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BY

WALTER G. SPENCER, M.S., M.B., F.R.C.S.

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BY

WALTER G. SPENCER, M.S., M.B., F.R.C.S.,

Surg. Westminster Hosp., Lect. on Physiol., Westminster Hosp. Med. School.

I.—Examination of the Stomach and its Contents.

It is about a century since Spallanzani and Réaumur made experiments upon the gastric juice by withdrawing some fluid with a sponge tied to a length of string. The curdling influence upon milk exerted by the calf's stomach was well known. Prout, in 1824, discovered the hydrochloric acid in the gastric juice, and Schwann, in 1836, the pepsin ferment.

It was the custom, it is said, to empty the stomach solely by emetics until Casimir Renaut, in 1802, washed out the stomach in a case of poisoning. The method did not come generally into use until Kussmaul invented his stomach pump in 1867, and Faucher the siphon method in 1879, when it was largely employed for relieving the stomach in pyloric stenosis.

Beaumont, it is well known, observed the movements and appearance of the interior of the stomach during digestion in the case of Alexis St. Martin, a Canadian who was suffering from a gastric fistula, the result of a bullet wound.

Inspection.—A dilated stomach may be observed through thin abdominal walls by its shape, when partly distended. A simple distension of the epigastrium may be produced by fluid in the lesser omental cavity or encysted above the colon, due to the perforation of a gastric ulcer. Even in a thin patient a pyloric tumour can rarely be seen until it has passed the operable stage.

Percussion.—The outline of the stomach can be percussed out at intervals varying with the time at which meals are taken. When the stomach contains fluid some hours after a meal, a tap on the epigastrium produces a lapping sound (*le bruit en claſotage*).

Palpation.—The pylorus itself, or one only very slightly enlarged, may be perceived in a thin person, but a malignant tumour of considerable extent may be obscured by tense and fat abdominal walls.

Auscultation. –This is chiefly of service in recognising the gurgling sound made by fluid falling from the œsophagus into the stomach which is delayed in œsophageal obstruction. Also, in an hour-glass stomach, fluid has been heard passing from one pouch to the other.

Vomit or Washings.—The examination of the vomit, considered in relation to the time of the previous meal, although important, does not yet allow of precise conclusions. Generally speaking, malignant disease diminishes the acidity of the gastric juice, which is thicker and more ropy with mucus, and shows lactic acid. But dyspeptic conditions attended by atrophy of the glands of the mucous membrane, with or without dilatation, also cause a diminution of hydrochloric acid with an increase of lactic acid, also of butyric acid. Generally speaking, in simple conditions the hydrochloric acid is normal in amount, or there may be a marked increase.

Delayed Digestion or Gastric Stasis.—Digestion is delayed beyond several hours in pyloric obstruction, and there is an excessive secretion of fluid which has a sickly odour like fermenting wine-lees.

Micro-organisms.—Most important observations have been made on the long and short bacilli, also on the sarcinæ and other organisms found in the stomach, but as yet no decisive conclusions have been reached.

There are other methods more elaborate and of less certain value and expediency which are generally applicable only in a few cases, as they are apt to be a source of discomfort to the patients.

Washing out, or Lavage of the Stomach.—Some patients are in no way troubled by the passing of an œsophageal tube and the irrigation of the stomach ; they become used to it or learn to do it for themselves. But others object strongly, it repels them from undergoing further treatment, and may cause marked shock. Generally speaking, it is better to confine oneself to the examination of the vomit rather than promote discomfort or worse. If the patient is fed for a few days before the operation, largely by the rectum, and during the last twelve hours entirely so, the natural antiseptic action of the hydrochloric acid is able to assert itself. If the patient is not disturbed, the contents of the stomach may be removed after a meal, *e.g.*, twelve hours after an ordinary meal, or six hours after a test meal of soup, meat, bread and a glass of water. If undigested materials are found after this interval it is evident that digestion is distinctly delayed—there is gastric stasis.

Artificial Distension.—As an addition to percussing the outlines of the stomach, the organ has been artificially distended. This has been done by giving a patient 40 to 60 grains of bicarbonate of soda,

followed by a similar amount of tartaric acid in a little water, repeating the dose in a minute or two if the distension is insufficient; or the stomach has been inflated with air through an œsophageal tube by means of a ball syringe.

Illumination of the Stomach.—Gastroscopy, or the adaptation to the stomach of the cystoscope, was commenced by Mikulicz in 1881, but has made no way. Millot, in 1867, started, and Einhorn, of New York, in 1889, developed the principle of diaphanoscopy by the insertion of a small electric lamp, not exceeding four-candle power, into the stomach and viewing the epigastrium in an absolutely dark room. By transillumination the umbilicus is illuminated, the ribs and liver are more opaque, and a tumour is supposed to cause a shadow, but so also do fæces in the transverse colon. Some have filled the stomach with water. Einhorn says the stomach should not be distended. The observations have as yet not been reliable.

Observations with the X-rays are especially valuable in indicating the presence of foreign bodies, safety-pins, coins, Murphy's buttons (after gastroenterostomy), etc. Boas and Levy Dorn have given the patient capsules of subnitrate of bismuth to swallow, and have watched the course by the fluorescent screen, a coin being placed on the skin of the abdomen. But this cannot with certainty indicate the position and size of the stomach, as it is as yet notoriously impossible to localise exactly with the X-rays.

Sounding.—The spiral stomach sound invented by Turck, called the gyromele, with a sponge or inflated bag at the end, need not further be mentioned.

II.—Wounds of the Stomach.

Wounds of the stomach are characteristically caused by stabs aimed at the heart which, missing their aim, penetrate the wall of the stomach. If the stomach is full the point of the weapon may not pass through the posterior wall, and so the large vessels are uninjured. As the dagger is withdrawn a rush of the fluid contents pushes out the wound of the stomach, and sometimes the omentum also. If the stomach is empty it may be transfixed and the vessels behind punctured, causing sudden death, or the contents are extravasated into the peritoneal cavity, where they set up general peritonitis, or, possibly, the inflammation may remain limited. Pistol bullets and rifle bullets of low velocity may cause the same sort of wound as a stab. Supposing the patient to escape sudden death from hæmorrhage, he is exposed to general peritonitis, to a local peritonitis producing a subphrenic abscess, or to a gastric fistula with or without

prolapse of the omentum. The latter may adhere to the wound, and if all the contents escape externally from the first, no peritonitis need be set up. A stab may wound the stomach across the lower part of the pleura and the diaphragm, and then there may be an escape of the contents into the pleural cavity. Lacerated wounds not immediately fatal, are very rare. Wounds of the stomach in war were considered to be always fatal (Otis, 99 per cent.), or generally so (Percy, 75 per cent.), but Bailey, in 1880, a pupil of Le Forts, went to the opposite extreme and said that seventy-five healed out of eighty-eight. In some cases, after a fistula has persisted for a time it has spontaneously closed, the patient only suffering from the fixation of the stomach. But now the systematic suture of wounds has rendered recovery probable in all uncomplicated cases. The earliest cases operated upon were those in which the stomach was prolapsed. Schenck von Grafenburg describes the wound of the stomach by a hunting spear which was successfully closed by suturing the abdominal wound and that of the stomach with one and the same suture. Rousset mentions a case of wound of the stomach with prolapse of the omentum which became gangrenous and was cut off; healing followed. A number of such cases are recorded. The frequency with which homicide is perpetrated in Italy by stabs aimed at the heart has given Italian surgeons the opportunity of leading the advance of surgery. Not only have wounds in the epigastrium been at once explored and suture carried out successfully, but also when the pleural cavity has been involved, ribs have been resected, the omentum, if prolapsed, ligatured off and returned, the wound in the stomach sewn up, and the organ returned through the diaphragm; then the diaphragm has been closed, and, finally, the pleural cavity washed out and drained. Mercanton described a successful case in 1876, Tansini, Facilides and Tilling cases in 1885, and since then many others. A patient, therefore, with a wound of the stomach, not immediately fatal from hæmorrhage, may be expected to recover unless neglected and septic peritonitis or pleurisy allowed to become established. The extravasation of partially digested food and fluid having an acid reaction is the pathognomonic sign of a perforation of the stomach. But this is no longer the special indication for an operation. Every punctured wound of this region should be explored by enlarging it so that it may be traced to its full extent.

The wound of the stomach by a small rifle bullet (Mauser), if not fatal from hæmorrhage, appears to heal well under expectant treatment.

When the wound in the stomach is found it should be invaginated

and closed by two rows of Lembert's sero-muscular sutures, the second invaginating the first. The question of washing and draining is the same as in the case of a perforating gastric ulcer. Generally the peritoneal cavity is wiped clean near the stomach, and sutured. Occasionally neglected cases have to be drained through the epigastrium, possibly from the pelvis. The pleura should be drained by a strip of gauze or tube if involved.

III.—Foreign Bodies in the Stomach.

Foreign bodies when swallowed are rarely returned by vomiting; generally they pass onwards and are discharged per anum. They may escape by the pylorus yet become arrested in the intestinal canal. Being prevented, from their size or shape, from escaping through the pylorus, they may remain in the stomach, causing merely discomfort, or may ulcerate outwards through the skin or elsewhere. Moreover, a foreign body, such as a tooth-plate, may lodge in the cardiac end of the œsophagus and be extracted through the stomach.

Foreign bodies may be swallowed by accident, such as coins held in the mouth, or tooth-plates slipping out of position whilst eating or during sleep. Sometimes it is the result of bad habits, as when girls chew ends of their hair or bite threads held in their mouths. Hair balls form in animals from licking, and many animals, when ill, swallow foreign bodies. Many foreign bodies are swallowed by the insane with suicidal tendencies. Jugglers have intentionally swallowed foreign bodies in the anticipation that they would escape in the ordinary way, or they have pretended to swallow whilst holding the knife in the pharynx until the trick has been done once too often. Since the use of Murphy's button for gastro-enterostomy many cases have occurred in which the button has fallen back into the stomach.

It is the exception for a foreign body to be returned by vomiting—curiously, there are instances of a very late return. A child of three and a half years who had swallowed a copper coin vomited it after one hundred and two days, and a gold shirt stud was vomited which had been two years in the stomach. The story told by Dickens in "Pickwick" about the boy swallowing marbles and rattling when shaken is exactly paralleled by one reported by Lynn Thomas. The escape of coins will vary with the age of the patient; a child aged three passed a franc piece per anum in twenty-four hours, a boy of fourteen a two-franc piece in the same time. In a man a five-franc piece stuck in the œsophagus, but moved on at the slightest touch of the sound; it stayed in the stomach some time, then passed through the pylorus with much pain, and finally lodged in the

ileocæcal fossa. Heyman, of Plendorf, said that whilst a child aged three was sleeping, a bat got into its mouth, which it swallowed and passed per anum in forty-eight hours. Rothmund says that a man aged thirty-four swallowed a piece of iron 23 cm. long, which he passed per anum in nineteen days. Velpeau says that an iron fork was passed twenty months after being swallowed, and Poulet reckoned that of twenty-three cases in which forks had been swallowed, in nine the fork passed through the pylorus. Brodie said that a madman swallowed a pair of compasses 3 inches long and passed them per anum in fourteen days. A sailor constantly swallowed knives until one day a blade got stuck in the rectum and perforated it fatally.

Exceptionally, the foreign bodies may escape in a harmless fashion by some other way. A girl was holding five hairpins in her mouth when she was suddenly frightened and swallowed them. They all passed out harmlessly with the urine.

In a considerable number of cases the foreign body has ulcerated out of the stomach and through the abdominal wall at the umbilicus, in the left lumbar region, or in the inguinal region. At the same time a subphrenic abscess may form, and needles and pins have passed through into the pericardium and heart. This is not an infrequent cause of death in cows which are attended by women or fed in fields where washed linen is spread.

It follows from a consideration of recorded cases that there is a great tendency even for unlikely objects to escape naturally. Only exceptionally do dangerous or fatal effects arise. Immediate perforation of the stomach is confined to cases of corrosive poisoning, unless it be extraordinary cases, as of a man looking up at a burning building and receiving a stream of molten lead straight through his open mouth into his stomach. A foreign body has remained in the stomach without setting up ulceration and perforation for very long periods, *e.g.*, in insane patients. Marcet recorded the case of an American sailor who died in Guy's hospital in 1809. He had swallowed about thirty-five knives, and thirty pieces of blades together with handles were found, but there were no recent nor other ulcers. Two blades had passed through the pylorus and were fixed transversely in the colon and in the rectum ; they had perforated the intestinal wall without setting up peritonitis.

The diagnosis of the presence of a foreign body in the stomach is now rendered easy by the X-rays. The older methods, that of observing the patient's symptoms, palpation, sounding, and the testing of the gastric contents for iron dissolved by the hydrochloric acid, are all uncertain. The easy means of diagnosis by the X-rays should

not tempt the surgeon to do gastrotomy except in those cases in which, from the volume, shape, etc., of the foreign body, its safe passage through the intestines is unlikely. At least, if it is causing no disturbances, objects like coins, closed safety pins, etc., may be left alone for a time. Thus, a brooch was seen in the stomach of a girl, aged eight, by aid of the X-rays, and it was passed per anum seventy-three days later. There is not much evidence to support the value of sticky pultaceous foods, for foreign bodies have been generally passed spontaneously without any special dieting. Dickson administered tow and figs, and the tow with seeds of the figs was found adhering to the foreign body when it escaped. But tow is decidedly objectionable, as it might form a ball in the stomach like hair.

