to be very thin, her eyes surrounded by dark circles; the skin was a dark greenish-yellow, but not distinctly icteric. On account of her previous history and this bronzing of the skin I thought of Addison's disease, tuberculosis of the suprarenal capsules. The thoracic organs were normal, the abdomen flat, liver-dulness normal, no tumor in the region of the gall-bladder. The borders of the liver could not be distinctly felt. There was no tumor in the epigastrium, and the aorta appeared normal. There was slight tenderness upon deep pressure in the median line midway between the xiphoid appendix and the umbilicus, but it was indistinct, and no swelling or resistance could be felt. Dr. Conley states that the patient says she has passed many gall-stones.

Operation. On October 8th, assisted by Dr. Waters, who administered the ether, Drs. Brougham and Brown, and in the presence of Dr.

Conley, I made a longitudinal incision an inch and a half to the left of the linea alba in the outer third of the rectus abdominis muscle. The peritoneum was stitched to the skin from the border of the ribs to the umbilicus, and later on to one inch below this point. A flat sponge was inserted to push back the omentum. Exploration revealed the border of the liver and the end of the gall-bladder, the latter appearing as a whitish, empty, folded sac, the end of which protruded like the end of a finger. It was $1\frac{1}{2}$ cm. in diameter, and firm to pressure, as if it were contracted around a small stone. This led me to believe that the lumen of the gall-bladder was obliterated behind a stone lodged in its distal end. The finger could be easily passed down to the neck of the gall-bladder and the cystic duct, and from here into the foramen of Winslow. The hepatico-duodenal ligament was palpated between the index-finger and thumb and two floating stones felt therein, which could be easily moved from the hilus down to the posterior surface of the duodenum.

The abdominal incision was prolonged to one inch below the umbilicus, making the incision in all 12 or 14 cm. in length, in order to gain operating-space without the necessity of making a transverse incision. The sponge over the stomach was held to the left by the fingers of an assistant, the liver held up by the fingers of another assistant, and I had my left index-finger in the foramen of Winslow. The tip of the finger could be seen through the hepatico-gastric ligament, above the hepatic artery which could be seen and its pulsations felt. One of the two stones was pressed against the anterior wall of the hepatico-duodenal ligament, whereupon I saw a blue strip or line above the stone, which I feared was the vena porta; but upon releasing the pressure I saw a branch passing downward from this vein, and therefore judged the blue line to be a branch of the vena porta dividing in the loose layer of the hepatico-duodenal ligament on the anterior wall of the left half of the dilated ductus choledochus. I now incised the duct over the stone below the upper horizontal branch and to the left of the descending branch, being guided by the stone, which showed through the wall of the duct, or rather gave the wall of the duct a whitish appearance. No enlarged lymph-glands were found. When the stone was reached, clear yellow bile escaped. The first stone was then squeezed out and the second stone brought into view and pushed out. I then easily inserted my little finger into the ductus choledochus for a distance of 2 inches, behind the duodenum, where I felt a small stone, and up into the hilus of the liver, where I could feel no stones. By manipulation with the left third finger in the duodenal half of the duct and the right index-finger and thumb on the duodenum and head of the pancreas I could push the small stone out on the end of the left third finger. I then attempted to bring the stone out into the incision in the common duct, but it would always slide off the finger. I then introduced a small sharp spoon-curette, but could not extract the stone with it. Finally, with the left third finger in the duct, and the sharp spoon, I brought the stone out into the wound, where it broke into small pieces, which were removed in the form of débris.

A flexible bougie, No. 13, French, was now passed through the common duct into the duodenum, and another bougie up into the liver. A flexible silver probe passed down through the duct to the duodenum did

not pass into the duodenum, but no stones could be felt; and when the probe was passed up into the liver no stones could be felt.

The incision in the common duct was closed by five or six silk mucosa sutures and a continuous suture through the wound in the anterior layer of the hepatico-duodenal ligament. Notwithstanding the introduction of additional sutures, bile still oozed out. The field of operation in the common duct was now cleansed and packed with sterilized gauze. As the stone in the end of the gall-bladder was immovable, I now incised the wall of the gall-bladder over it. The wall was thick and considerable hemorrhage followed the incision. The stone, which lay in a bed of mucosa which enclosed it snugly, was now removed, but broke into débris during this process. I introduced my little finger into the gall-bladder and found it empty, but so contracted as only just to permit my finger, 14 mm. in diameter, to pass down to the cystic duct, where no stone was felt.

A drainage-tube was now inserted into the gall-bladder and gauze packed in over the wound in the common duct, up between the liver and stomach, and above and below the drainage-tube, which was passed down to the incision in the ductus choledochus. The gall-bladder wound was now united to the upper end of the external wound, the lower part of which was closed. The union of the wound was then completed with the exception of the opening for drainage-tubes and gauze-packing in the wound over the common duct.

The operation lasted an hour and a half. At its close the patient was in good condition with strong pulse. The operation was easy, as there were no adhesions. I feared tuberculosis, but found the peritoneum normal and no enlarged glands in the hilus of the liver. I also feared collapse from the cholæmia, but the patient bore the operation well, and five hours afterward was in good condition; pulse 80, strong; no vomiting; and was anxious to see the stones which had been removed.

October 9th. The patient had a fairly good night; no vomiting. The dressings were removed and found to be soaked with bile coming mostly from the large tube leading to the common duct. She vomited three times during the day a small quantity of bile, and on the day following vomited considerable quantities of bile. *11th.* She vomited several times very small quantities of bile. *12th.* Wound was dressed, found to be perfectly clean; no bile was found in the dressings, but only a serous, odorless discharge. *13th.* A portion of the gauze-drain in the gall-bladder and of that passed down to the common duct was removed. The icterus appeared to be less, and the patient's general condition was much improved. *17th.* All the gauze was removed from the gall-bladder wound; patient was continuously improving. *19th.* The remainder of the gauze-drain and also the drainage-tubes were removed. No bile in the dressings. *21st.* Stitches removed, wound in good condition, and the discharge materially decreased.

December 17th. Wound healed and patient left hospital. She has gained thirty-eight pounds in weight, looks well, feels well, has a splendid appetite, and feels no pain.

ANATOMY. In attempting to outline the field of operation for the common duct, and its topographical anatomy, it must be remembered that when operating we do not have a normal duct to deal with, but a duct more or less dilated. I, therefore, think it justifiable to use the

specimen here presented as a paradigm, and the exact anatomical relations between the organs in the hilus of the liver in this specimen will hold good for the majority of the cases of this kind with which we have to deal. I have found this to be the case in four out of five cases in which I have operated, and think it safe to conclude that the conditions about to be described will be those generally found. I will describe the organs in the position in which the operations are made; the patient lying on the table in the dorsal position and the anterior border of the liver held up by assistants, which makes its normally somewhat dependent position almost vertical; that is, the plane of the lower surface of the liver forms a right angle with the frontal plane of the body. Thus, the vertical position is changed, when the patient is upright, to a horizontal position. This does not change the relations of right to left, but changes the anterior or horizontal direction to a vertical or upright one, and *vice versa*. The vessels, bile-passages, and duodenum have been injected with colored paraffin. (See colored plates I and II.)

The organs to be considered are located between the two folds of the hepatico-duodenal ligament. This extends from the transverse sulcus, called the hilus of the liver, downward and consequently backward to the transverse colon, the duodenum, and the lesser curvature of the stomach, from right to left. Its right border is free and forms a free border between the posterior and anterior surface, being the free border of the entrance to the cavity of the lesser omentum, the anterior border of the so-called foramen of Winslow. The posterior surface is the anterior wall of the beginning of the lesser omental sac, and a finger introduced at this point will have the bile-ducts, vena porta, and hepatic artery on its anterior surface. The anterior surface of the ligament is covered with peritoneum from the large peritoneal cavity, continuous with the anterior surface of the greater omentum. When the index and third fingers of the left hand are passed into the foramen of Winslow and the thumb laid on the anterior surface of the ligament, the organs in question will be between the ends of the fingers. The ligament is on the average 5 to 6 cm. long, 3 to 4 cm. broad; its direction, being the direction of the common duct, is oblique, and forms an angle of about 54° with the frontal plane of the body.

Lymph-glands. In the loose connective tissue below the anterior (lower) surface of the ligament are situated from two to four lymph-glands, usually somewhat enlarged; I have seen them as large as a walnut. The upper, anterior glands are situated on the vena porta; the lower, posterior ones on the anterior surface of the common duct. In the connective tissue in this locality and running in the direction of the common duct there are three or more branches of the vena porta 1 to 2 mm. in diameter, 3 to 4 cm. long, and two or three branches of the hepatic artery of the same length and about 1 mm. in diameter.

