termed the fourth phase—that is, the phase between (a) the change from a clear to a duller weakened sound, and (b) the extinction of the sound (fifth phase). As the armlet pressure is being lowered and the diastolic index has been passed (beginning of the fourth phase), the sound, even when the armlet pressure has fallen to zero, may persist in some arteries, while it may disappear much earlier in others—that is, at higher levels of armlet pressure. Such levels vary in different limbs and segments of limbs. With the armlet in different situations the extent to which the sound persists below the diastolic index is (a) greatest in the upper arm, (b) next in the forearm, and (c) least in the calf of the leg. The rule seems to be that the sound disappears earlier in the distal segment of a limb than in the proximal one, and in the lower limb earlier than in the upper. (It has been already stated that the precise values obtained from the popliteal arteries are in some cases open to question, but the broad relation between the results got with the armlet on the thigh and the leg respectively are clear enough.) Thus there may be abolition of the sound at armlet pressures of 30 mm., etc., in the leg, while in the arm and forearm the sound continues to be audible even after the armlet pressure has been reduced to zero. The sound often persisted down to zero in the upper arm, though extinguished in other parts while the armlet pressure was still at considerable heights—for example, in one case 80 mm. on the leg and 60 mm. on the forearm; in another case, 53 mm. on the leg and 38 mm. on the forearm; in a third, 70 mm. on the leg and 60 mm. on the forearm.

Duration of Persistence of Sound below Diastolic Index in Limb Segments.

The extraordinary variability in the levels of armlet pressure at which the sound disappears in different limb segments constitutes additional evidence that the lower limit of the sound cannot be taken as an index of diastolic pressure; according to such an index the diastolic pressure would be represented as varying in the different arteries in an obviously impossible fashion.

In the leg extinction of the sound may almost immediately follow the change which constitutes the diastolic index, while in the arm of the same person the sound may persist till the armlet pressure has fallen to a much lower level.

Differences (in mm. Hg) between Diastolic Index and Extinction of Sound.

Number.	Forearm.	Upper Arm.	Calf.
1	3	7	—
2	15	5	7
3	—	10	10
4	—	4	6
5	—	18	9
9	62	45	34
10	8	45	5
12	10	15	10
13	—	20	20
15	15	7	—
16	32	67	—
17	10	30	20
18	20	50	—
19	15	70	10
Average ...	13.5	28.0	9.3

In order to test the influence of a regurgitant leak at the central pump upon the pressures at different distances along the stream, experiments were performed with a circulatory schema, similar in a general way to that described in former papers from this laboratory.⁷

A syringe, worked in regular fashion by a motor, supplied a pulsating stream through the schema. At two points in the stream at different distances from the pump sets of valved manometers, proximal and distal, were connected so as to measure the pressures, especially the

minimum or diastolic pressures at these points. The relation of the pressures in the proximal and distal manometers was determined when the pumping syringe was provided with efficient valves. Comparative observations were then made after valvular defect, causing regurgitation into the syringe, had been induced. It was found that the diastolic pressure in the proximal manometer was reduced relatively to that in the distal manometer, the fall of pressure, induced by regurgitation, at the central end or origin of the pulsating stream telling on the proximal portion of the stream and its associated manometer more than on the more distal portion and its manometer.

I have to record my thanks to Professor MacWilliam for much kind assistance and advice during this investigation, and also to the honorary staff of the Aberdeen Royal Infirmary (where the clinical part of this investigation has been carried out) for permission to investigate the cases in their wards.

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THREE CASES OF PANCREATIC CYST.

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The following three cases of pancreatic cyst, which have been operated on successfully, were of different types, the first an isolated cyst in connexion with the back of the head and the other two of the prepancreatic or peripancreatic variety.

The first, apart from other features, was of interest from the point of view of diagnosis. The possibility of the existence of an enlarged gall bladder was considered, but the freedom of the cyst from the liver and its apparently deep and retroperitoneal situation made this improbable.

The two other cases had much in common clinically. In Case III the cyst pushed its way forwards between the stomach and the transverse colon, perhaps in the more usual direction. In Case II the cyst projected above the stomach, pushing it downwards and to the left. They were both what Körte, Osler, and others have described as "pseudo-cysts," but not of that form to which the same term is also applied in which the effusion occurs primarily into the lesser sac of the peritoneum. The onset of both was attended by acute symptoms, starting without any apparent cause, and both were associated with destructive changes in the gland tissue.