Gastrotomy is indicated whenever the foreign body gives trouble, or when it is unlikely to escape without harm, such as a knife, fork, needles, etc., or when it has remained a long time in the stomach, like a coin or Murphy's button, for fear that ulceration and perforation may ultimately occur.

The first recorded case of gastrotomy for the removal of a foreign body was done at Prague in 1602 by Florian Matthis, of Brandenburg. A Bohemian peasant had swallowed a knife about forty days before, whilst trying to perform the trick of swallowing water whilst holding the knife in the pharynx. In 1635 Daniel Schwalbe, of Königsberg, repeated the operation on a very similar case. About forty days before, a young peasant was tickling his throat to produce vomiting when the knife slipped down his throat. He was tied down and a cut made about two fingers' breadth under the left rib, the stomach drawn forwards by a hook, and the knife cut out. The wound was drawn together and the patient completely recovered.

In 1720 a woman swallowed a knife under the same circumstances as in the last case. Hütner, of Rustenberg, found on the eleventh day an abscess pointing four fingers' breadth to the side and two fingers' breadth above the umbilicus, in which the point of the knife could be felt. He incised the abscess, drew out the knife, and in thirteen days the patient had healed. These early successes were not followed up, surgeons generally waiting until the foreign body threatened to ulcerate out. Bell, in 1860, said that a bar of lead 30 cm. long was successfully removed. In 1878 Kuh found that fourteen cases had been operated upon and twelve had recovered. In 1883 Fiedler enumerated eighteen cases of gastrotomy for foreign bodies with four deaths. Since it has become general to operate, and unless perforation has already taken place or the case is very exhausted

success is most likely. Masses of hair have been removed, all from girls : In 1883 Schönborn, of Königsberg, removed a mass of 9 or 10 ozs. ; in 1886 Knowsley Thornton one of 2 lbs ; Berg, of Stockholm, in 1888, 30 ozs. ; Swan, of Plymouth, in 1895, more than 5 lbs. Great care of the peritoneal cavity must be taken, for the masses of hair are most foul.

Mayo Robson, in 1894, removed a great quantity of nails, etc. Eve had to operate, in 1894, on a case after perforation ; the man had gained his living as a "human ostrich," and a collection of small objects was found in the stomach and intestine, the patient being under the impression that he had passed them per anum. Le Dentu, in 1889, successfully extracted from the peritoneal cavity a large wooden kitchen spoon.

A more difficult operation is the removal of a foreign body, such as a tooth-plate, wedged in the lower end of the œsophagus. As will be mentioned later, Loreta, in 1883, first dilated the cardiac orifice ; following this, Richardson, in the United States, in 1886, extracted a plate which had been impacted for ten months. Other surgeons have also been successful in similar cases of great difficulty.

Gastrotomy for the removal of a foreign body should be begun by a median epigastric incision ; the stomach is then drawn forwards and the peritoneal cavity well protected. The incision into the stomach should run longitudinally between the curvature, and it is most essential that it should be so long that its edges need not be bruised in extracting the foreign body. The gastric wound is closed by a double row of sero-muscular sutures, the second row invaginating the first.

IV.—Gastrostomy.

This operation affords permanent relief in the case of inflammatory strictures of the œsophagus which do not yield to dilatation by bougies and tubes. The application of the operation is in this respect a limited one, and there are still further restrictions, owing to the success attending retrograde dilatation of the cardiac orifice and œsophageal strictures through a gastrotomy opening. Unfortunately, the cases to which gastrostomy has mostly to be applied are often unsuitable for any operation owing to the exhaustion which has already set in, and the steady progress of the œsophageal cancer cuts short the patient's existence independently of the power of taking food.

Gastrostomy has notoriously been on the whole an unsuccessful operation, and the various modifications do not materially improve the general results. It has led to a wide divergence of views as to the indications for the operation in malignant disease of the œsophagus.

One extreme view is held by Ferrier and Hartmann, who advise a gastrostomy as soon as the diagnosis of malignant stricture is established in anticipation of the difficulty in swallowing which will in the future ensue. They speak of performing gastrostomy some weeks before any marked impairment of swallowing, and before it was necessary to feed the patient through a fistula. Of course, their reason for this is the greater immediate success of the operation, owing to the unexhausted condition of the patient. A less extreme view is held by many surgeons who perform gastrostomy early in unexhausted patients only. The opposite view, with which I agree, is that gastrostomy is not of service in cases of malignant disease of the œsophagus, except where complete obstruction comes on early, is well marked, and resists other measures. Quite apart from the immediate risks of the operation, there is no sufficient evidence that gastrostomy prolongs life or relieves the patient, except in the cases mentioned above. And if the numbers of patients whose lives are somewhat shortened by being submitted to gastrostomy are considered, there is much to deduct from the average prolongation of life in the successful cases. There is no evidence that gastrostomy retards the rate of growth or delays the extensions into the respiratory tract, posterior mediastinum or pericardium, which cause the death of the patient. It does not diminish the pain excited late in the case by the growth. The operation adds two conditions which either cause discomfort or to some are extra miseries, viz., the fixation of the stomach, causing pain or even vomiting during digestion; and secondly, a revulsion of appetite which makes the patient dislike to take food through the fistula in spite of his hunger. What is very suggestive is, that patients will often go back to swallowing through the œsophagus in spite of the gastric fistula. I do not see the necessity for gastrostomy except in a very few. Granting the diagnosis and some difficulty in swallowing, the suitable regulation of the diet is of considerable importance. The patient will swallow better by sucking **Ice,** or **Cocaine** or **Morphine Lozenges** just before meals. **Iodide of Potassium** administered for a few days relieves congestion, but the chief relief is found in **Opium** or **Morphine,** taken first at night only and later by day. A great deal of relief is given by resting the patient's œsophagus by putting him to bed and keeping him entirely on rectal enemata for a day or two with only a little water to sip. Afterwards liquid food is taken, and then well-divided solids. I certainly agree with those who condemn the excessive use of the bougie. If a bougie will pass easily it may often give relief, or Symond's tubes may be inserted, except when the cancer is near the larynx, when they cannot be borne. In short, it is

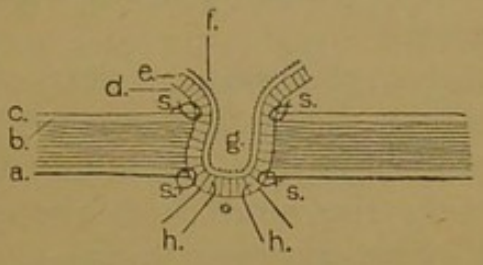
spasm which in many cases causes the difficulty in swallowing, and this being relieved, the patient will live under the above treatment quite as long as after gastrostomy. Ten months is a very long time for a patient to survive after gastrostomy for malignant disease, and a patient of mine has lived that time, although when he first came for treatment he could hardly swallow at all. The patients, according to my experience, have less discomfort without than with gastrostomy. Should such measures fail, and starvation threaten the patient, then gastrostomy is indicated. Gastrostomy is of no use if the malignant disease has already invaded the respiratory tract; life cannot be prolonged by it. The objection raised to such a limited indication is that the immediate mortality is very large, but the operation is merely a palliative one and has this essential objection, that it fixes the stomach.

Gastrostomy as an operation was suggested by observations on gastric fistulæ, and, following Beaumont's case, Blondlot, in 1841, made some gastric fistulæ on dogs, which experiments were repeated by others. Sédillot had previously written on the subject in 1846, and he performed the first gastrostomy on a patient in 1849. The patient was emaciated and half dead. He simply opened the stomach and inserted a cannula without fixing the stomach. The cannula slipped out and the patient died. Sédillot repeated the operation in 1853, also on an exhausted patient. He fixed the stomach by sutures to the abdominal wall, but in consequence of the vomiting the sutures gave way and he had to seize the wall with forceps. Suppuration and peritonitis ensued, and the patient died on the tenth day. He used first a crucial incision, afterwards an L-shaped one. He gave the important method how to find the stomach when shrunken, through a small incision, when the organ does not immediately present itself. The under surface of the left lobe of the liver is followed backwards until it comes in contact with the lesser curvature, which is then traced up to the cardia. Fenger operated in 1854, using the oblique incision, and Cooper Foster for the first time in this county in 1858. Following this, the operation was attempted by various surgeons; twenty-six at least are on record without a single success, until Sydney Jones, in 1875, had the first recovery; he had failed twice before. The patient was aged sixty-seven; feeding was begun on the sixth day. The man died of bronchitis and hæmorrhage forty days after the operation. In 1876 Verneuil was successful in fixing the opening in the stomach to the skin by passing silver wire with a tubular needle through all the coats; he then fixed in a tube and corked the mouth. The wire was removed on the twelfth day.

There was by this method much danger of peritonitis from passing sutures through all the coats, and the wide opening tended to allow gastric juice to escape and cause eczema or erysipelas. Langenbuch advised the fixation of the stomach by sutures through its superficial coats only, and the opening he made was a puncture with a trocar. Others commenced feeding through the needle of a hypodermic syringe. The operation became a firmly established one owing to the improvements introduced by Howse in 1879. He made the oblique incision parallel to the costal margin ; before that there had

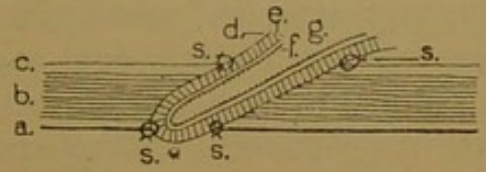
DIAGRAMS OF GASTROSTOMY.

A.—Cone fixed by double row of sutures. Howse's method.



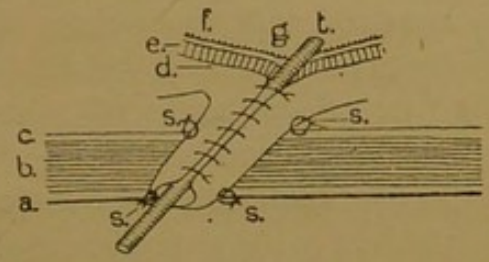
A

B.—Cone drawn obliquely through a second opening in the skin. Method of Hahn, Sabaneef, Frank, and Kocher.



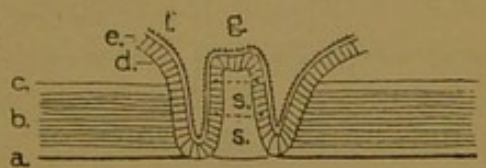
B

C.—Oblique valve made in cone by folding over tube. Method of Witzel.



C

D.—Circular valve made by invaginating cone. Method of Kader and Senn. (*a*,) Running in and out sutures inserted round the opening.



D

(*a*,) Skin ; (*b*,) Muscle of abdominal wall ; (*c*,) Parietal peritoneum ; (*d*,) Visceral peritoneum ; (*e*,) Muscle of stomach wall ; (*f*,) Mucous membrane ; (*g*,) Cavity of stomach into which opening in cone leads ; (*) Apex of cone where the opening is made ; (*h*,) Fixing threads ; (*s*, *s*,) Sutures ; (*t*,) Tube.

Fig. 1.

been much variation—a vertical median incision or one in the linea semilunaris, and even a horizontal one had been tried—and although it does not matter much when the stomach is dilated, the oblique incision has the advantage when, as it often is, the stomach is

shrunken. Howse did not cut through the muscles, but stretched them, thus giving a much better chance for a sphincter to form and the escape of gastric juice to be prevented. He further insisted upon the selection of a spot in the vertical portion of the cardia. Many operations have failed because the stomach has been opened much nearer the pylorus than the surgeon suspected. He placed two fixing threads in the cone of the stomach, by which it was drawn out and fixed to the skin by a double row of sutures passed through the superficial coats. Finally, he delayed the opening of the stomach until adhesions were formed, as late as the fifth day, when it was made by a small incision with a narrow knife guided by the fixing threads.

Kaiser reckoned, in 1877, that of thirty-one operations only two had been successful permanently, the stricture being fibrous. Vitringa reckoned, in 1885, one hundred and twenty-four additional cases with fifty-six recoveries from the operation. Kocher, following Howse, had three successes running. According to Cohen fifty-three non-cancerous stricture gastrostomies had a mortality of 54·7 per cent. Zezas reckoned thirty-one operations for syphilitic strictures with eleven deaths, and one hundred and twenty-nine cases of cancerous strictures with one hundred and eleven deaths. Better results showed an immediate mortality between 30 and 50 per cent.; Gross collected, two hundred and seven cases with sixty-one deaths, *i.e.*, 29 per cent., and the mean survival being eighty-three days. This was after the introduction of antiseptic surgery. The chief evils essential to Howse's operation were: Its duration, and the delay in giving food on the one hand, and the leakage causing erythema, erysipelas, and ulceration; with a tendency of the fistula to enlarge, the longer a tube or obturator was kept in. Many contrivances were employed to prevent this escape. Also, attempts were made to do the operation more quickly. Howse tried clip forceps to fix the stomach instead of putting in the two rows of sutures. Macnamara (1884), Barrow, Chavasse, Jessett and Clutton all successfully trussed up the stomach by passing two hairlip pins.

The operation of gastrostomy has undergone a modification in two directions: The first consists in drawing the cone of the stomach obliquely through the parieties; the second makes a valvular opening by invaginating the stomach wall.

The Cone drawn obliquely through the Parieties.—This operation is only suitable when the stomach is not shrunken; the more dilated it is, the better is it carried out.