Common Duct. The common duct is 6 to 7 cm. long, runs in an oblique direction, forming an angle of 45° with the frontal plane of the body, and when it contains a stone or stones is ordinarily dilated. It is thus 15 to 20 mm. in diameter, and may be divided into three portions, each 2 to $2\frac{1}{2}$ cm. long.

The upper or anterior portion, nearest the hilus, begins at the junction of the cystic and hepatic ducts. Its upper half is partially covered with the main trunk of the vena porta, which gradually retreats from its anterior to its posterior surface, to disappear behind the common duct at about its middle.

The middle portion has no vena porta on its anterior surface, but the upper half of the lower or right border is overlapped by the retreating vena porta. At its upper or left border the hepatic artery passes behind it on its way to the hilus of the liver, and at this point gives off a branch which passes forward on the anterior surface of the common duct, where it divides into two branches, one of which runs upward and to the right to the cystic duct, the other downward and to the left on the anterior surface of the lower half of the common duct. This middle portion of the common duct, the anterior surface of which is not in relation with the vena porta, is the place of choice for the incision in choledocholithotomy, as at this point only small branches of the vena porta and hepatic artery, as already described, are met with—vessels too small to cause serious or uncontrollable hemorrhage. Its upper border, together with the right free border of the duodenum and the hepatic artery, forms a triangular space.

The third, lower or posterior portion of the duct is almost entirely hidden by the duodenum which covers its anterior surface and its entire upper border for 2 to $2\frac{1}{2}$ cm., while only 1 to $1\frac{1}{2}$ cm. of its lower border is covered by the intestine. This part of the duct lies partly in the head of the pancreas. Its lower end is, as a rule, dilated and forms a cul-de-sac, usually a little smaller than the duct higher up, and at some place in this cul-de-sac (the dilated diverticulum Vateri) the opening into the duodenum is situated. The possibility of passing a sound down into the intestine from the incised common duct depends upon the situation of the duodenal opening in this cul-de-sac, and upon the direction of the canal through the wall of the duodenum. In some cases it is easy to pass a sound down, in others impossible, although the opening may allow free exit to bile (this may be due to valve-formation or to the fact that the probe or bougie is caught in a fold). The head of the pancreas overlaps or comes down below the lower border of this portion of the duct for 1 cm. or more.

Vena Porta. The vena porta commences behind the pancreas, runs as a trunk 18 mm. in diameter from left to right, slightly upward, first, behind the middle portion of the common duct; about its middle it

emerges on the lower or right border of the duct and runs from here upward and to the right for a distance of 3 to 3½ cm., when it divides into its hepatic branches. On its way it passes from the posterior surface around the lower border up on to the anterior surface of the upper portion of the duct and covers the lower part of this, extending to or a little upon the cystic duct. The terminal portion of the vena porta is situated on the anterior surface of, and consequently covers, the hepatic duct and its branches. Its termination is about 10 cm. above and to the right of the end of the cystic duct; in dividing, it gives off a main branch for the right lobe of the liver at an angle of about 110°, which passes downward and to the right. This main branch is 1½ cm. long and 10 to 12 mm. in diameter. From the place of division a branch for the quadrate lobe, 2 cm. long and 7 mm. in diameter, passes downward, backward, and a little to the left. At the left border and behind this branch is the bile duct for this territory of the liver, which is 3 mm. in diameter. Behind the bend and the upper border of the branch to the right lobe the upper border of the right branch of the hepatic duct comes into view. At the place where the trunk of the vena porta curves around from the lower upon the anterior surface of the common duct it takes up three other branches which run along this surface.

Hepatic Artery. From behind the pancreas, the hepatic artery, with a trunk 3 mm. in diameter, passes from left to right into the hepaticoduodenal ligament, for a distance of 15 mm. from the right border of the duodenum horizontally to the right until it reaches the common duct; then on its posterior surface into the hilus of the liver. When it reaches the common duct it gives off a branch which passes forward to the anterior surface of the common duct. This branch soon divides into two or three smaller branches, one running upward and to the right for the upper part of the common duct and the cystic duct, the others downward and to the left to supply the middle and lower portions of the common duct.

Cystic Duct. The cystic duct is about 4 cm. long; its lower half, which runs upward and to the right in the direction of the common duct, is 10 mm. in diameter, but gradually diminishes until its diameter is only 4 mm. Its upper portion runs vertically, forming an obtuse angle with the lower portion, the concavity being to the left. At its entrance into the gall-bladder in this specimen it is only 3 mm. in diameter. (In the specimen here described a round diverticulum, thin-walled, 2 cm. in diameter, was found upon its upper vertical portion.) The upper or distal half of the cystic duct may be incised in a vertical direction for the removal of stone at any place in its extent without wounding the vena porta; the lower or proximal half should be incised for stone as far from its lower or right border as possible so as to avoid wounding the vena porta.

Hepatic Duct and its Branches. The hepatic duct goes off from the common duct at the same place as the cystic duct and bends backward behind the latter and behind the vena porta and its branches. It is $2\frac{1}{2}$ to 3 centimetres long, passes to the right, downward and backward, and then divides into the branches for the liver. The upper border of the upper anterior branch to the right lobe can be seen behind and over the border of the vena porta. The branch to the quadrate lobe can be seen to the left behind the corresponding branch of the vena porta. The hepatic duct is thus situated behind and is covered by the cystic duct and the vena porta. A stone in this duct can therefore scarcely be felt from the anterior surface through these two organs, and when a floating stone is pushed or passes up here it apparently disappears into the liver, and search and manipulation are required to bring it again down into the common duct.

Gall-bladder. The gall-bladder, when distended, is pear-shaped, with its fundus toward the free border of the liver which, in its normal condition, it never overlaps, so that it can never be felt when the condition of the patient is normal (Rheinstein). It is from 8 to 14 cm. long and 3 cm. in diameter. At the entrance to the cystic duct it narrows down to 3 mm. in diameter. When retracted and atrophic from inflammation or protracted emptiness and disuse, as in the specimen here described, it may shrink to a length of 4 cm. and to a diameter of $1\frac{1}{2}$ cm., or, as in Case V., to even smaller dimensions.

REMARKS. The descriptive anatomy as detailed in the text- and hand-books differs to a great extent from that just given, partly because of the pathological condition of the specimen described—the dilatation of the common and hepatic ducts and the atrophy of the gall-bladder; but at the same time the position of the vena porta in its relation to the bile-ducts is so different from that given by Henle that I hardly think that the entire difference can be due to the pathological condition. Henle says (page 200): "The common duct is situated at the right free border of the hepatico-duodenal ligament or at the free border which forms the fold at the entrance of the foramen of Winslow. The hepatic artery is situated on its left side close to it, and behind both lies the vena porta."

These are entirely different relations between the upper part of the common duct, and particularly the hepatic duct, from those found by me, and would naturally lead to the conclusion that any of these ducts might be incised without risk of opening into the vena porta. From the relations described by me it will be seen that a stone in the hepatic duct cannot be cut down upon without passing through the vena porta, with the exception, perhaps, of a small place at the beginning of the duct and behind the cystic duct. In the upper half of the common duct it is unsafe to incise close to the free border of the hepatico-duodenal ligament, because the vena porta here may overlap the right or lower border

of the common duct; and it is only the lower half of the common duct that lies close to the free border of the ligament, entirely covering the vena porta. Thus only the lower or right half of the common duct can be incised without danger of opening into the vena porta.

PATHOLOGY. It has been the general belief that most of the choledochus-stones are formed in the gall-bladder and pass secondarily through the cystic duct down into the common duct. We also know that stones form in the hepatic branches and consequently, in all probability, also in the hepatic and common ducts. In 62 out of 150 cases, one or more stones were found in the common duct alone. In the remaining 88 cases stones were found simultaneously in one or more of the biliary passages. (Courvoisier.)

The stones in the common duct are ordinarily from 1 to 2 cm. in diameter; that is, they are on the average larger than the stones in the gall-bladder. In two-thirds of the cases only one stone has been found; in the remainder from two to six, but seldom in large number. The shape is usually oval, more rarely globular or irregular.