Hahn, in 1890, tried to make the costal cartilages serve as a sort of

sphincter by fixing the stomach in the eighth left intercostal space. He first found the stomach through the usual oblique incision below the ribs, and, guided by this incision, he drew the cone of the stomach through a second small incision in the eighth intercostal space, where he fixed and opened it. Subsequently, the abdominal wound was quite closed. The objection to this operation was not that the diaphragm was liable to injury, but that necrosis of bone and cartilage of the ribs ensued.

Sabaneef, of Odessa, in 1890, followed this plan, but with the object of being able to close the fistula by the pressure of an external pad. He drew the cone of the stomach through a second opening in the skin of the abdominal wall. Frank, in Vienna, in 1893, followed independently the same plan. Kocher, in 1897, improved it by drawing the cone through the muscular fibres of the rectus so as to obtain the additional control by means of the sphincter-like action of the fibres.

The objections to this form of operation are, that the stomach must be large ; it fixes it very much to the abdominal wall and does not prevent leakage. The undermining of the bridge of skin and muscles is not free from danger ; the most virulent septic emphysema has been set up.

The Valvular Methods.—Witzel, in 1891, introduced an oblique valvular method by making an oblique canal, passing through the abdominal and gastric wall. He made the usual skin incision, split the rectus longitudinally and the transversalis horizontally, made a small hole into the stomach in which he inserted a tube, and over the outer part of the tube sutured a fold of the stomach so as to enclose a canal 4 cm. in length. This was all fixed outside the peritoneum by suturing to the abdominal wall. Witzel supposed that in this way an oblique opening would be made into the stomach, just as the ureters enter the bladder obliquely through the wall. *Post-mortem* examinations do not support this view, for the canal through the stomach wall itself has become straight, the closure of the fistula being due to the muscle of the abdominal wall and the puckered folds into which the cone of the stomach is thrown. Marwedel's modification consists in doing the operation at two sittings. Kocher fixed the stomach to the abdominal wall first of all, then formed the canal, and finally, at one end of this canal, punctured the stomach, pushed in the end of the tube, and closed the canal over it.

But the formation of a circular valve is at present most in favour. It can be quickly done ; the patient can be fed through the tube from the first ; it can be employed for the most contracted stomach ;

there is little or no leakage; and when established, a tube is only passed at meal times. The special point is to obtain the invagination of the apex of the cone so that the opening into the stomach shall be at the bottom of a funnel which projects into the cavity of the stomach. Pénières, Fontan and Ricard made experiments, but the operation was introduced by Kader and by Senn in 1896. Bidwell, also in the same year, emphasised the importance of fixation to the peritoneum only, so as to allow the stomach more mobility than when it is extensively adherent to the skin.

The principle of the operation consists in inserting two, or even three, concentric running-in-and-out sutures. A puncture is made in the centre and the tube inserted, then the inner suture is drawn tightly, acting like a string closing a bag, round the tube. Then the tube is pushed inwards and the second suture tightened so that the apex of the cone is invaginated with the tube, and a third bag suture may be added. This invagination may be fixed to the peritoneum or drawn through the fibres of the rectus muscle. The patient is fed through the tube, which is closed by a clip. In a week or ten days the tube becomes loose and can be easily taken out, washed and returned. When healed the tube is passed only at meals. There is a marked absence of regurgitation. Two recent cases show how this operation can be adapted to special circumstances. My colleague, Mr. W. Turner, had a man with a scirrhous cancer which had early prevented him from swallowing, and through which no bougie would pass. At the operation he found the stomach so shrunken that no cone could be brought to the surface. He therefore fixed in a tube by the above method and then detached the peritoneum all round the parietal opening, pushed it backwards, and fixed it round the opening into the stomach. He thus had the opening into the stomach at the bottom of a deep, conical wound, which he filled with gauze without suturing either the muscles or skin of the abdominal wall. The result was surprisingly good; the man was fed by the tube from the first and rapidly improved; the cavity was closed by the skin tucking inwards. He went out of the hospital with a good, non-leaking fistula, and lived for some time. A patient of mine, a woman, had a very tight stricture a little above the cardiac orifice which had slowly developed, but there was no cause for a fibrous stricture. I failed to obtain dilatation by bougies, and at last she gave an unwilling consent to let me try retrograde dilatation. I opened the stomach sufficiently to admit my finger and bougies, and although I could enter the cardiac orifice, I could not pass any bougie upwards. I had, therefore, to make a gastrostomy opening. I selected a glass cannula, such as is used for

venous infusion, with a projecting rim, inserted this into the opening, and closed and invaginated it by two bag sutures, one outside the other. I then drew the tube and inverted cone through the rectus muscle and stitched the skin around. Although a large wound had been made in the gastric wall, a perfectly good result was obtained. The glass cannula came out about the tenth day, and afterwards a soft rubber catheter was passed at meals. The patient temporarily improved, but it became clear that she really had a malignant stricture, and she died three months after the operation. The opening gave no trouble, and all the food had to be taken that way, but the woman always expressed a great dislike to the fistula.

The mortality following this valvular method is independent of it and must vary with the particular condition of individual patients.

GASTRIC FISTULA.—A gastric fistula is the result of a wound, or follows the perforation and escape of a foreign body. Some tend to close spontaneously, others persist. Attempts to assist closure were at first limited to cauterising the mucous lining of the fistula. Middledorpf, in 1859, introduced a simple plastic operation; but Billroth, in 1877, after several unsuccessful attempts, finally cured his patient by completely separating the stomach from its adhesions to the abdominal wall before closing the fistula. Esmarch also resected a portion of the indurated wall of the stomach. This is the operation which should always be done: The complete separation of the stomach from its adhesion to the abdominal wall, the excision of all the scar tissue around the fistula, and the union of healthy tissues. Anything short of this is likely to fail and the fistula to re-form. Even if a partial operation closes the fistula, it leaves the stomach adherent to the abdominal wall, and hence discomfort or pain is caused whenever the stomach is distended or undergoes peristaltic movement.

Exceptionally, when a gastrostomy opening has had to be made for a fibrous stricture, impossible to dilate by passing a bougie either upwards or downwards, after a period of rest the stricture at last yields to dilatation, and then the gastrostomy opening can be closed Clutton did gastrostomy, using harelip pins, about six weeks after a child, aged four years, had swallowed a piece of caustic soda. For four months no bougie could be passed either downwards or upwards; then a fine whalebone was passed through. Dilatation was very slow and was not completed until a year and a quarter after the gastrostomy. The track of the fistula was subsequently cauterised, and finally closed two years and a half after the gastrostomy. Clutton refers to a previous case of Morgan's, having a similar course, in which the gastric fistula had been permanently closed.

V.—The Results of Simple Gastric Ulceration.

Surgical interference is becoming more and more successful in its attack upon the complications which result from simple ulceration of the stomach ; not only so, but some attempts have been made to anticipate the complications by attacking the chronic ulcer itself. Amongst these complications are : Acute perforation into the peritoneal cavity, subacute perforation with the formation of subphrenic abscesses and empyema of the thorax, simple pyloric stenosis and the resulting dilatation and displacement, recurrent hæmorrhages, painful adhesions.

(*A*,) *Special Signs of Gastric Ulcer.*—The special signs of gastric ulcer which precede these complications are often entirely absent, or no evidence can be obtained of their existence, so that the ulcer is latent until the onset of one of these complications.

(*a*,) *Pain.*—Typically, an ulcer of the stomach should cause pain, epigastric uneasiness, tightness, or a dull, gnawing, burning pain over the pit of the stomach, or at one special spot there is pain on pressure, or the pain may be referred to the back, at the level of the eighth or ninth dorsal vertebra and to the left of the spine. The dorsal pain may appear later than the epigastric pain, or alternate with it. The pain generally comes on a few minutes after taking food, but it may be delayed for an hour or two, and lasts until the end of digestion. When there is an excess of hydrochloric acid the pain may be independent of meals.

(*b*,) *Pulsation or Throbbing.*—Pulsation or throbbing is felt in the epigastrium with or without pain, a reflex vaso-motor disturbance.

(*c*,) *Vomiting.*—This is very variable, usually small in amount unless there is dilatation ; generally it consists of "pyrosis," acid vomit, due to an excess of hydrochloric acid. If the pain is severe, vomiting often accompanies the attack, and if it occurs an hour or two after taking food, it generally relieves.

(*d*,) *The Complications.*—More positively the presence of an ulcer is known by its complications. It has been said to last a long time ; Brinton says thirty to thirty-five years, but it may be asked, how, in the absence of its complications, can the continuance of an ulcer be assured ? A revision of diagnosis is necessary in those cases where a chronic ulcer is said to continue for years without complications.

(*e*,) *General Signs.*—There are general conditions which accompany ulceration : A variable appetite, rendered bad on account of the pain, constipation, anæmia and wasting.

(*f*,) *Gastric Tetany.*—Gastric tetany occurs especially when severe ulceration is going on to scarring and stricture of the pylorus with

dilatation. Bouveret and Deric, in 1892, suggested the ptomaine or auto-intoxication theory. Soltau Fenwick supported this in 1893 and insisted on the importance of washing out the stomach. In 1898 Mayo Robson refers to it as an important indication for surgical interference, for, as shown in Trevelyan's review of the subject in 1898, a rapidly fatal termination from exhaustion may ensue. Attacks of gastric tetany are always preceded by vomiting, and the first sign may be tingling in the extremities, then cramps in the limbs and in the abdomen. Washing out the stomach affords partial relief, but, according to Mayo Robson, it is not only absorption from the stomach, but the pyloric spasm preventing the emptying of the stomach by peristalsis, that causes the cramps. If surgical interference is delayed, and especially when the patient is already exhausted and has albuminuria, there are severe spasms closing the jaw, the trunk muscles are involved, so that respiration is impeded and the patient becomes blue, clonic cerebral convulsions appear, and he dies exhausted.

(*B*,) *Acute Perforating Gastric Ulcer.*—An ulcer of the stomach may perforate and fluid slowly leaks out, with the result that an abscess forms in the neighbourhood of the stomach. The subject of subphrenic abscess and fæcal empyema was first of all fully dealt with in a paper by Tillmans in 1882, in which he recommended immediate surgical interference.

The first operation for the relief of acute perforation was successfully performed by Mikulicz in 1884, and is now the only recognised form of treatment. The success of the operation is mainly dependent upon the performance of the suture within a few hours of the perforation, subsidiary conditions being the amount of shock and the position of the ulcer. Later cases are saved, as a rule, only when the acute peritonitis is localised by adhesions, although there are a small number which have recovered after general peritonitis has set in. The all-important question is the early diagnosis, the recognition of the signs of perforation before the onset of peritonitis.

The diagnosis of perforation cannot be made from any one sign, but from the general bearing of all the features of the case. A special sign of perforation is a sudden acute pain felt in the left hypochondrium or epigastrium, accompanied by an amount of shock varying from transitory faintness to collapse or insensibility. The pain may be very slight and subside for a time, or be referred to the umbilicus, or to the right hypochondrium, when it may be confused with gallstone colic, pyloric adhesions and duodenal ulcer, or may be severe and felt generally all over the abdomen. Young women

between sixteen and thirty, especially when anæmic, are the commonest subjects, but men and older women suffer, although less often. A history pointing to previous gastric ulceration is suggestive, yet the ulcer may have been latent until the moment of perforation, or the patient may be unconscious or so collapsed as to be unable to give an account of herself. At first the epigastrium is soft, after a few hours it becomes rigid and retracted, then distended as peritonitis becomes established. The early lack of rigidity may prove deceptive. With this there may be diminution or loss of liver dulness. This is a very uncertain sign ; it is due to the collection of gas above the transverse colon. Yet old adhesions may prevent the gas from influencing the liver dulness, which therefore persists ; also, the liver dulness is a variable quantity which is altered by distension of the colon, whether by constipation or by a band. The relation of the time of perforation to a meal is uncertain ; typically it occurs soon after and during digestion. Over-distension may cause rupture, but it also takes place when the stomach is empty. Vomiting is often absent ; it may occur once or so at the time of perforation, and be repeated if anything is swallowed, but usually it does not become frequent until peritonitis has set in. Characteristically the patient suffers from shock and is pale, with a pinched abdominal facies, but may be in the early stage quite placid and retain a colour. The breathing is typically short and catchy ; the temperature is sub-normal or normal and may not rise until late in the peritonitis. The pulse is usually quickened and steadily rises. Perhaps a steadily rising pulse is, in an obscure case, the most certain indication for surgical interference ; exceptionally, when the shock is very severe the pulse rate is sub-normal. Subsequently, the signs of general peritonitis become more and more marked.

The cases about which a mistake is likely to be made are : Firstly, the passive form, in which all signs are very slight ; in such a case the steadily rising pulse, the increasing epigastric distension with the loss of liver dulness are the important features, and these ought to prevent a surgeon from postponing exploration ; secondly, mistakes may be made in cases where the abdominal pain is general or not localised in the epigastrium, so that the first incision is not made in the right place, and yet the abdominal exploration will lead up to the correct diagnosis. The most likely cases to be explored unnecessarily are the hysterical ones ; there is only one rule for recognising them, viz., the finding of inconsistencies between the various signs. Thus, a servant girl was admitted to the hospital for supposed perforation. She was partly unconscious, rolling the head from side to side and

moaning, the mouth was open, and the tongue covered with a thick, brown, dry fur. The epigastrium was distended and painful, and there was only a narrow strip of liver dulness remaining. But the rest of the abdomen was soft, the pulse was between 80 and 90, and the temperature normal. The extremities were quite warm and the face was not shrunken. All the history obtained was that the attack had commenced four days before, that she had vomited continuously since, and that menstruation was overdue. In consultation with my colleague, Dr. Allchin, we agreed that the symptoms did not coincide with a perforation, that she had neither shock from a quite recent perforation, nor the general peritonitis she ought by then to have had if the perforation had occurred four days before. Moreover, the delayed menstruation was suggestive. The patient was ordered large fluid enemata, all feeding by the mouth was stopped, and calomel was given. When seen three hours after, she had not vomited and was no worse. The next day the bowels had been opened, menstruation had begun, the tongue was cleaning, and the patient soon got quite well.

In a doubtful case the patient should be watched hour by hour, and it is most important not to administer opium or morphine until the diagnosis has been made.

Generally speaking, it will be impossible to foresee the condition of affairs before the abdomen is opened. A median incision should therefore be made, entering just below the xiphoid process, for if the perforation is in the anterior wall, the effusion may be shut off from the rest of the abdomen by the line of the transverse colon and omentum. The incision can then be enlarged downwards or outwards to the left according to circumstances. In a simple and early case gas and stomach contents escape from a cavity in front of the stomach, and an ulcer is found to have perforated on the anterior abdominal wall. If this ulcer has not a very indurated zone around it, the best method is to tuck it in and close by a double row of sero-muscular sutures. Excision should be avoided, if possible, because the operation takes longer; it may be difficult to control hæmorrhage; the stomach wall is more widely ulcerated than appears, and the patient is not in a good condition for healing. Hence, after excision, healing may not occur, the sutures give way, and the patient die with a large gaping hole in the stomach. Nevertheless, excision may be very successful in an early case. Near the pylorus or cardiac orifice it may be impossible either to tuck in the edges or to excise, and a gastric fistula in this position would almost certainly be fatal. Hence, it is necessary to follow Bennett, and push a tag of omentum into the hole, afterwards stitching the omentum to the wall of the stomach all

round. If the extravasation is confined to the front of the stomach, the whole is washed, wiped out and sutured without drainage.

But the stomach contents may have already spread over the abdominal cavity, especially by passing down the sides into the loins and the pelvis. Yet, if decomposition has not previously existed in the stomach, the antiseptic action of the gastric juice protects the peritoneum from the immediate onset of peritonitis. All that is necessary then is to remove the extravasation from the abdominal cavity. A suprapubic incision is made and a glass tube passed down into the pelvis. Then from the epigastric incision and through the pelvic tube streams of hot water are passed until the water returns absolutely clear. Then the abdominal wounds are closed. When, however, general peritonitis has set in (and this occurs early when the gastric contents have already undergone decomposition, or when pus has escaped from the lesser into the greater peritoneal cavity), the chances of saving life are very small. According to the position of the chief collections of fluid, a glass drain may be passed through a suprapubic opening into the pelvis, or a woman may be drained through Douglas's pouch into the vagina, or tubes may be passed from each kidney pouch out through the skin of the loins. Then the abdominal cavity is abundantly irrigated with hot water until everything is returned clear. The epigastric wound is sewn up and the other tubes left in position. McGillivray has this year reported two cases which recovered, the abdomen in each was found full of pus, and Douglas's pouch contained more than a pint.*

It is more difficult when the perforation is on the posterior wall and the escape is first of all into the lesser peritoneal cavity. The contents may pass by the foramen of Winslow into the general peritoneal cavity. This orifice is often closed by adhesions, and the cavity is entered below the stomach through the gastrocolic omentum. The extravasation may extend forwards over the lesser curvature and to the left between the spleen and the diaphragm. The ulcer will generally be adherent posteriorly, *e.g.*, to the head of the pancreas, so that it will be impossible to treat it by the invagination or excision

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*Since writing this paper I have had the following case. A gentleman, aged 60, under Dr. Allchin and Dr. Batterham, of St. Leonard's, having suffered a long time from ulceration and pyloric obstruction, had perforation at two or more points of a pyloric ulcer, with general extravasation of fluid, more than a pint being found in the pelvis. He recovered after his operation, which consisted in anterior precolic gastro-jejunostomy by suture, washing out the abdomen, draining the pelvis through a hypogastric tube, and placing gauze in contact with the pyloric ulcer through the epigastric wound. The pyloric mass forming the ulcer was so soft and rotten that it could not be touched. The patient has now gone abroad, taking soft solids.

method. The ulcer must be left, and a drainage tube is passed from the epigastric wound above the lesser curvature, backwards and to the left, through one of the lower intercostal spaces and out by the skin behind. The epigastric end of the tube is packed round with gauze ; then the tube can be frequently washed through from the epigastrium, and, as the patient recovers, drawn backwards day by day, letting the epigastric wound close first, and, finally, the counter-opening behind.

The mortality following acute perforation has been gradually diminishing as surgeons undertake the operations at an earlier period. Keen and Tinker, in 1898, report twenty-six cases operated upon within twelve hours, giving a mortality of 19·23 per cent. ; whereas sixteen cases operated upon between twelve and twenty-four hours after the perforation showed a mortality of 50 per cent. Bennett, in 1898, published six cases, all of whom recovered.

(*C*,) *Subacute Perforation ; Subphrenic or Perigastric Abscess.*—A slow leakage through the floor of an ulcer tends to the formation of an encysted abscess. This abscess may be discharged into the stomach and the pus vomited : it may perforate the colon and give rise to a gastrocolic fistula, the special sign of which is fæcal vomiting without intestinal obstruction : the pus may travel up behind or through the diaphragm and cause a foul empyema : it may burst into the pericardium and prove fatal, or into the lung and be coughed up. A subphrenic abscess may point and burst through the abdominal wall at or above the umbilicus.

The diagnosis of subphrenic or perigastric abscess is aided by a history pointing to gastric ulcer, but there may be absolutely no history preceding the development of the abscess, as in a case recently under the writer. The development of the abscess is indicated by the fever pointing to suppuration, and a collection of fluid and gas below the diaphragm, as shown by a tympanitic percussion note, and sometimes by emphysema or œdema of the skin. Generally the abscess is to the left side, but it may extend up in front of the liver to the right ; it bulges forwards or pushes the diaphragm upwards. It is difficult or impossible in some cases to distinguish a subphrenic abscess marked by pushing up the diaphragm from one that has already extended through into the thorax. An early exploration should be made through an incision in front. A trocar or aspirator is useless ; if pus is reached, an incision must follow ; if there are no peritoneal adhesions, the withdrawal of the trocar may allow of pus escaping into the peritoneal cavity. A negative result of the puncture gives no information at all, and may lead to harmful delay. Generally,

an incision is made in front and a tube or strip of gauze inserted. When the abscess extends backwards it is as well to make a counter-opening behind and to the left. The thorax is opened by removing a portion of one or more ribs, and the pleural cavity is filled with gauze. If the pus is still below the diaphragm, this structure is fixed to the upper margin of the thoracic wound so as to shut off the rest of the pleural cavity. Then, forceps are pushed through the diaphragm and the opening stretched. In a successful case under Dr. Allchin, the writer resected a portion of three ribs, and carried a long strip of gauze through the lower pleural cavity downwards and behind the diaphragm. The long track gradually filled up under daily dressing, the patient saying that he could taste the iodoform.

(*D*,) *Chronic Non-perforated Gastric Ulcer.*—A chronic gastric ulcer which has not yet perforated may call for surgical treatment on account of adhesions, hæmorrhage, pyloric spasm, and stenosis with dilatation, a bilocular or hour-glass stomach, or stenosis of the cardiac orifice. Apart from these complications, does the chronic ulceration itself stand in need of surgical interference? If there is severe and persistent pain after meals, with frothy vomiting containing mucus, shreds, etc., especially with loss of flesh, unrelieved by a course of medical treatment, then an operation should be advised. Fournier, Flexner and Mackay have described syphilitic ulceration and hæmorrhage rapidly cured by iodide of potassium, but in all these cases the patients have had well-marked syphilitic manifestations. The object of the operation is, in the first place, exploratory ; adhesions, pyloric stenosis, or a malignant tumour may be met with.

An ulcer on the anterior wall, not close to the cardiac or pyloric orifices, with a thin floor but without much induration around it, may be folded in and fixed by a double row of Lembert's sero-muscular sutures, with the object of obtaining atrophy of the invaginated portion. If there is a marked zone of induration which prevents invagination excision of the ulcer is indicated, the line of removal being carried through healthy tissue. Hæmorrhage is arrested by ligaturing any bleeding point and then bringing the edges together by a suture passed through all the coats ; this is covered in by a superficial sero-muscular row.

If a single ulcer can be felt on the posterior wall by passing the finger behind the stomach through an aperture in the gastrocolic omentum, the ulcer may be exposed through an incision in the anterior wall, cleaned of *débris*, and its floor then seared by the cautery. When the ulcer is near the pyloric orifice, or there is widespread destruction or atrophy of mucous membrane, as shown

by a diminution of hydrochloric acid, gastro-enterostomy should be done.

If there is much ulceration near the cardiac orifice or end of the stomach, gastrostomy may be performed, or enterostomy (Furner), in order to place the diseased portion of the stomach at rest for a while.

(*E*,) *Adhesions of the Stomach.*—The principal causes of adhesions are intrinsic, chronic ulceration being the common cause. Adhesions may arise from extrinsic causes, such as injury (Kroenlein), gall-stone colic (Marchiafava), or umbilical hernia; also, as has been mentioned, gastric fistulæ, whether produced accidentally or by operation, are liable to give rise to the same troubles.

The chief sign of adhesions is pain, gastralgia in the epigastrium, exaggerated by movement, and gastric distension, generally out of proportion to other stomach symptoms and lasting unaltered for a considerable period. The pain may cause loss of weight owing to the patient not taking food from fear of causing pain, and there may be a rigidity of muscles, giving rise to the idea of a tumour. If the band compresses the pylorus, there are the special signs of pyloric obstruction; if the colon, then distension with chronic obstruction. Mayo Robson operated in 1893 for an adhesion compressing the pylorus. Terrier, also in 1893, was the first surgeon in France to relieve adhesions. It can hardly be said that the diagnosis can be definite; the operation commences usually as an exploration. A band may be found fixing the stomach to the abdominal wall, to the ring of an umbilical hernia, attaching the pylorus to the liver or to the colon. The thinner kinds of adhesions may be freed by dividing them between two ligatures, and so, by a comparatively slight operation, the patient be completely and permanently cured. If, however, the adhesions are very extensive, if the pylorus is closely adherent to the under-surface of the liver or gall-bladder, it would be dangerous or impossible to separate the adhesions. Gastro-enterostomy is to be done, and the most successful results may follow this operation. Merklen, however, had a case of extensive perigastritic adhesions following subphrenic abscess. He divided all except a thick one joining the liver to the stomach. As the symptoms continued, he operated the second time and cut away the adherent liver with the cautery. This measure was successful.

(*F*,) *Gastric Hæmorrhage.*—Gastric hæmorrhage is not the same thing as hæmatemesis, for, to say nothing of other causes, the latter may be due to a leaking aneurysm or varicose œsophageal veins. Terrier and Hartmann prefer the term gastrorrhagia. Gastric hæmorrhage may occasionally be traumatic where blood appears in the vomit

immediately after an injury. Also, blood appears in the vomit in connection with cancer, but the question of surgical interference with the special object of arresting hæmorrhage arises only in cases of chronic ulceration. A latent gastric ulcer may open into one of the large branches of the gastro-duodenal artery, usually near the head of the pancreas, and is then suddenly fatal. Indeed, the patient may never vomit and the cause of death remain unsuspected until the *post-mortem* examination. The patient may suddenly vomit a pint or two of blood besides what is passed subsequently as melæna. Sometimes this hæmorrhage is preceded by a sharp pain ; in others the patient feels suddenly faint, a sensation of rapid distension of the stomach with a warm fluid ensues, and then, with a scarcely perceptible effort, blood pours from the mouth. The patient is thus suddenly reduced to a state of acute anæmia in which she may continue (especially if there is a continual leakage) for some time. Here we are confronted with an important and, as yet, undecided question. The patient has not died from the first unforeseen hæmorrhage. Will another occur, and, if so, will the second or some subsequent hæmorrhage prove fatal? The general opinion held by the majority of physicians hitherto is, that gastric hæmorrhage rarely proves fatal, and that one severe hæmorrhage having occurred, a second or subsequent one is not likely to prove fatal. But this question requires a thorough re-examination ; it requires to be looked at from the standpoint of the surgeon. The traditional view is probably a wide generalisation in which all cases of gastric hæmorrhage are included, the slighter with the more severe forms. The chronic cases of hæmorrhage, from being more often seen, are apt to impress the mind and to remain in the memory longer than cases dying suddenly, in which no thorough *post-mortem* examination having been made, the fact that it was due to hæmorrhage from an ulcer, which might have been amenable to surgical treatment, has escaped being recorded. At the present time there is certainly not enough known to warrant surgical measures after the first severe hæmorrhage, although further observations may tend in this direction, especially, perhaps, by exploding the notion that one severe hæmorrhage may be followed by a complete and permanent recovery. But after the occurrence of a second severe attack of gastric hæmorrhage a surgical exploration should be made. The reasons for this are that medical treatment alone cannot prevent its recurrence or do anything to actually arrest the hæmorrhage when it occurs. Moreover, the patient and friends must remain in dread of bleeding setting in at any moment. Two attacks of severe hæmorrhage can hardly arise except from a considerable ulcer which, even if it does

not cause death by hæmorrhage, will eventually prove fatal in some other way if left alone. Less severe attacks of recurring hæmorrhage are due to small ulcers connected with the smaller arteries and veins at a little distance from the lesser or greater curvature, or are due to more or less widespread, yet superficial, excoriations of the mucous membrane, giving rise to capillary hæmorrhage. The patient is weakened and rendered anæmic by recurring losses of blood, becomes emaciated from lack of food owing to loss of appetite, pain, vomiting, or fear of exciting hæmorrhage. Granted, therefore, that recurring attacks of hæmorrhage, anæmia and emaciation can only go on until some fatal complication is set up, a surgical operation is clearly called for in such chronic cases.