The locality in the common duct where the stones are found (according to Courvoisier) is, in 67 per cent. of the cases, the lower or duodenal portion, in about 15 per cent. in the upper or hepatic portion, and in the remaining 18 per cent. in the middle portion. I think it is singular that Courvoisier devotes so little attention to floating stones. He says: "The stone was sometimes—in 5 cases only out of 150—found movable in both directions in its cul-de-sac," but does not seem to appreciate that a stone might float through the entire common duct. As he makes his deductions from the literature, it is likely that other authors have overlooked the mobility of the stones in many cases and have simply noted the place where the stone was found, paying no attention whatever to the ease with which it could be moved; for instance, from the more narrow duodenal portion up into the wider upper territory of the common duct.

The natural and usual effect of a stone in the common duct is occlusion to the passage of bile and subsequent dilatation of the biliary passages in a proximal direction. Dilatation of the common duct was noted in 47 out of 200 cases. The duct was dilated from the size of the thumb up to 2 to 4 cm. in diameter. It was rarely—in 14 cases only—dilated to a large cyst-like cavity. The hepatic duct and its intrahepatic branches were found dilated in 25 per cent. of the cases. While it was always believed previously that the gall-bladder would be found dilated in cases of obstruction from choledochus-stones, Courvoisier found, in 1890, to his great surprise, that the gall-bladder was atrophic and more or less empty in 80 per cent. of the cases of choledochus-stone and dilated in only 20 per cent. He explains this curious fact in the following manner: Supposing the stones are found in the gall-bladder and

have secondarily emigrated to the common duct, they have caused while in the gall-bladder a chronic inflammation of its walls, terminating in retraction and atrophy. In support of this view, he mentions cases in which local losses of substance or cicatricial territories indicated pre-existing gall-stones. But in many cases such traces of local injury are not found; the cystic duct is open and normal. The atrophy in these cases, hitherto incomprehensible, is easily explained by the ball-valve action of a floating choledochus-stone at the distal end of the cystic duct, as described above. This atrophy of the gall-bladder is, as Courvoisier has rightly pointed out, so characteristic for choledochus-stone that it is a valuable symptom in the differential diagnosis between stone and other causes of occlusion of the common duct.

Out of 35 operations for obstruction of the common duct, collected by Courvoisier, 17 were on account of stone and 18 on account of non-calculous obstructions, strictures, tumors, obstructions within or outside of the duct, etc. In 4 of the 17 cases of stone the gall-bladder was dilated; in 13 it was atrophic. In the 18 cases of non-calculous obstruction the gall-bladder was dilated in 16, and in only 2 was there no ectasia.

The contents of the dilated biliary passages is ordinarily bile, either normal, light yellow, or thickened and dark. Pus was found in only a minority of the cases; empyema of the gall-bladder in 8 cases; empyema of the bile-ducts—that is, suppurative cholangitis—in 5 cases; and these conditions combined, in 5 out of a total of 18 cases. In 10 cases only, the dilated biliary passages contained no bile, but either watery, colorless, or slightly mucoid fluid bearing no resemblance to bile, a condition of acholia ascribed to pressure-atrophy of the liver-cells, depriving them of the faculty of manufacturing bile. In all the 10 cases collected by Courvoisier, not one case of gall-stone was found, but tumors in or outside of the duct, and in 1 case pyæmia was observed.

The relation of the icterus to "gall-stone disease," or gall-stone in the different parts of the bile-passages, is as follows:—

Stones in the gall-bladder cause no icterus (the so-called "gall-stone colic" is suppuration of the gall-bladder).

Stones in the cystic duct—

(a) In the upper proximal half cause no icterus.

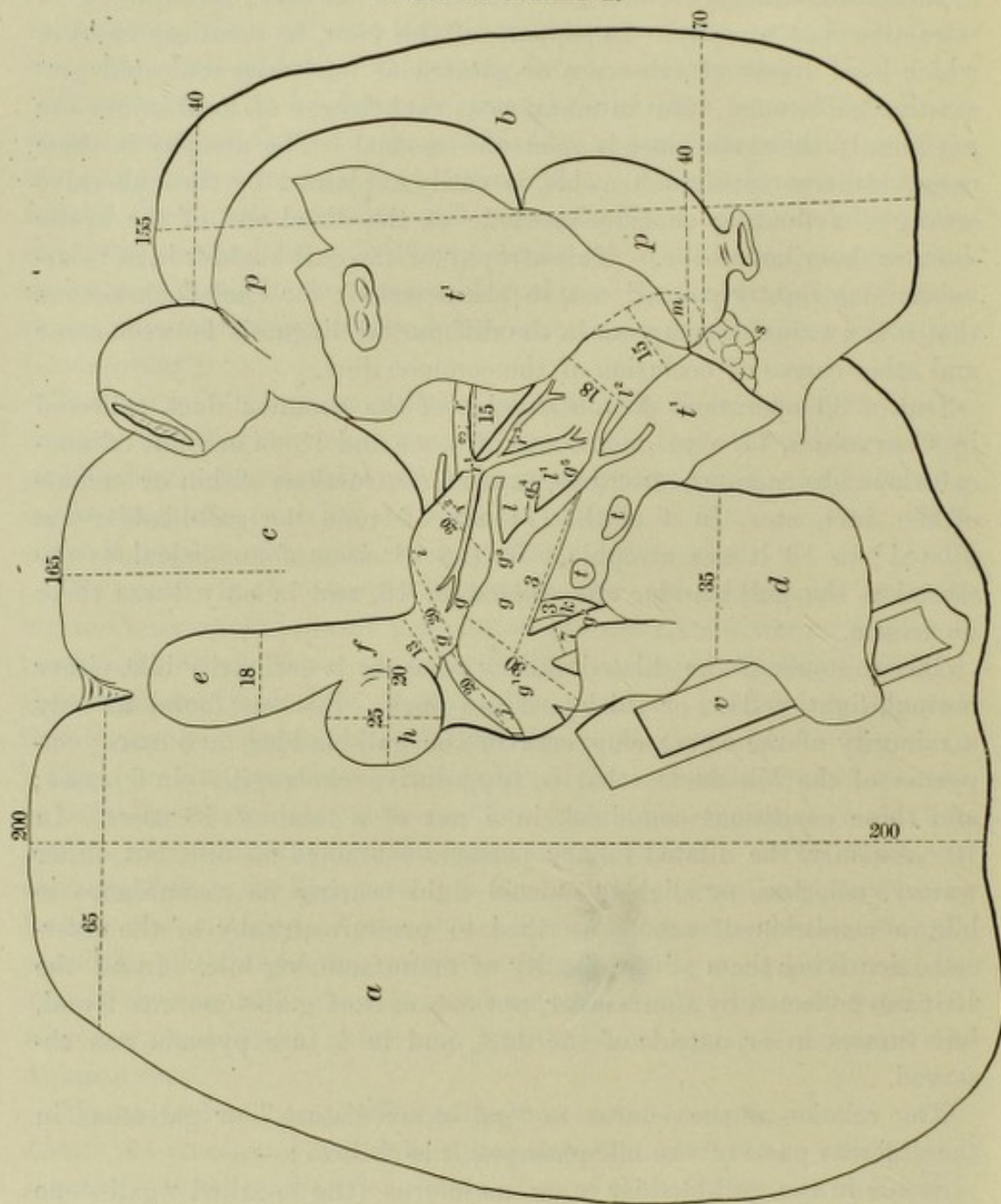
(b) In the lower distal half may cause icterus from compression of the hepatic duct.

Stone in the common duct causes icterus by impaction, obstruction, or ball-valve action.

Stone in the hepatic duct causes icterus when impacted in a narrow duct.

SYMPTOMS. In the attempt to build up a special group of symptoms

KEY TO PLATE I.



a. Right lobe. *b.* Left lobe. *c.* Quadrate lobe. *d.* Lobus Spigelii. *e.* Gall-bladder. *f.* Upper vertical portion of cystic duct. *g.* Lower oblique portion of cystic duct. *h.* Diverticulum in upper portion of cystic duct. *i.* Hepatic duct. *j.* Branch of hepatic duct to right lobe. *k.* Branch of hepatic duct to lobus Spigelii. *l.* Common duct, upper portion. *m.* Common duct, medial portion. *n.* Common duct, lower portion. *o.* Diverticulum of Vater. *p.* Duodenum. *q.* Vena porta. *q¹.* Vena porta branch to right lobe. *q².* Vena porta branch to lobus Spigelii. *q³.* Vena porta branch taking up—*q⁴.* *q⁵.* Smaller branches of vena porta from anterior surface of common duct located in hepatico-duodenal ligament below its anterior peritoneal surface. *r.* Trunk of hepatic artery. *r¹.* Branch of hepatic artery to anterior surface of common duct giving off—*r².* Branch of hepatic and cystic ducts, and *r³.* Branch of lower half of common duct. *s.* Pancreas. *t.* Lymph-glands in hepatico-duodenal ligament. *u.* Peritoneal surface of hepatico-duodenal ligament divided and dissected off from vena porta and common duct. *v.* Vena cava inferior.

PLATE I.





characteristic for stone in the common duct we are confronted with certain difficulties:—

1. In nearly one-half of the cases stones are present not only in the common duct, but also in some other portions of the biliary passages.

2. Very few authors have attempted to separate the cases of choledochus-stone, as a distinct group, from the general gall-stone group, but have given the symptoms of the entire class. Courvoisier was, I believe, one of the first to make a separate classification, and I agree with him that it is possible to differentiate choledochus-stone as a distinct class, by means of a somewhat characteristic group of symptoms:

1. *Gall-bladder*. The condition of the gall-bladder, as has already been stated, furnishes valuable information. Atrophy, or at least absence of tumor, abscess, or local tenderness in this locality, is characteristic for uncomplicated choledochus-stone. (Courvoisier.)

2. *Icterus*. The most important, or, as Courvoisier avers, the cardinal symptom in choledochus-obstruction is icterus. It must be present when obstruction occurs. Multiple small stones may not obstruct the flow of bile, but larger stones will do so, either by occlusion of the lumen of the duct or by ball-valve action. And one very small stone may, as in Case V., cause intermittent obstruction by ball-valve action.

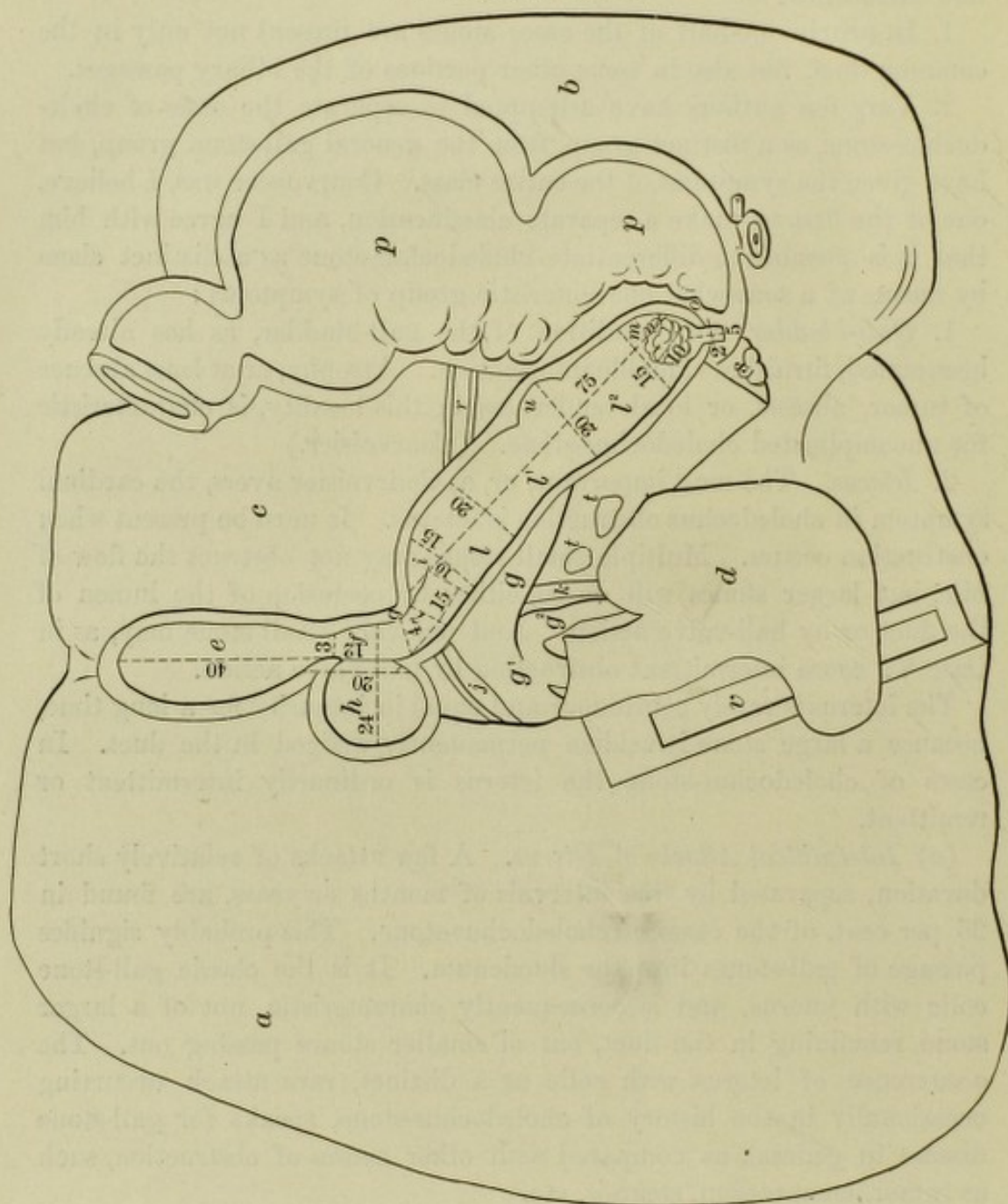
The icterus is rarely continuous and equal in intensity for a long time, because a large stone is seldom permanently wedged in the duct. In cases of choledochus-stone the icterus is ordinarily intermittent or remittent.

(a) *Intermittent Attacks of Icterus*. A few attacks of relatively short duration, separated by free intervals of months or years, are found in 25 per cent. of the cases of choledochus-stone. This probably signifies passage of gall-stones into the duodenum. It is the classic gall-stone colic with icterus, and is consequently characteristic, not of a larger stone remaining in the duct, but of smaller stones passing out. The occurrence of icterus with colic as a distinct, rare attack occurring occasionally in the history of choledochus-stone, speaks for gall-stone disease in general, as compared with other causes of obstruction, such as tumor, compression, stenosis, etc.

(b) *Remittent Icterus*, on the other hand, slight, and, as we might say, incomplete attacks of icterus, occurring as often as once or twice a week, is characteristic of stone in the common duct, and, in my opinion, of floating choledochus-stone. This remittance is such that the icterus varies in intensity. In the short interval between attacks of complete occlusion, with a day or two of clay-colored stools, followed by the presence of bile in the passages, the skin becomes less yellow, but another occlusion takes place before the icteric color has had time to disappear entirely.