The suitable time for the operation is as soon as the patient is fairly convalescent from the last attack of hæmorrhage, yet before he has fully regained a normal pulse tension. During the convalescence preceding the operation, the patient should be kept in bed on a semi-solid diet with as little liquid as possible, the bowels well open, and iron given. To operate during the acute anæmia is a very hazardous procedure. Whilst bleeding is still going on, even if small leakages are continuing, the patient is so weak that success is most unlikely (Tubby), and in the present position of affairs the future of the operation may be unduly prejudiced. Upon opening the abdomen the source of the hæmorrhage may be found as a single ulcer, and it may be possible to tie the vessels on the outer surface of the stomach which supply the ulcer, and afterwards to tuck the ulcer in by sero-muscular sutures. Alternatively the ulcer may be excised. But if the ulcer is not made apparent by its induration, is on the posterior wall, or there are widespread excoriations, two courses are open, one to incise and explore the stomach for the bleeding point, the other to do gastro-enterostomy. The exploration of the stomach is the more severe, but the most satisfactory operation in a strong patient. A free opening is made longitudinally midway between the curvatures, and by passing the fingers through the gastro-colic omentum behind the stomach, the wall is pushed forward and the inner surface appears in the wound. An ulcer is cleaned of *débris* and foreign bodies. Küster successfully removed a cherry-stone embedded in a deep ulcer on the posterior wall near the pylorus. After cleaning the ulcer the surface is seared with the cautery. When there are only minute bleeding points or widespread excoriations, the successive portions of the inner wall must be examined under a good light, and any points likely to bleed touched with the cautery (Dieulafoy). In some cases, one of the larger gastric arteries may be tied on the outer wall of the stomach;

the wound in the stomach is then sewn up. Pyloroplasty may be done if co-existing pyloric stenosis is present. Gastro-enterostomy may be employed when the ulceration cannot be defined without opening the stomach, an operation which the patient seems too weak to stand, its great value being to drain off excess of hydrochloric acid and the remains of food. It may also be done after the interior of the stomach has been explored, when very extensive excoriation or marked pyloric stenosis, not likely to be cured by the simpler pyloroplasty, has been found. A number of successful operations have now been recorded. I have used three of the methods, viz., ligature of the afferent artery, pyloroplasty, and gastro-enterostomy.

VI.—Simple Pyloric Obstruction.

The pylorus is obstructed by malignant disease, or the cause may be of non-malignant and inflammatory origin.

A kinking of the pylorus may be set up by displacement of the stomach by tight lacing, gastroptosis.

A spasm of the pylorus is a reflex result of an excess of acid in the gastric juice or of ulceration.

An organic stricture narrowing the pylorus is the result of ulceration and scarring of the mucous surface, of fibrous contracture replacing the sphincter muscles, or of inflammatory bands on the peritoneal surface.

A congenital hypertrophy narrows the pylorus in infants; whether this is to be looked upon as an inflammatory or a tumour formation is doubtful. The first case, a child six weeks old, was unsuccessfully submitted to gastro-enterostomy by Stern in 1898, since then others have succeeded.

(*A*,) *Signs.*—The special sign of pyloric stenosis is the retention of undigested food in the stomach with much fluid, gastric stasis. This gives rise to an increasing discomfort and distension after meals until it is relieved in the course of three or four hours by vomiting. The food vomited is undigested and generally mixed with much acid fluid. According to the duration the stomach becomes more and more distended, the patient more and more emaciated, and life a burden. So much is digestion arrested that the simplest food remains undigested. A patient of mine vomited, nearly unaltered, some orange jelly he had taken two days before, and in doing so recognised distinctly the taste of the orange flavouring.

In the early stages of pyloric stenosis, the stage of interest to the surgeon, it is impossible to distinguish with certainty the simple from the malignant cases. As time goes on the malignant ones become

evident by the growth of the tumour, the simple by the increase of the symptoms and of the dilatation in the absence of a tumour. To maintain an expectant attitude, however, until the diagnosis is certain, allows the malignant disease to go too far.

Persistent pyloric stenosis with a steady loss of weight, even in the absence, on the one hand, of marked dilatation or, on the other, of a growing tumour, should become the indication for an exploration. Medical treatment by careful dieting, by administering drugs to prevent decomposition, and by systematically washing out the stomach, ought not to be continued beyond a month or so if the symptoms persist and the patient loses weight.

(*B*,) *Dilatation and Pyloroplasty.*—The first surgeon to relieve pyloric stenosis was Loreta, of Bologna, in 1882, who published in 1883 two cases in whom he had stretched the pylorus through a gastrotomy opening, and there was no recurrence of the symptoms a year after the operation. The possibility of dilating a strictured pylorus had been noted by Richter, of Breslau, in 1881. Loreta operated twenty-nine times successfully ; one of his cases died from hæmorrhage, another from peritonitis. At first, the operation was only repeated in Italy, then in Europe and America. Some used the finger or dilators, others bougies. Hagyard, of Hull, did the first case in this country in 1886. But the operation proved to have a considerable mortality from the rupture causing hæmorrhage or peritonitis, and the simple stretching without rupture tended to relapse.

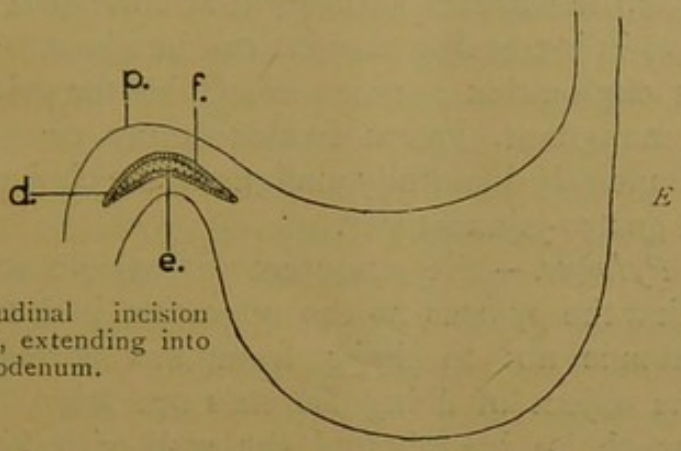
Hence, Loreta's operation on the pylorus has fallen into disuse. For it Heinecke substituted in 1886 the operation of pyloroplasty ; Mikulicz followed in 1887. According to Terrier and Hartmann there were nineteen deaths amongst one hundred and twenty-one cases, or 15·7 per cent. There seems to be no necessary mortality connected with the operation, but the patients are often extremely exhausted ; otherwise, if the operation is done early enough, it may be termed a safe one. The objection raised to it is that there are relapses ; this objection is met by selecting cases. Having exposed the pylorus, pyloroplasty is indicated when the pylorus is not enlarged and is free from cicatricial adhesions to the liver or pancreas. An enlargement of the pylorus will raise the question of a new growth ; it would be most dangerous to attempt the separation of an adhesion to the liver on account of hæmorrhage, to the pancreas for the same reason, and also for the almost certain danger of setting up peritonitis. Adhesions to the abdominal wall, or bands stretching to the colon, may be safely freed, yet if extensive they may re-form and then the case will relapse Some enlargements of the pylorus may be simply inflammatory ; a

smooth and uniform swelling, softer than cancer and unaccompanied by any sign of glandular swelling, may suggest this. In such a case the surgeon must elect : (*a*,) To excise ; (*b*,) Do gastro-enterostomy, and excise later if cancer develop ; (*c*,) Close the wound. He should not do pyloroplasty because union will probably be imperfect and so fatal peritonitis follow, or the case will relapse. A surgeon may decide not to do pyloroplasty if he finds that the pylorus has been kinked by an external adhesion which can be divided, or if the stomach seems simply displaced.

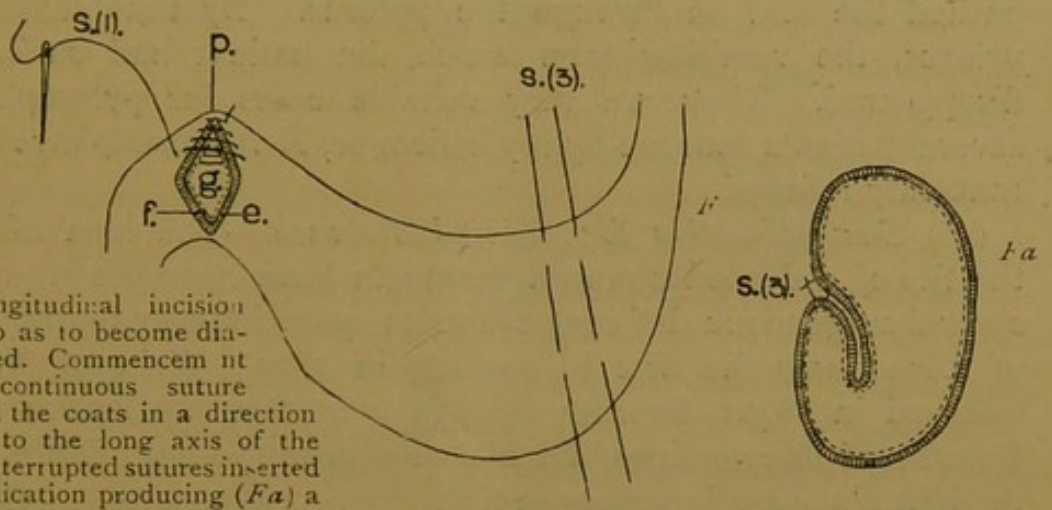
Operation of Pyloroplasty.—The patient is kept without food for twelve hours, but may take plenty of hot water which will either wash out the contents or be returned by vomiting. Meanwhile, nutrient enemata are administered. The stomach is washed out only when the patient does not object ; patients often learn to do it for themselves and therefore no shock is caused. An incision is made longitudinally through the pylorus, midway between its upper and lower border, curving slightly towards the stomach and towards the duodenum so as to keep in the long axis of these organs. The incision should be three inches in length ; a short one is apt to be followed by relapse ; it is deepened on the stomach side first of all, or the duodenum may be entered if preferred ; then a probe can be passed through the narrowed pylorus as a guide to its lumen. The wound is retracted so as to make it diamond-shaped, and is sutured at right angles to the line of incision, the end of the incision in the stomach being joined to the ending in the duodenum. The suture material to be used should be of fine Chinese-twisted silk, threaded on small round sewing needles. It should be inserted continuously, with a fixing loop after every fourth or sixth puncture, in two rows ; the deeper row includes all the coats, the superficial row is sero-muscular only and extends a little beyond the deep row at either end. With respect to the difficulties of the operation, it is only done when the pylorus is well in view, not when buried in adhesions ; the narrow lumen of the pylorus can be exactly divided longitudinally if the stomach (or duodenum) is entered first and a probe passed through. All that should escape from the stomach is a little frothy gastric juice which can be at once sponged away ; it is, as a matter of fact, not septic owing to the presence of the hydrochloric acid. As to the hæmorrhage which occurred in Loreta's operation, any specially bleeding point in the mucous membrane or submucosa may be tied, but the hæmorrhage is all stopped by the approximation of the edges by means of the deep suture through all the coats. I have always found that the continuous suture does excellently ; it is much quicker and gives a better apposition than

interrupted sutures. There is no occasion for inserting a bone bobbin. Failure of union will not occur except when the case is wrongly selected, *e.g.*, when the pylorus is much hypertrophied or doubtfully malignant. Relapse may occur when there has been much previous

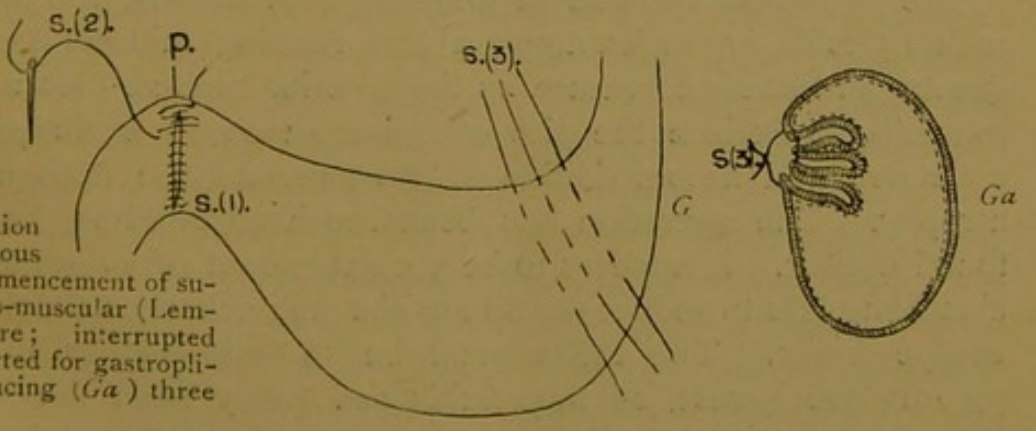
DIAGRAMS OF PYLOROPLASTY AND GASTROPLICATION.