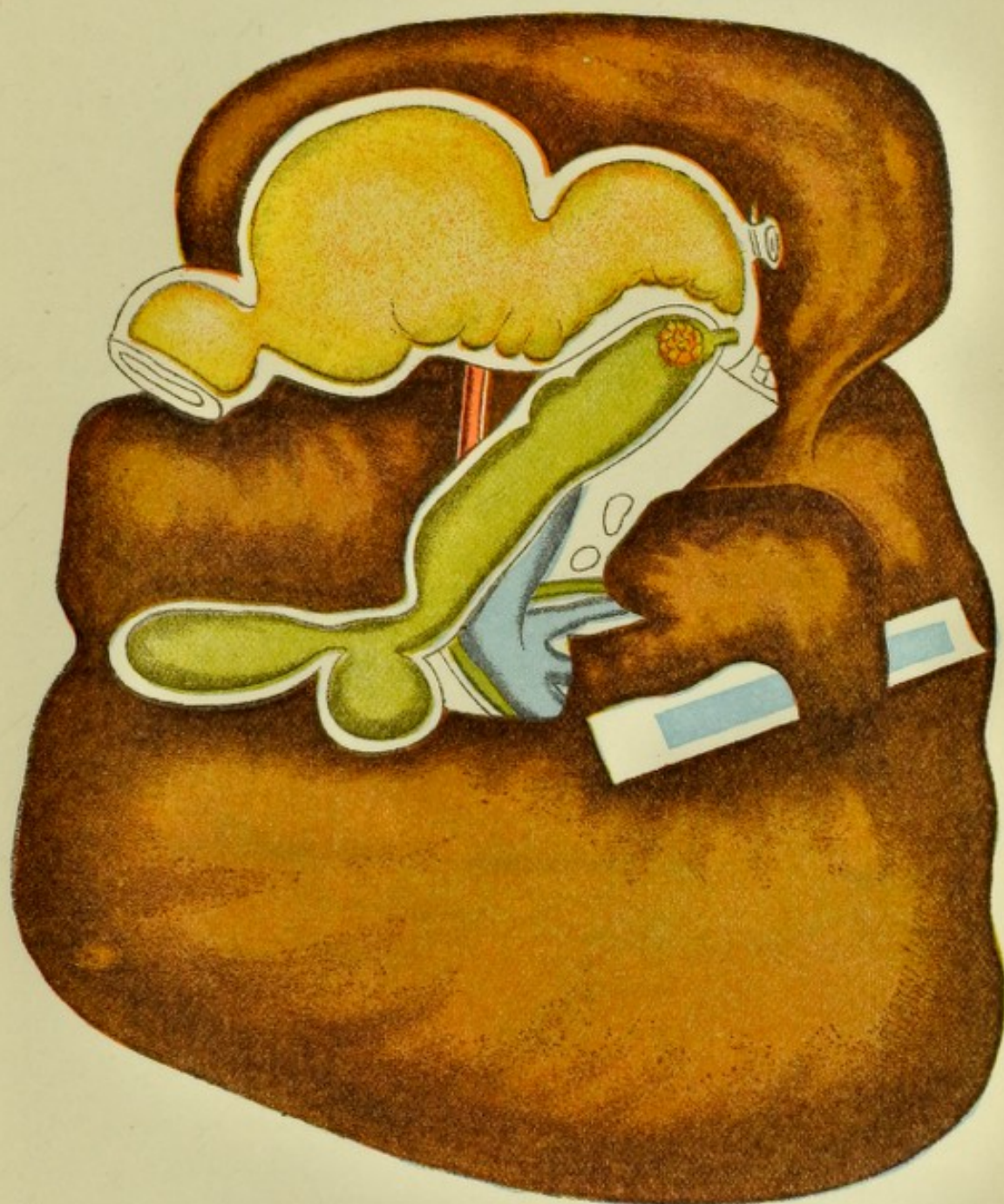
In rare cases the icterus may temporarily disappear because of a

KEY TO PLATE II.



a. Right lobe. *b.* Left lobe. *c.* Quadrate lobe. *d.* Lobus Spigelii. *e.* Gall-bladder. *f.* Upper vertical portion of cystic duct. *g.* Lower oblique portion of cystic duct. *h.* Diverticulum in upper portion of cystic duct. *i.* Hepatic duct. *j.* Branch of hepatic duct to right lobe. *k.* Branch of hepatic duct to lobus Spigelii. *l.* Common duct, upper portion. *l'.* Common duct, medial portion. *l''.* Common duct, lower or duodenal portion. *m.* Diverticulum of Vater. *n.* Stone in diverticulum. *o.* Duodenal opening of common duct. *p.* Duodenum. *q.* Vena porta. *q¹.* Vena porta branch to right lobe. *q².* Vena porta branch to lobus Spigelii. *r.* Trunk of hepatic artery. *s.* Pancreas. *t.* Lymph-glands in hepatico-duodenal ligament. *u.* Diverticulum in common duct. *v.* Vena cava inferior.

PLATE II.





longer interval between attacks, or because of a shorter period of occlusion—one day, for example. In such cases the icterus is incomplete, the skin may be yellowish, but the conjunctiva normal, with bile in the urine, and the interval may be sufficiently long to allow even this slight icterus to disappear temporarily.

Cruveilhier gives the following explanation of remittent icterus: During the attack of complete icterus with clay-colored stools the stone is tightly grasped by or wedged in the wall of the common duct, and complete occlusion occurs. Accumulation of bile on the proximal or liver side of the stone causes dilatation of the duct on this side, the wall is pressed away from the stone, some bile is thereby permitted to pass down, and a state of incomplete occlusion ensues with bile-colored stools and decrease of the icterus. The distention of the duct on the proximal side of the stone subsides, the wall again contracts closely over the stone, and the preparation for another exacerbation is now complete.

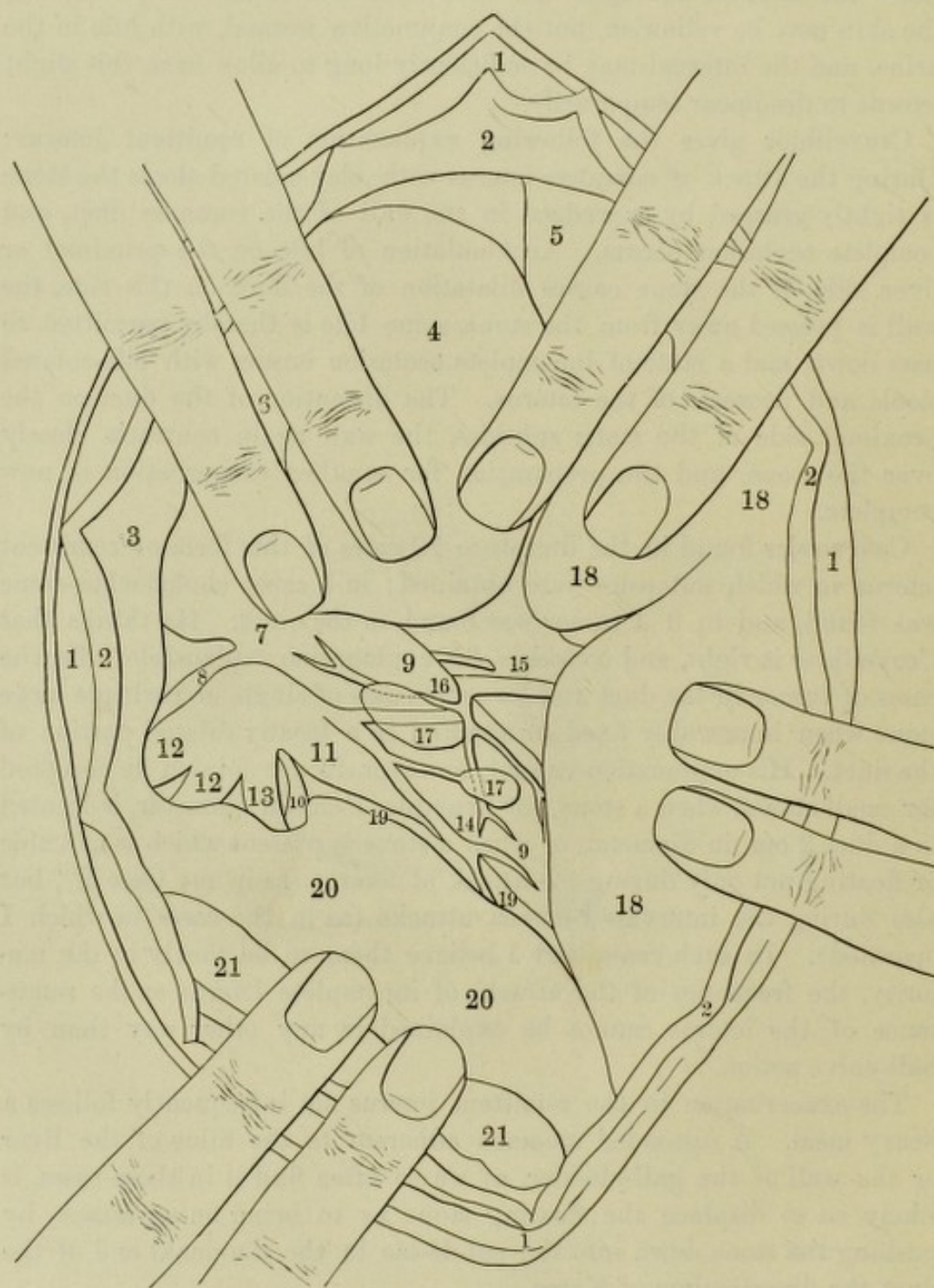
Courvoisier found in the literature 12 cases of this form of remittent icterus in which autopsies were obtained; in 9 cases choledochus-stone was found, and in 3 a tumor was found in the duct. He thinks that Cruveilhier is right, and considers his explanation "plausible" for the cases of tumor in the duct and for some cases of single or multiple large stone when immovably fixed or situated in a locally dilated portion of the duct. His explanation cannot, however, in my opinion be accepted for small stones, when a stone, for example, 1 cm. in diameter, is located in a duct 2 cm. in diameter, or when a stone is present which is movable or floating not only during the attack of icterus (as in my Case I.), but also during the intervals between attacks (as in the cases in which I operated). In such cases, and I believe them to be vastly in the majority, the frequency of the attacks of incomplete icterus or the remittance of the icterus cannot be explained in any other way than by ball-valve action.

The exacerbation in the remittent icterus not infrequently follows a heavy meal. A distended stomach adherent to the hilus of the liver or the wall of the gall-bladder, as we so often find it in these cases, is likely so to displace the floating stone as to bring on an attack, by pushing the stone down into the cul-de-sac in the duodenal end of the duct, the diverticulum of Vater.

If Courvoisier's explanation is correct, the increased secretion of bile following a heavy meal would act in an opposite manner and would cause an existing attack to disappear by permitting some bile to pass by the obstructing stone.

I might even go so far as to say that the frequently repeated incomplete attacks of icterus—the remittent icterus—rather indicate choledochus-stone and ball-valve action from a floating stone.

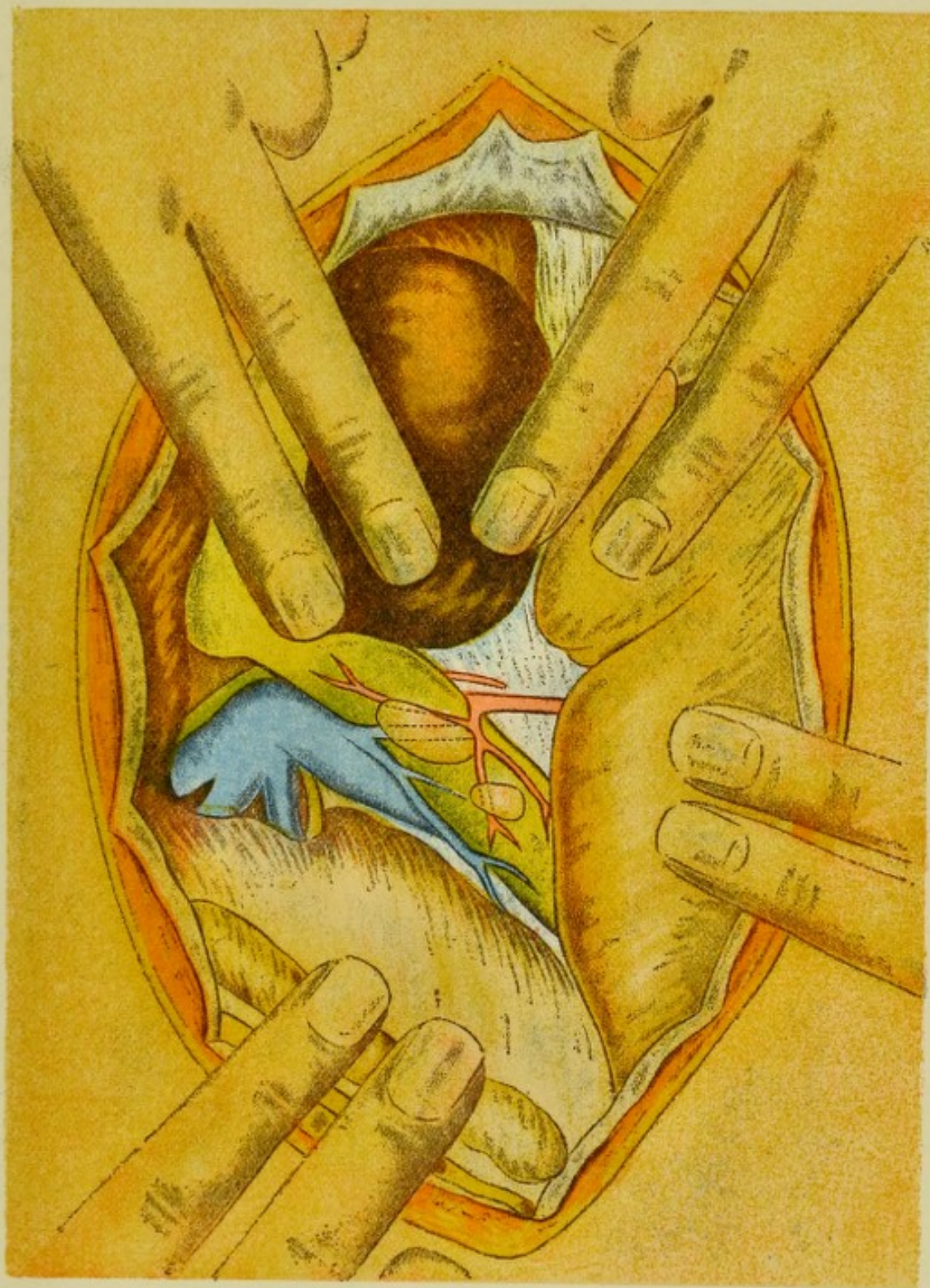
KEY TO PLATE III.



FIELD OF OPERATION.

1. Wound through abdominal wall. 2. Parietal peritoneum sutured to skin. 3. Right lobe of liver, lower surface. 4. Quadrate lobe of liver. 5. Suspensory ligament of liver. 6. Gall-bladder. 7. Cystic duct. 8. Hepatic duct. 9. Common duct. 10. Branch of hepatic duct to lobus Spigelii. 11. Trunk of vena porta. 12. Branches of vena porta to right lobe. 13. Branches of vena porta to lobus Spigelii. 14. Small branch of vena porta in hepatico-duodenal ligament. 15. Hepatic artery. 16. Branches of hepatic artery to hepatico-duodenal ligament. 17. Lymph-glands in hepatico-duodenal ligament. 18. Duodenum. 19. Entrance to foramen of Winslow. 20. Hepaticocolic ligament. 21. Transverse colon.

PLATE III.





Is icterus present in cholelithiasis outside of the common and hepatic ducts? In stones of the gall-bladder with or without inflammation it is not present. If the stone enter the dilated cystic duct, it may, by its size or possibly by pericystic inflammation, cause compression of the hepatic duct and icterus. This would explain those cases of stone in the gall-bladder in which icterus is present and removal of the stones by cholecystotomy effects a cure. In some cases the cystic duct might be large enough to permit the stones to float down into the common duct and back into the gall-bladder. Remittent icterus would, of course, be expected in such cases.

Continuous or remittent icterus persisting for years may be caused by stone or by non-calculous occlusion. If the icterus exists for two or more years without cachexia, it is probably due to stone, because a malignant tumor in the duct or duodenum would cause death in a shorter time. Lawson Tait states that intense icterus lasting for years speaks for stone in contradistinction to tumor. Courvoisier, from his investigation of the literature, arrives at a diametrically opposite conclusion. Intense and continuous icterus on the whole speaks for tumor; but Lawson Tait is correct in stating that icterus extending over a number of years is presumptive evidence of stone. This explanation will render possible the reconciliation of the opinions of both these authors.

3. *Colic.* It is generally conceded that colic is a capital symptom of stone in the biliary passages. In eighty cases of obstruction from choledochus-stones collected by Courvoisier he found colic in 51, or 63.7 per cent.; the symptom was not mentioned in 19, or 23.7 per cent.; and it was positively stated to be absent in 10, or 12.5 per cent. In seventy-four cases of obstruction from tumors colic was noted in only 9 cases, or 12.2 per cent., and was absent in 65, or 87.8 per cent. Thus it will be seen that colic speaks strongly for choledochus-stone as the cause of occlusion, as opposed to tumors.

Preceding attacks of colic indicate choledochus-stone which has passed into the duodenum. Courvoisier states that in fifty-one cases of choledochus-stone colic stones were found in the feces in only five cases.

Colic is a natural companion to icterus of sudden onset, but continued attacks of colic and icterus speak for occlusion from stone in the common duct, either temporary, when the stone passes down into the duodenum, which is relatively rare; remittent, in floating choledochus stones, which is common; or, finally, permanent, when the stone is impacted and causes complete, permanent occlusion, which is also rare.

4. *Localization of Pain.* In the cases of stone in the common duct the pain, according to my observation, is seldom localized in the region of the gall-bladder or in the right hypochondrium, unless concomitant inflammation of the gall-bladder, caused by stones in that viscus, is

present. I found the pain located in the epigastrium in Cases II., III., and V.; in III. and V. there was simultaneous pain in the region of the gall-bladder. The pain was located in both lumbar regions in Case VI.; equally in both hypochondriac regions in Cases V. and VI.; and in the lower part of the back or lower dorsal region in Cases I., II., III., and VI. I consider this localization of pain outside of the gall-bladder as a characteristic symptom of floating choledochus-stone.