E. — Longitudinal incision through pylorus, extending into stomach and duodenum.



F. — Longitudinal incision retracted so as to become diamond shaped. Commencement of deep continuous suture through all the coats in a direction transverse to the long axis of the pylorus. Interrupted sutures inserted for gastroplication producing (*Fa*) a single fold.



G.—Completion of continuous suture; commencement of superficial sero-muscular (Lembert's) suture; interrupted sutures inserted for gastroplication producing (*Ga*) three folds.

(*d f*,) Visceral peritoneum; Muscular coat; (*f*,) Mucous membrane, (*g*) Cavity of stomach; (*p*,) Level of pylorus; (*s* 1,) Continuous deep suture through all three coats; (*s* 2,) Continuous superficial sero-muscular (Lembert's) suture; (*s* 3,) Interrupted sero-muscular sutures.

Fig. 2.

ulceration and scarring. In a doubtful case pyloroplasty should be chosen as the less severe operation ; it allows the patient to regain strength, and if it does relapse gastro-enterostomy may be done later. After the operation the patient is supported by nutrient enemata until recovery from the anæsthetic, then is tried with small quantities of water. As soon as the water is kept down and the patient is without nausea, liquid food in increasing amount can be given.

If the case on exploration appears unsuitable for pyloroplasty and is certainly not malignant, gastro-duodenostomy or gastro-jejunostomy should be done. If doubtfully malignant, the choice lies between pylorectomy and gastro-jejunostomy.

Spasm of the Pylorus.—The symptoms of pyloric stenosis are of reflex origin, so that the pylorus at the operation is found in appearance and consistence not to differ from the normal. Jaboulay operated with the object of doing Loreta's operation, but instead of opening the stomach he invaginated the wall with his finger and pushed the fold on through the pylorus. By thus stretching the pylorus, the vomiting from which the patient had suffered quite disappeared. They are very suitable cases for pyloroplasty, and several patients sent me by my colleague, Dr. Murrell, have been permanently relieved.

(*C,*) *Gastroplication for Dilated Stomach.*—The idea of reducing the size of a dilated stomach seems to have been put in practice by several surgeons in different countries quite independently. Bircher, of Aarau, was the first to operate, in 1891 ; Weis, of New York, followed in 1892 ; Bennett did the operation in London in 1893 ; Brandt, of Klausenberg, did his case in 1894 ; and Faure, of Paris, thought his operation also novel in 1897.

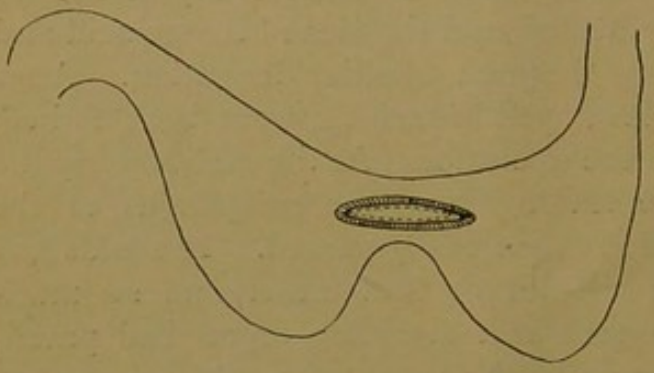
The operation consists in reducing the size of the stomach by making folds or tucks along a line running midway between the greater and lesser curvature on the anterior surface. Its object is to immediately reduce the size of the stomach so as to prevent the collection and decomposition of the contents, the folds undergoing atrophy. The operation has been much objected to, having been found useless. It appears to be a complement of pyloroplasty ; it is clearly useless to reduce the size of the stomach when the fluid cannot escape freely. The tucks must be so fashioned as to leave the pylorus the lowest, so that fluids run freely from the œsophagus towards the pylorus. Gastro-enterostomy is preferred by many, to which it may be objected that the operation is more severe and less natural, as evidenced by the tendency to regurgitation. As an addition to pyloroplasty, gastroplication has acted well in my cases. The follow-

ing observation has confirmed me in this view : A very emaciated and exhausted patient was admitted with a bed-sore and alkaline urine, with pus. Her illness was found to be entirely the result of long-standing pyloric stenosis with enormous dilatation. After a consultation with Dr. Murrell, I did pyloroplasty and made a series of large folds from the cardiac end nearly to the pylorus. After the operation the patient could take fluid and semi-solid food given her without any of the old symptoms, her bed-sore nearly healed, and the urine became acid and almost free from pus following frequent bladder irrigation. After three weeks she got up, then developed bronchitis, went back to bed, and died about six weeks from the operation. At the *post-mortem* the stomach formed a thick tube leading from the œsophagus to the pylorus, through which the index finger easily passed. The folds had much shrunken, the mucous membrane had undergone so much atrophy that the use of the stomach as a digesting organ had practically disappeared. This seems to be the value of combining gastroplication with pyloroplasty, so that the food shall no longer be delayed in the stomach, where, owing to long-standing atrophy, it cannot be digested and must decompose. On reference to the diagrams the methods of inserting the sutures will be understood.

(*D*,) *Kinking at the Pylorus from Displacement of the Stomach—Gastroptosis* (*Glénard's Disease*).—Glénard, of Lyons, in 1885, drew attention to the forms of displacement of abdominal organs, and Treves has written on the same subject. The intestinal tract is ten to fifteen times longer than the distance between the mouth and the anus ; it is thrown, therefore, into various loops, each with a special suspensor or mesentery. By the displacement, kinking takes place, leading to partial or complete obstruction. The stomach is the highest of these loops, and its displacement is recognised by percussing its outline. It may or may not be accompanied by moveable kidney, displaced liver, transverse colon, or pelvic organs. The general treatment for Glénard's disease is a belt supporting and pressing up the intestines, and drugs for dyspepsia and constipation. Exceptionally this is not sufficient, and Duret, of Lille, in 1895, first practised gastropexy. He fixed the pylorus and lesser curvature to the abdominal wall by the following method : He made a median epigastric incision, but in the upper part of the wound left the peritoneum and transversalis fascia undivided. He then passed sutures from the lesser curvature through this undivided fascia and peritoneum, and thus obtained a firm hold for the sutures. Of course, if the displacement is complicated by pyloric stenosis and dilatation, this operation would not be sufficient.

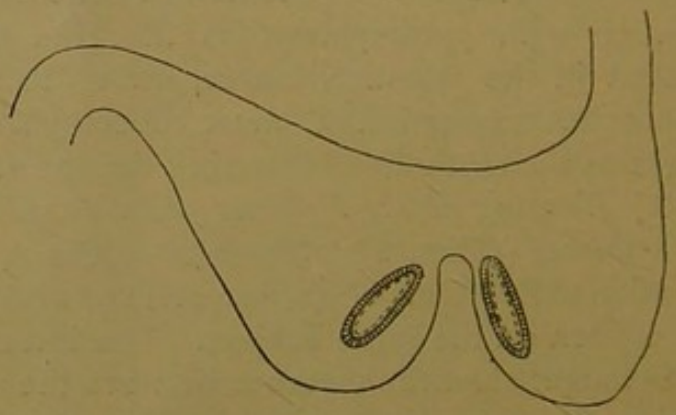
(*E*,) *Hour-glass or Bilocular Stomach.*—This is the result of ulceration and scarring, the stomach being constricted in the middle, and the two halves communicating with one another by a narrow channel. It would generally cause increasing dyspeptic symptoms, but it is doubtful whether it can be diagnosed beforehand. The bilocular

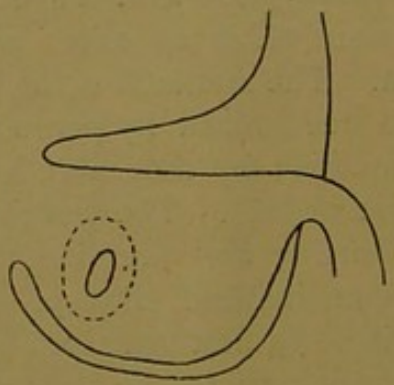
DIAGRAMS OF HOUR-GLASS STOMACH AND GASTRO-GASTROSTOMY.



H. — Longitudinal incision through neck. Suture applied as in pyloroplasty.

I. — Oblique openings into cardiac and pyloric pouches. Sutures applied as in gastro-enterostomy.





J.—Folding of pyloric pouch in front of cardiac, union between the two being obtained within the dotted area.

Fig. 3.

shape of the stomach may be noted when distended. An œsophageal tube being passed, it may empty the cardiac half, but being pushed on, fluid may commence again to flow. The fluid has been heard by the stethoscope trickling from one half of the stomach to the other as the patient was turned from one side to the other (Burney Yeo). The The X-rays have been said to make a shadow between the two halves.

Generally speaking, the condition, although suspected, is not diagnosed until the stomach is exposed.

An hour-glass stomach has been treated in various ways. Wölfler, in 1895, made a free anastomosis between the two sacs, and this appears to be the most suitable, but owing to the diseased condition of the stomach, leakage may take place at a suture (Eiselberg). Others have operated by the method adopted for pyloroplasty (Watson Cheyne). This may be done when there is not much scarring and the contraction not markedly indurated, but if it forms a thick mass with a very narrow opening, the anastomo is or gastro-gastrostomy of Wölfler is the best. Tuffier tried gastro enterostomy, connecting the cardiac sac with the intestine, but the symptoms continued until he had made a second free anastomosis between the pyloric pouch and the intestine, then all symptoms disappeared. A more severe, but perhaps more satisfactory, operation would be to resect the central portion with the neck between the pouches, but apart from the severity of the operation in an emaciated patient, the adhesions to the head of the pancreas would generally prevent the operation from being carried out. Watson united the two sacs by turning the pyloric forwards upon the cardiac portion, using the strictured neck between the two sacs as a hinge. Wölfler's and Watson's plans require a freely moveable stomach. When the stomach is fixed by adhesions the plastic operation is the most suitable.

VII.—Stenosis of the Œsophagus and Cardiac Orifice: Retrograde Dilatation.

It has been already stated under the subject of foreign bodies that gastrotomy has been done and the cardiac orifice explored. The cardiac orifice has also been dilated by bougies and the fingers, and by that means retrograde dilatation of strictures of the œsophagus has been possible, when attempts to traverse the stricture from above were prevented by the bougie entering an œsophageal pouch above the stricture.

Cardioplasty, the application of the operation carried out on the pylorus to the œsophageal opening, has been done experimentally on dogs and on the cadaver, but is apparently too difficult an operation for success to be likely (Levy). The dilatation of the cardiac orifice was done by Loreta soon after his pyloric operation in 1883. Richardson examined this subject in dead bodies in connection with his successful extraction of a tooth-plate in 1886.

Loreta, in 1889, not only dilated with success the cardiac orifice,

but also the pylorus at the same time. Kendall Franks, in 1894, dilated the œsophagus successfully by the retrograde method. In addition to passing bougies, a string has been threaded and passed through ; then, by holding the two ends taut and see-sawing, strictures have been partly cut through.

VIII.—Cancer of the Stomach.

(*A*,) The most important subject connected with the stomach is concerned with the possibility of diagnosing cancer at such an early stage that it may be safely removed and ensure a considerable prolongation of life. Up to the present, removal has been the exception, and of the relatively few cases operated upon it has been only in a small minority that life has been considerably prolonged.

The importance of the matter is obvious when one considers that one-sixth or more of all cancerous diseases occur in the stomach. It has been said to be the cause in 1 per cent. of all deaths on the Continent (Virchow and Espine), of 0·4 per cent. in the United States (Welch).

Registrar General's Report, 1897, for England and Wales :—

Population, Males ..	15,047,580	Population, Females ...	16,007,775
Deaths from Cancer ...	9,573	Deaths from Cancer ...	14,870
Ditto of Stomach ...	1,978	Ditto of Stomach ...	1,983
i.e., 20 per cent. of all males dying of cancer.		*i.e.*, 13.3 per cent. of all females dying of cancer.	

As regards localisation, by far the greater number, in fact, nearly all, begin at or in the region of the pylorus.

There are many points of special interest in connection with cancer of the stomach which can only be mentioned here, its occurrence in several members of the same family, as in that of Napoleon, its origin in an inflammatory condition, the different types, clinical and pathological. The scirrhous type causes a rapid constriction of the pylorus and so, early signs ; the medullary infiltrating form extends rapidly beyond the stomach and renders an operation hopeless ; a peculiar type affects the whole wall of the stomach without, for the time, infecting the glands, in which it has been possible to remove the whole, or nearly the whole, of the organ successfully. The microscopic variations are peculiar, but have not yet been fully connected with the clinical course of the tumours.

The extension of cancer is most peculiar in that the duodenum escapes and is not infiltrated or involved, at any rate until the growth has first extended to the peritoneal surface. The cancer generally spreads to the glands along the lesser curvature ; also, but to a less

extent, into the glands in the gastrocolic omentum along the greater curvature. But the chief importance from the surgeon's point of view attaches to the involvement of the lymphatic glands about the head of the pancreas.