5. *Remittent Pain.* The frequent remittance of pain, either slow or sudden in onset, and suddenly disappearing, attended by a flow of bile, but with no stone in the feces, signifies a single stone or a few stones that do not pass through, but float in a dilated common duct. The attacks of colic or pain in the course of the disease become more and more frequent, from once or twice a month to once or twice a week, and in some cases even daily. In Case II. the attack of pain lasted for ten hours; in Case V. from half an hour to two hours.

6. *Vomiting.* Vomiting was present in Cases I., II., III., and V. In Case VI. the patient experienced relief from vomiting, so much so that she was accustomed to force vomiting in order to gain relief from the pain.

7. *Relief of Pain in Certain Positions.* The pain is frequently relieved and the attack brought to an end by changes of position, which probably displace the floating stone, or by the maintenance of some one position. In Case IV. the patient obtained relief by lying on the stomach; in Case VI. by inducing vomiting; in Case V. by flexing the thighs upon the abdomen.

8. *Loss of Weight.* An important and characteristic symptom I have found to be the rapid and considerable loss of weight, which cannot be explained by fever, as fever is either absent or only of slight degree; by sepsis in the bile, as the bile may be aseptic, as in Case IV.; or by the severity of the icterus, as icterus is frequently slight, and as the feces are intermittently or generally bile-colored. The loss of weight must, in my opinion, be attributed to intermittent, frequent ptomaine-intoxication—that is, bile-absorption, as well as to disturbed digestion.

The loss of weight is characteristic and rapid, and after the operation the patient rapidly regains weight. In Case I. the loss of weight was sixty pounds; in Case II. the patient lost fifteen pounds in ten weeks, but after the operation gained fifty pounds in three months; in Case III. the patient lost fifty pounds, and after the operation gained twenty pounds in three months; in Case IV. the patient lost twenty-five pounds in seventeen days, and after the operation gained forty pounds in forty days; in Case V. the patient lost twenty-three pounds; and in Case VI. the patient lost fifty-three pounds, and since the operation has gained thirty-eight pounds in weight. In Czerny's Case XX., reported by Mermann, the patient lost thirty-six pounds, and after the operation

gained forty pounds in nine months; in Case XXI. the patient gained four pounds in one month after the operation; and in Case XXII. there was a loss of weight of twenty-five pounds.

9. *Fever.* Intermittent or remittent biliary fever ordinarily follows or precedes the attacks of colic and icterus. It is not yet decided whether this rise in temperature is due to absorption of retained aseptic bile, or whether the microbic invasion from the intestine, which infects the bile, causes inflammation of the wall of the duct, thus making the fever septic. Charcot described an intermittent hepatic fever due to absorption of retained aseptic bile. Schüppel is inclined to believe that inflammation—that is, infection from microbes—is essential in the causation of fever. Courvoisier, after analyzing the cases collected from the literature, found fever in 25 per cent. of the cases of occlusion from stone, and only in 10 per cent. of the cases of occlusion due to other causes. In all these latter cases he found a well-defined microbic cause for the fever. He, therefore, accepts Schüppel's opinion in this regard. Acorimbini believes that the fever is caused by bacteria which enter the bile-passages from the duodenum or from the circulation. He states that the bacterium coli communis is normally found in the bile-passages, and is a factor in the formation of gall-stones. The bacteria cause a desquamative angiocholitis (Dujardin-Beaumetz, Mosler, Naunyn), and the stone contains the colon-bacillus throughout its mass. When the stone has formed it causes abrasion of the epithelium of the ducts, and the microbes enter and cause inflammation of the wall, which leads to the plastic peritonitis which causes the formation of adhesions between the peritoneal surfaces of the ducts and the surrounding organs.

It seems to me, however, that we cannot positively deny the possibility of a rise in temperature due to the absorption of aseptic bile caused by sudden retention from obstruction due to stone. The fever, according to R. Schmitz, sometimes precedes the colic, and is consequently the earliest symptom of occlusion. If bacterial infection and inflammation of the wall of the ducts cause the fever, why should it cease with the removal of the obstruction? If infection of the bile contained in the biliary passages, the bile being the culture-medium for the bacteria contained in the stone, and if the ptomaines thereby produced cause the fever by their absorption, why should the fever in some cases be the earliest symptom, even preceding the pain caused by the obstruction? Furthermore, would we not expect to find in all cases of stone causing remittent attacks of fever that the bile contained some of the microbes, even the most innocent, the colon-bacillus? In my Case IV. the bile from the common duct was sterile, and yet the attacks of retention were always accompanied by marked fever.

OPERATION. Many operations have been employed for the removal of stone in the common duct.

Indirect lithotripsy, crushing, leaves *débris*, some of which may remain in a pouch in the duct, increase in size, and, as the stone is always a bacterial depot, may cause inflammation of the wall or even cholangitis.

Cholecystenterostomy, the formation of an anastomosis between the gall-bladder and the jejunum, is only possible when the cystic duct is patent.

Choledochoduodenostomy is more generally applicable, but it does not remove the stone, and consequently does not remove the cause of septic inflammation, even if it removes the retention of bile and icterus. A patient of Körte's died from cholangitis caused by a choledochus-stone, notwithstanding the existence of a duodenal fistula which permitted free egress to the bile.

Cholecystenterostomy is an operation of necessity when the obstruction cannot be found or removed. It is never an operation of choice, and will very rarely be called for in cases of choledochus-stone.

Cholecystotomy. It is only in rare cases that a choledochus-stone can be removed through the gall-bladder; namely, when the cystic duct is so dilated as to permit the passage of the stones back into the gall-bladder or of a forceps down to grasp or crush the stones. It is impossible, however, to be sure of removing all of the multiple floating stones through the gall-bladder, as the exploration of the common duct through its lumen can be accomplished only very imperfectly by a sound or probe through the gall-bladder.

Perfect, thorough exploration of the common duct should be made by the finger, and should extend up into the hepatic duct, and this can be accomplished only by choledochotomy and exploration through the opening thus made.

The only remaining operation of choice, which has a legitimate field, but is rarely called for, is the trans-duodenal incision over a stone in the dilated diverticulum of Vater. One case of this kind is reported by Pozzi and one by McBurney.

Internal choledochotomy, division of strictures in the common duct through an opening in the gall-bladder, a successful case of which Abbé has reported, is rarely applicable and is a dangerous procedure, as it is an operation in the dark, and there is grave danger of wounding the vena porta or the hepatic artery. My preference in such cases would be to make an external choledochotomy and then deal with the stricture.

Choledochotomy, the choledocholithotomy of Courvoisier, the excision of the gall-stone from the ductus choledochus, is the operation of choice, which is most commonly indicated, and which effects the most complete cure. This operation was proposed by Langenbuch in 1884. Charles T. Parkes, of Chicago, also spoke of the operation in 1885, and proposed to leave the duct open and drain it by means of a rubber drain-

age-tube, or to close the opening in the duct by sutures. Kümmel, in 1890, stated that several years before, about the time Langenbuch proposed the operation of cholecystectomy, he had a patient, a woman of forty years, in whom, after having extirpated the gall-bladder, he found a choledochus-stone the size of a walnut in the dilated common duct. He incised the duct, removed the stone, and closed the opening with sutures. The operation was long and severe, and the patient died twenty hours after. (Courvoisier.)

Courvoisier was the first to perform choledocholithotomy. He had made the diagnosis of choledochus-stone, and had planned the operation beforehand. He made the first operation on January 22, 1890; operated on a second patient February 18, 1890, and on a third on March 17, 1890, and all three of these operations were successful.

The remarkable success achieved by Courvoisier immediately secured for choledocholithotomy a place in the front rank of the operations for choledochus-stone.

In 1892 Martig had already collected 27 cases, and in 1895 Mermann collected 17 additional, making a total of 44 cases of choledochotomy, with a mortality of 18 per cent.

Technique of choledocholithotomy. The operation is not always easy and requires at the least one to two hours for its performance. The wound is necessarily deep, and the operating on the duct has to be done at the bottom of the wound. The liver is often swollen and hard, and adhesions are almost always present. Good light is absolutely essential. (Mermann.) I prefer daylight to artificial light. Skilled assistants are necessary, as the liver must be lifted and held up, preferably, by the fingers of an assistant. I prefer this to the method proposed by Studsgaard, who had the liver held up by means of a loop of silk passed through the liver-tissue near the border of the organ. (See Plate III.)

A. Incision. An incision of ample length is required in order to secure operating-space, and it is often necessary to supplement the longitudinal lateral incision with a transverse horizontal one. (Czerny.) The peritoneum should then be sutured to the skin.

B. Adhesions. After the introduction of large flat sponges, the adhesions between the gall-bladder, stomach, transverse colon, and the greater omentum, which are common, should be separated. These organs, together with the duodenum, are often adherent to the common duct. These adhesions are often band-like and comparatively easy to loosen, either by blunt dissection or by division between ligatures, but they necessarily prolong the operation. In some cases, fortunately rather rare, the duct is found buried in such extensive and firm masses of cicatricial tissue that it is impossible to isolate it or even to find the stone. Thus Körte reports two cases of attempted choledochotomy in which he was unable to isolate the common duct, and could not find the stone. At the

autopsy on the first case he found, but not until he had removed the liver from the body and laid it upon the table, a small stone in a parietal dilatation of the common duct. In the second case he tried at the autopsy, first, to find the stone through the wound of operation, but in vain, and it was not until the liver and surrounding organs had been removed and laid upon the table for dissection that he was able to find a stone the size of a bean in the common duct, which was firmly adherent to the surrounding organs.

C. *Examination of the gall-bladder.* After isolation of the gall-bladder from the adherent organs it is usually found to be small, atrophic, and empty; it may even be obliterated, but no reports of this condition are on record. Prof. Frank Billings has, however, told me of two cases when he was present at the operation, in which this condition was found. In rare cases it is found to be dilated. A distended gall-bladder should be emptied by aspiration. When stones are found in the gall-bladder and in the common duct the stones in the former must be removed by cholecystotomy. I think it sufficient to open the gall-bladder only when a stone can be felt through its wall. Czerny (Mermann) considers it necessary to incise the gall-bladder and examine it for stones whether stones can be felt through its wall or not.

D. *Isolation of the common duct.* After loosening the adhesions to the gall-bladder the cystic duct is exposed, and the attempt should now be made to lay bare the anterior surface of the hepatico-duodenal ligament. I have ordinarily found in this locality one or more enlarged lymph-glands. The ligament should now be laid bare downward and to the left until the right border of the duodenum is reached. The free right border of the hepatico-duodenal ligament should now be isolated, and the foramen of Winslow found. The index-finger of the left hand should now be passed upward and to the left in the foramen, whereupon the contents of the ligament, namely, the vena porta, the common duct, and the hepatic artery, may be palpated between the index-finger and thumb.

E. *Palpation of the stone* is made by searching the duct from behind the duodenum, at about its middle, upward and to the right as far as the hilus of the liver. A floating stone, if present, is felt at the duodenal end or elsewhere in the duct, and often slips away when the attempt is made to engage it between the finger and thumb. It is easy to find the stone again anywhere in the common duct, but when it slips up into the hepatic duct it disappears, and may require considerable manipulation to bring it down into the common duct again. Czerny in Case XX. (reported by Mermann) performed choledochotomy without finding a stone, but removed two stones from the gall-bladder by ideal cholecystotomy. In Case XLI. biliary colic existed for one week five months prior to the operation. The icterus gradually

decreased. The patient was emaciated, had lost thirty-six pounds in weight, and was sleepless. On three occasions small gall-stones were found in the feces. The patient was pronouncedly icteric, and the feces acholic. A median incision was made, and the gall-bladder found to be atrophied. During the loosening of adhesions to the greatly dilated hepatic and common ducts a sudden flow of bile occurred, and, as Mermann states, "consequently a tear or an opening in the common duct." The operator felt through the walls a stone, which was easily displaced, and slipped or floated up under the liver. No stone could be found after exploration with the sharp spoon and the forceps, but only old, blackish-green coagula were brought out. (This, I think, was the crushed stone, as in my Case VI. I encountered a small, third stone, which I could feel with the tip of my finger in the wound, but could not dislodge into the wound by manipulation of the hepatico-duodenal ligament.) The operator searched for the choledochus-stone for an hour, but could not find it. The ductus choledochus was sutured and tamponed; on the second day the drain was removed. The operation lasted two hours; the patient was out of bed in three weeks, and in nine months after the operation had gained forty pounds in weight. Mermann remarks: "Where did the stone that disappeared under the palpating finger, and could not be found, although searched for for an hour, go to? It is not clear; it was not found in the feces. It has probably not remained, as the patient recovered, and was well nine months after the operation. The stone was the size of a pea, and could hardly have passed into the gall-bladder, as the calibre of the cystic duct was not sufficient to permit this." My own idea is that the stone was either crushed during palpation between the thumb and finger, or by the sharp spoon, and that the blackish-green coagula were simply the débris of the crushed stone.

The field of operation should now be surrounded by three, four, or five large flat sponges.

F. *Fixation of the stone* at the place of intended incision is made by grasping the stone between the finger and thumb, and holding or pushing it up against the anterior surface of the duct. When the stone is floating, and we are consequently able to select the point of incision into the duct, it should be moved to the anterior surface of the left or lower half of the duct close to the duodenum. When the stone is yellow we can sometimes see it shining through the thin wall of the duct. In order to ascertain whether a stone or a tumor of the duct is present, a needle should be passed in, which will grate upon the stone.

G. *The incision in the duct* should be $1\frac{1}{2}$ to 3 centimetres long, and in the direction of the axis of the duct, over the surface of the stone, which should present in the opening and should then be lifted out. The removal of the stone is ordinarily followed by a flow of bile, from which

cultures should always be made. The place of incision in case of floating stone can be chosen, and should be, as I have already pointed out in the anatomy, in the duodenal portion of the duct, to avoid wounding the vena porta.

H. *Exploration of the duct* through the wound in it may be made with the finger; in the majority of cases the duct is sufficiently dilated to admit the little finger. It is my custom to explore in both directions: down behind the duodenum and up into the hepatic duct. By this means a small stone not felt upon external palpation of the hepatico-duodenal ligament may be discovered and extracted.

I. *Extraction of stones.* Stones of the common duct can usually be pushed up into the opening by manipulation and will then slide out, or they may be removed by forceps, or lifted out by sliding a sharp spoon behind them, or may be crushed and the débris removed by the sharp spoon. I have had made for this purpose a sharp spoon with a long, flexible handle, which may be bent in any position for the removal of the stone from the duct.

J. *Sounding* the common and hepatic ducts for stone should be accomplished with a metal probe, which upon touching the stone imparts a grating sensation. For this purpose I employ a silver uterine probe. A stone may also be dislodged by this means from the hepatic duct, as in my Case IV.

K. *Probing* to ascertain if the opening or passage down into the duodenum is free cannot always be accomplished, not because of an obstructing stone or stricture, but because the sound may meet a fold of mucosa in the dilated common duct. As bile passes after the removal of the stone, as we know from the remittance of the obstruction symptoms, any further attempt at opening the passage into the duodenum by means of the probe is unnecessary.

L. *Closure* of the wound in the common duct should be accomplished by a double row of sutures: an inner row through the muscular and external coats of the wall of the duct, but not penetrating the mucosa; and an outer row, including or taking in the peritoneum of the anterior wall of the hepatico-duodenal ligament. I usually leave the sutures long, in order to hold up the wound in the duct during the insertion of the following sutures. The insertion of sutures is easy when the wall of the duct is thickened, but difficult when the wall is thin, as the needle penetrates the mucosa and bile flows through the needle-punctures. The outer row of sutures may stop the flow of bile, but it is sometimes impossible to seal the wound hermetically, however carefully the sutures may be applied. In two of my cases no bile exuded from the wound, but in others, which terminated as favorably, there was a discharge of bile for a limited time—a much shorter time than obtained in the majority of my cases of ordinary cholecystotomy.

M. *Drainage* is accomplished by a rubber drainage-tube passed down to the wound in the duct, and gauze drains inserted one above and the other below the rubber drainage-tube. When the gall-bladder is opened, and instead of being closed is united to the abdominal wall, I drain the gall-bladder by a rubber drain only, and unite the abdominal wall below so as to separate the drains in the gall-bladder and common duct.

CONCLUSIONS. 1. In the great majority of cases of stone in the common duct the duct is dilated, and the stone floats in it.

2. Choledochotomy is the operation of choice, and should be employed whenever applicable, as it is far superior to all other methods of operation.

3. Choledochotomy is applicable in the vast majority of cases of stone in the common duct; the cases demanding other operative procedures are rare.

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