The Early Diagnosis of Cancer.—The interest of the surgeon is confined to the early diagnosis of cancer. The chief point is the existence of a tumour, generally in the position of the pylorus, occasionally in some other part of the stomach. It is not, however, by any means infrequent that no tumour is to be felt until the cancer is beyond removal, whether because the abdominal walls are fat or rigid, or the tumour is so soft, or because the pylorus is displaced, as is often the case. Because a pyloric tumour can be felt, it does not follow that it is malignant ; inflammatory thickening and adhesions may be felt ; also there are the rarer benign tumours of the stomach, cysts, polypi, papillomas and sarcomas.

As to the early symptoms, they are those of dyspepsia, or pyloric stenosis. Persistent small hæmorrhages producing the coffee-ground vomit are very suspicious indications. Great attention has been paid to the question of the diminution of hydrochloric acid since Golding Bird, in 1842, found it so in a case of cancer. As an early sign the diminution of hydrochloric acid with the presence of lactic acid is a suspicious sign ; at any rate, hydrochloric acid is not increased in amount, but the acid may be much diminished or nearly absent in severe gastritis and atrophy of the mucous membrane.

Therefore, the presence of a pyloric tumour with loss of flesh and gastric disturbance is an indication for exploration as well as the previously mentioned symptoms, where there is no palpable tumour, viz., persistent "gastric stasis" and loss of flesh.

To wait until the signs of cancer become more positive is to allow the opportunity for removal to pass away.

(*B,*) *Gastrectomy.*—The operation for removal of a cancer of the stomach can be traced in its evolution from earlier experiments and operations. Raindohr, of Wolfenbüttel, in 1727, resected two feet of gangrenous intestine in a case of inguinal hernia, and united the two ends by invaginating the upper into the lower bowel. The man died of pleurisy one year later, and a good union of the intestine was found. Astley Cooper made use of a double row of sutures in his experiments for gangrenous hernia, but seems to have rendered success impossible by allowing the ends of the sutures to hang out of the wound. Merrem, in 1810, experimented on dogs by removing the pylorus and joining the stomach to the duodenum ; but all his animals died. Lembert published his method of suture in 1826, and

Dieffenbach, in his operative surgery, 1848, said that round sewing needles should be used. The gastrostomy operations and the closure of gastric fistulæ have been mentioned. The Italian surgeon, Torelli, in 1865, resected the gangrenous portion of a stomach which had prolapsed into the wound, following a stab, and closed the wound with sutures.

The possibility of a successful removal of cancer was shown in Gussenbauer and von Winiwarter's paper published in 1874. They examined the *post-mortem* records in Vienna and found that among nine hundred and three deaths from cancer of the stomach, five hundred and forty-two were cancers of the pylorus, of which two hundred and forty-three were without secondary nodules, and in one hundred and seventy-two cases there were no adhesions of the cancer to adjacent organs. Czerny, Rainer and Billroth subsequently made experiments on dogs. The first pylorectomy was done by Péan, in Paris, on April 9th, 1879. He excised the disease as well as a nodule in the mesocolon, and joined the duodenum to the stomach with catgut sutures. The patient died on the fifth day from inanition without sign of peritonitis, but there was no *post-mortem* examination.

Cavazzani also, in 1879, took away a tumour which involved the abdominal wall and part of the anterior wall of the stomach. He closed the wound by suture, and recovery followed, but the tumour afterwards recurred.

Rydygier, in 1880, performed the second pylorectomy, the patient dying in twelve hours, of inanition. Billroth did his first case in 1881 ; the patient recovered, but died four months later from recurrence. The method he followed, subject to modifications, is still the best one. Billroth's second case, in 1881, was a failure. The stomach was much dilated, and a kink took place at the junction of the stomach and duodenum causing death on the eighth day. His third case died on the day of operation. Wölfler did a successful operation, so did Czerny.

Billroth first employed his second method, viz., pylorectomy combined with gastro-enterostomy, in 1885.

The preparation for removal of cancer is similar to other operations on the stomach ; the patient is fed by nutrient enemata for twelve hours and given hot water to drink. The stomach is washed out only when it can be done without distressing the patient.

After opening the abdomen through a median epigastric incision, which can be afterwards extended downwards or horizontally, the surgeon has first to make out that the disease is probably cancer, and secondly, whether, being cancer, it is removable. A doubt as to

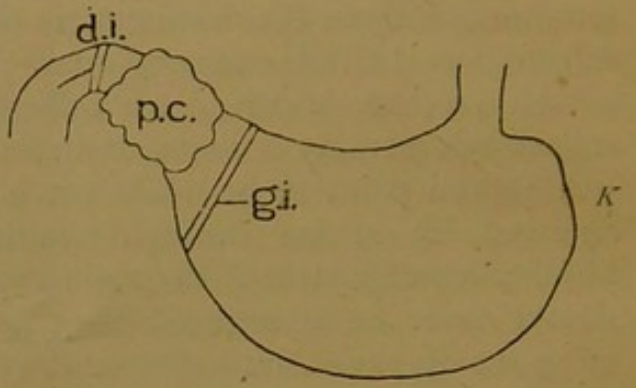
cancer is raised when the pylorus is uniformly enlarged ; if nodules appear on the surface, or irregular extensions or glandular enlargement, the disease is probably cancer. A uniform enlargement with considerable dilatation, the symptoms having been present for some months, and even when there is a soft enlargement of glands, is consistent with an inflammatory origin. Here, the duration of the symptoms without the development of an undoubted mass of cancer will support the inflammatory view. If the pylorus is enlarged yet buried in a mass of adhesions, a diagnosis is not so urgently necessary, as pylorectomy is contra-indicated in either case.

A second point to be made out is whether all the cancer can be removed by cutting through healthy tissue. Partial operations, whether leaving parts of the main growth or of the enlarged glands, should never be attempted ; they are useless, harmful, and tend to bring the operation into discredit. It is not only necessary to find that the disease is free by surface palpation ; one finger must be introduced into the gastro-hepatic omentum and the other through the gastro-colic omentum. The fingers should meet behind the pylorus and feel that there are no adhesions between the main growth and the head of the pancreas, nor any enlarged glands. The finger will recognise, however, the normal band or posterior ligament passing between the pylorus and the head of the pancreas. All adhesions, except those connecting the tumour with the abdominal wall, contra-indicate operation. Their separation is immediately dangerous from hæmorrhage or from the suppuration and peritonitis which so often follow separations of adhesions to the pancreas. The separation of adhesions has been fatal owing to hæmorrhage from the liver, ligature of the gall-bladder or duct with extravasation of bile, wounding of the vena porta or vena cava, gangrene of the stomach owing to ligature of the gastro-duodenal artery, or from injury to the duodenal vessels beyond the line of excision. Glands and masses infiltrating the mesocolon have been removed, including the excision of the portion of transverse colon, followed by recovery (Roux, Manteuffel, Kocher). Undoubtedly, the most important preliminary is to exclude the adhesions posteriorly to the pancreas by examining with the fingers before commencing the operation.

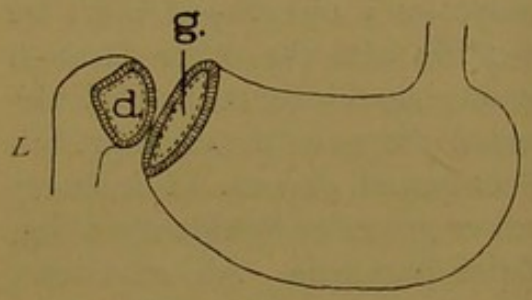
(*C*,) *Pylorectomy with End-to-end Union: Billroth's First Method.*— The tumour is first isolated by ligaturing off the gastro-hepatic omentum above and the gastro-colic omentum below, then drawing forward the pyloric tumour, and protecting the peritoneum by sponges. Glands along the lesser curvature and in the gastro-colic omentum are at the same time dissected out. The lumen of the

stomach and of the duodenum is next shut off. This may be done by passing a piece of elastic tubing or a very thick piece of silk ligature and fixing with a clamp; but this plan puckers up the ends inconveniently. Large safety pins may be used with a piece of flat

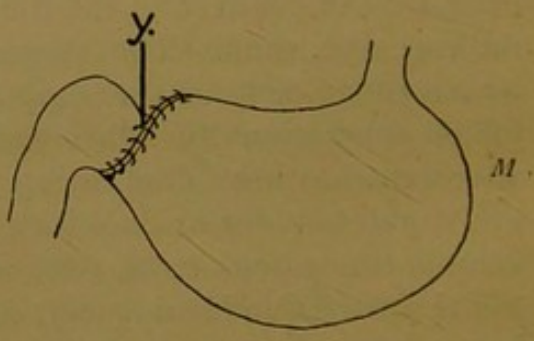
DIAGRAMS OF PYLORECTOMY.



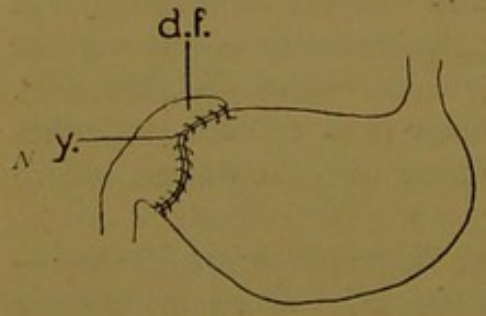
K.—Lines of incision, including longitudinal incision after Morison to enlarge the duodenal end.



L.—Gastric and duodenal ends ready for suture.



M.—Gastric and duodenal ends united.



N.—Fold of duodenum drawn over the Y-shaped union.

(*d*,) Cavity of duodenum; (*di*,) Duodenal incision; (*g*,) Cavity of stomach; (*gi*,) Gastric in ision; (*pc*.) Pyloric cancer; (*y*,) Y-shaped union; (*df*,) Duodenal fold to cover over Y-shaped union. (If the duodenal opening can be made equal to that of the stomach, there is no need for this folding over.)

Fig. 4.

sponge between the upper bar and the gut. Special long clamp forceps are used with springing blades, closing by a ratchet ; the blades may be covered with drainage tubing. Two flat bars of glass or metal may be passed, one in front and one behind, and their ends fixed together by rubber bands. There are also other methods ; *e.g.*, an ordinary pair of clamp forceps are passed behind, one end of a piece of rubber tubing is clamped in the jaws of the forceps, and the tube is then brought over the gut and fixed to the handle of the forceps ; a piece of flat sponge may be slipped between the tube and the upper surface of the gut. In this way there is elastic pressure without any special apparatus, yet the ends of the stomach and duodenum are kept flat, not puckered up. The line of incision should run wide of the obvious disease by at least an inch, and the mucous membrane must be cut quite up to, or a little beyond, the level of the other coats. The main bleeding vessels are clamped and tied after the completion of the excision. Next, Morison's plan is adopted of enlarging the duodenum so as to fit the stomach, viz., by making a longitudinal incision in it on the aspect opposite to the mesentery. The ends are united by two rows of sutures (the deep row through all the coats, chiefly in order to control hæmorrhage and to fix the ends), the superficial row, sero-muscular, or Lembert's sutures to prevent leakage at the suture holes.

Finally, a second modification of Morison's is adopted, the folding the slack duodenum over the line of union and fixing it with sero-muscular sutures. The best suture to use is the continous one with an occasional fixing loop composed of fine round sewing needles and Chinese-twist silk. First of all, the superficial sero-muscular row is inserted behind ; next, the deep row through all the coats is completed ; and finally, the superficial sero-muscular row is inserted. Other sutures used are the interrupted and Halsted's quilted suture ; if so, all the needles must be threaded and ready to hand or the operation will be unduly prolonged.

The chief after-treatment is concerned with the weakness of the patient. Nutrient enemata with brandy and suppositories should be begun at once and continued every three hours or so. As soon as the patient can keep it down, a little brandy and water or champagne may be given by the mouth, and liquid food follows.

The chief modification of this operation is pylorectomy with gastro-duodenostomy, the insertion of the end of the duodenum into a fresh opening made in the posterior wall of the stomach. It is the method adopted by Kocher in 1893. The opening into the stomach is completely closed by a double row of sutures, then a small opening,

corresponding to the lumen of the duodenum, is made into the stomach and the duodenal end joined. A variation of this is to close the duodenal end and all the stomach opening except the lower end, which is made to anastomose with a loop of the jejunum. The matter is still in doubt, but Morison's modifications appear to overcome the objection to the unmodified Billroth's operation, viz., the inequality in the lumen of the stomach and duodenum, and the liability for a leak to take place at the Y-shaped junction. Kocher's modification is somewhat longer and more difficult to carry out. This operation has been done by using Senn's bone-plates (Rawdon), Murphy's button, or other special apparatus, but there does not appear to be any necessity for these complications.

(*D*,) *Pylorectomy with Gastro-enterostomy: Billroth's Second Method.*—The objection to it is that the complications connected with gastro-enterostomy are introduced, and it should be reserved for special occasions. The tumour is excised, and then both the stomach and the duodenum are closed separately by a double row of sutures, after which a gastro-enterostomy is performed. It is required when so much of the stomach (or duodenum, which is rare) has to be taken away that the ends will not come together.

Gastro-enterostomy may be done first of all, and pylorectomy subsequently. This operation may be indicated when the disease appears most probably inflammatory, but if there is any suspicion of cancer, and the case is fairly operable, it is dangerous to allow the growth to progress. It has been proposed to do gastro-enterostomy first of all, and allow an exhausted patient to regain strength before the pylorectomy. Tuholske did this in 1891, doing the pylorectomy three months (!) later. Others have done the two operations at intervals varying between fourteen days and six weeks. But, as Czerny has found, patients are apt to put off the second operation, as they at first feel so much improved by the gastro-enterostomy and do not understand the urgent necessity of the second. It is only when a patient is too weak for pylorectomy that it should be postponed until a second operation.

(*E*,) *Resection of the Stomach.*—Cylindrical resection of the body of the stomach with approximation of the cardiac and pyloric ends is exceptionally necessary. Enough of the cardiac portion should be removed to reduce it to the size of the pyloric segment.

(*F*,) *Cardiectomy.* — Excision of the cardiac end has not been successful (Levy).

(*G*,) *Complete Gastrectomy.*—Nearly the whole of the stomach has been removed, the piece left undergoing considerable enlargement

(Schuchardt). The complete removal of the whole of the stomach was done by Schlatter for diffuse carcinoma or cancerous induration of the whole of the wall of the stomach without adhesions or glandular enlargement. The patient was a woman, aged fifty-six. The whole of the stomach was evidently removed, for a piece of œsophagus and duodenum were included at either end. A loop of intestine was attached to the œsophagus after sewing up the duodenal end, which would not reach far enough for end-to-end union. The patient lived comfortably on a fluid and semi-solid diet given every two or three hours, confirming the results of experiments on dogs (Pachon and Carvallo). She gained 8·4 kilos (18½ lbs.) and remained in fair health for a year, then began to go down hill, and died fourteen months after the operation with recurrence in the œsophageal end, also infiltration of mesenteric, retro-peritoneal, bronchial and supra-clavicular glands. The tumour was described as a small-celled alveolar glandular carcinoma. Brigham, of San Francisco, repeated the operation on a woman, aged fifty-six; he obtained end-to-end union by using Murphy's button. Six weeks after the operation she was gaining weight; the button had not appeared.

(*H*,) *Results of Operations for Cancer.*—The operations have been practised for a much longer period and in far greater numbers by German surgeons, so that for all late results it is necessary to quote their papers. According to Haberkant, the pylorectomies up to 1887 had a mortality of 62 per cent., between 1888 and 1894 the mortality had fallen to 40 per cent. Since then, by more experience in the selection of cases, the mortality has been further reduced, so that for a small number of cases the mortality has been *nil*. How important it is that the cases should come before the surgeon at an earlier stage is seen from the following, showing that less than a quarter of the cancers brought to surgeons could be removed: Mikulicz, out of seventy-five cases, did eighteen excisions, twenty-one gastro-enterostomies, seven explorations only, and in twenty-nine did no operation; Krönlein, out of sixty-seven cases, did fifteen excisions, four gastro-enterostomies, eighteen explorations only, and in thirty did no operation; Czerny, out of one hundred and nine cases, did twenty-six excisions; Garré, out of sixty cases, did five excisions, nineteen gastro-enterostomies, eight explorations only, and in twenty-eight did no operation; Roux, out of sixty-five cases, did fifteen excisions. Most of the patients who survive the operation die of recurrence within two years. Recurrence has, however, taken place at a later date (in one of Carle's cases after five years). Of the few who have lived over three years, it may be said that the result "approximates

or assimilates to a cure." Kocher found that fourteen patients were alive two to four years after the removal ; three, four years after ; four, five years after ; one, six years after ; and, two eight years after. Out of fifty-seven resections of the pylorus, one woman was alive ten years after ; one, five years after ; one, three years after ; one man, two years after ; and four others had died more than three years after operation without recurrence, *i.e.*, seven "cured" out of fifty-seven. Krönlein had two cases between three and four years ; Czerny, one case seven years, one case three and a half years ; Lobker, one case seven years ; one case five years ; Maydl, one case six years ; Hahn, one case seven years ; one case four years ; Hacker, one case six years ; Karg, one case three years ; Frank, one case seven years. Further improvements are to be hoped for from a more definite classification of the different clinical and pathological varieties of carcinoma, but, above all things, from earlier diagnoses.

IX.—Gastro-enterostomy.

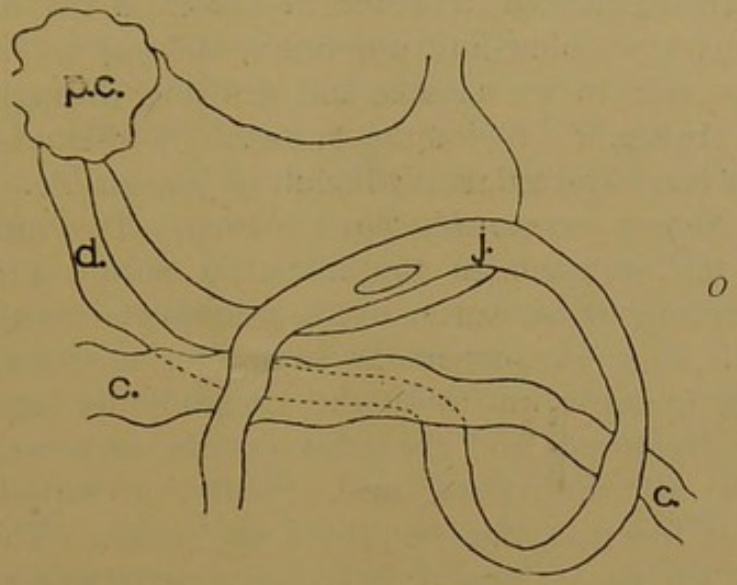
Gastro-enterostomy is the general term for an artificial fistulous communication established between the stomach and the intestine. Gastro-duodenostomy is the union between the anterior surface of the stomach and the descending portion of the duodenum. Gastro-jejunostomy is the union between the stomach and jejunum, but gastro-enterostomy is the better term when it is uncertain what part of the small intestine has been connected.

(*A*,) *Anterior Pre-colic Gastro-enterostomy.*—This was the first gastro-enterostomy. It was done by Wölfler in 1881, at the suggestion of his assistant, Nieoladoni, on a man, aged thirty-eight, with inoperable pyloric cancer. He joined up a loop of intestine 50 cm. from the duodeno-jejunal junction to the anterior wall of the stomach by bringing it upwards in front of the colon. The patient lived a month, and after death an orifice was found 2 cm. wide. The special difficulty about the operation is the selection of a loop of the jejunum, since the ileum, and even the cæcum, have been joined up, and the patient has died of inanition. The duodeno-jejunal junction must be sought for below the great omentum and transverse colon, to the left of the vertebral column, and to the right of the descending colon. Measuring from the point where the jejunum begins, viz., at the end of the ascending and fixed portion of the duodenum, a point, 18 inches to 2 feet distant, is selected for apposition to the stomach in order that the transverse colon may not be compressed by the loop. To avoid the formation of a spur, and the regurgitation of bile, a length of 3 to 4 inches should be fixed in the long axis of the stomach. This

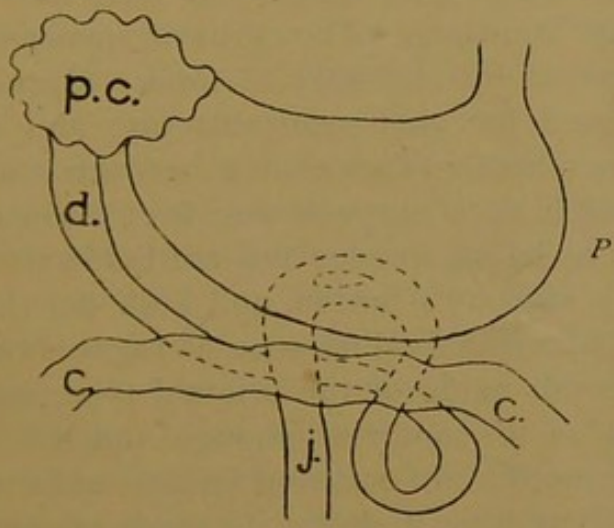
remains the simplest and easiest operation, and, perhaps, is as successful as the other modifications. It must be done when the stomach is fixed by growth behind and the gastro-colic omentum and mesocolon are infiltrated.

DIAGRAMS OF GASTRO-ENTEROSTOMY.

O.—Anterior pre-colic gastro-jejunostomy.



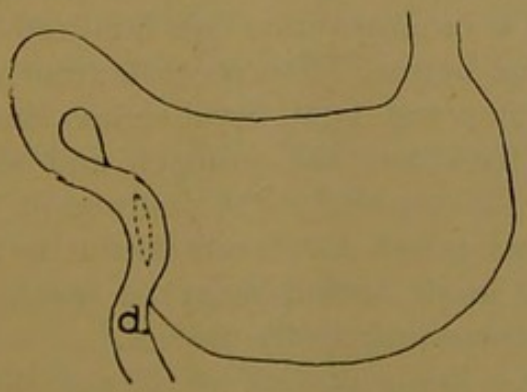
O



P

P.—Posterior retro-colic gastro-jejunostomy.

Q.—Gastro-duodenostomy.



Q

(p c,) Pyloric Cancer; *(d,)* Duodenum; *(j,)* Jejunum; *(c,* Colon.

Fig. 5.

(*B*,) *Posterior Retro-colic Gastro-enterostomy* was first practised by Courvoisier in 1883. He opened the gastro-colic omentum to expose the under-surface of the stomach, and then, through a hole in the mesocolon, drew a loop of intestine and fixed it to the posterior surface of the stomach. A narrow hole in the mesocolon is apt to cause strangulation. Hacker, in 1885, did the operation by raising the transverse colon and omentum, making an incision in the meso-colon parallel to its vessels, and drawing through the posterior wall of the stomach. When the stomach is dilated, this plan is easy; when it is contracted, it is difficult or impossible.

(*C*,) *Suture versus Murphy's Button.*—Two methods are employed to fix the stomach to the intestine, suture and Murphy's button. If a continuous suture is used, a loop of intestine is united to the stomach by a sero-muscular suture for at least 4 inches, then an opening is made into both the stomach and intestine, any bleeding from it ligatured, and the edges of the incision united by a suture through all the coats, and, finally, a superficial sero-muscular suture is inserted, the length of the other. The reason for fixing such a length of loop is to avoid a spur which will turn the bile into the stomach and set up vomiting. The sutures, instead of being continuous, may be inserted by Halsted's method. Murphy's button is also very widely used for gastro-enterostomy, and has quite superseded Senn's bone-plates. The choice between suture and Murphy's button is one which each surgeon decides for himself. The suture appears to be best, as being simpler and not liable to the special complications attending Murphy's button, and I do not think that with practice there is any appreciable difference as regards time. The Murphy's button must be well made of the original type, small, its closure neatly adjusted so as to compress enough and not too much. According to Murphy, there is no occasion for any additional suture, and, indeed, the operation loses thereby its merit of speed. Czerny has used it in more than one hundred cases without a failure attributable to the button. Murphy's button has failed owing to the surfaces separating and fatal fæcal extravasation taking place; the button may fall back into the stomach and set up so much trouble that it has to be removed; the button, in passing, may become arrested, and perforation has been distinctly traced to its influence. Moreover, as a small button must be used, the opening is apt to contract and become practically useless.

Complications.—Regurgitation of bile is the important complication following gastro-enterostomy which has not yet been overcome; indeed, Hartmann says that evidences of bile are to be found in

the stomach of every case after this operation, and this may cause the patient to vomit until he dies exhausted. Where there has been a chronic regurgitation of bile, secondary operations have been done to remove the spur which deflects the bile into the stomach. An anastomosis has been made between the duodenal or proximal limb of the loop and the jejunal or distal limb. The duodenal end has been cut off and implanted into the gut lower down. The best plan to avoid the regurgitation of bile is the fixation of a good length of gut to the stomach, and for this purpose the original pre-colic operation is, in my experience, the best. None of Kappeler's thirty-nine cases suffered from vomiting.

(*D*,) *Gastro-duodenostomy.*—This anastomosis allows the gastric contents to enter the duodenum above the bile papilla, and there is, therefore, not the danger of regurgitation of bile into the stomach. The operation was proposed by Jaboullay in 1892, and has been recommended by Mikulicz. It is most easily done when there is a dilated and moveable stomach with a free duodenum. It is an impossibility when the growth involves the pyloric third of the stomach and the duodenum. I have recently had a successful case in which, owing to adhesions, it would have been impossible to do either pyloroplasty or gastro-jejunostomy.

(*E*,) *Results of Gastro-enterostomy* —At first the mortality was great for a palliative operation, 50 per cent. ; it has now fallen. In 1897 Czerny reported a mortality of 32 per cent. among ninety cases ; in the simple stenosis cases the mortality was only 10 per cent. In 1898 Carle reported an even lower rate among forty-eight cases, viz., 20 per cent. and 8·3 per cent. respectively. Tricomi reports out of twenty-one operations for simple ulcer, nineteen successes, 15 per cent. of whom had a history of hæmatemesis. Many cases of fibrous stenosis are wonderfully benefited, some are cured, and tumours thought malignant have quite disappeared. True cancer cases generally experience much immediate relief, and even put on flesh ; this may last for three to six months before they again go down-hill. Survivals of a year or more are doubtful. In Ahlsfield's case, however, the patient lived three and a half years after gastro-enterostomy, and after death, cancer was found obstructing the pylorus.

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