CASE I.—*Cyst of the Head of the Pancreas: Enucleation.*

A married woman, aged 31, was seen by me in November, 1912, in consultation with Dr. Tonking, and she gave the following history. About twelve months before she commenced to have frequent action of the bowels to the extent of four to five actions in the day; this occurred in attacks lasting two or three days, and then she was well for two or three weeks. Recently, when the attacks occurred, the daily actions were not as numerous. There was griping pain at these times, but none in the intervals, and she had never passed blood or mucus; they were accompanied by distension, but there was never any sickness. There had been no appreciable loss of flesh. She stated that the trouble almost immediately followed the birth of a child, and that seven years before, also after the birth of a child, she developed asthma, which only ceased at this last birth. There had never been any jaundice.

Examination showed a prominence under the right rectus above the umbilical line, not extending beyond the mid-line; here a rounded lump about the size of an orange could be felt definitely elastic on deep palpation, which was not movable vertically, but could be displaced laterally into the inner part of the left hypochondriac region. The belly generally was soft, without any intestinal distension or visible peristalsis. The diagnosis seemed to be a retroperitoneal cyst below the pylorus, and probably connected with the head of the pancreas.

She was sent into St. Thomas's Hospital, and further investigation showed that her pulse and temperature were normal, and that there was considerable visceroptosis, which was confirmed by a bismuth meal, the stomach and transverse colon both being considerably dropped, but there was no evidence of any obstruction.

The operation was performed on November 27th. On opening the abdomen through the right rectus a tumour was found behind the vertical part of the duodenum and also on its mesial aspect; the larger part of the swelling was above the level of attachment of the transverse mesocolon, which crossed the duodenum at a lower level than normal. A vertical incision was made through the peritoneum on the outer side of the duodenum as low as the mesocolon, and the duodenum was turned over towards the mid-line, when a rounded grey cystic swelling was exposed. This was packed round with gauze and tapped, when a thin yellowish mucoid fluid drained away. The cyst wall was then dissected off the back of the duodenum, and the common bile duct was exposed, running down and entering the latter. The deep aspect of the cyst was in close apposition with the inferior vena cava for 1½ in., and had to be dissected from it with very great care; a small vein coming off it at the upper part had to be cut and ligatured. The cyst was quite free from the kidney, and was connected with the back of the upper part of the head of the pancreas; in its removal Wirsung's duct was not seen. After dry sponging the duodenum was replaced, and the peritoneum stitched with fine catgut except at one spot, into which a fine drain with a wick was placed. The abdominal wall was sutured in layers. The cyst wall showed some thinned compressed pancreatic tissue, and had a smooth lining which the microscope confirmed; the fluid collected was not sufficient for any extended examination, but it gave no evidence of urea, and a very few mononuclear cells were present.

During the first three days after the operation frequent attacks of vomiting gave some anxiety, but it then passed off and was not repeated. Except for a slight rise of temperature and pulse during the first twenty-four hours these were always at the normal level. There was practically no pain or inconvenience. The wick was removed from the tube on the 29th, and there was very little discharge, and on December 3rd the tube itself was taken out and replaced by a plug. On removing this on the morning of the 5th a lot of glairy purulent fluid escaped; some of this was collected and examined in the clinical laboratory, but no proteolytic or amylolytic ferments were detected. Her subsequent progress was uneventful; she was up on the 12th, and left for home on the 20th.

The first question that has to be considered in this case is, Was it really a pancreatic cyst, or was it a retro-peritoneal cyst derived from some Wolffian remains? This can be answered, I think, from the fact that the wall of the cyst consisted of thinned pancreatic tissue. That being so, it was a true cyst due to retention.

Removal of the cyst by dissection has a very limited application, as the size, situation, and nature of the cyst do not allow of such radical measures; thus the instances are rare where it has been accomplished. The operation presented no special difficulty except in the dissection of the collapsed cyst wall from the vena cava.

CASE II.—*Cyst Projecting between the Liver and Stomach: Drainage.*

A single woman, aged 33, was admitted into St. Thomas's Hospital under my colleague Dr. Turney on October 14th, 1909.

In the previous November, while at her work of a servant, she was seized with violent pain in the right side, accompanied by the vomiting of green fluid looking like bile and tasting very bitter. This pain, with varying severity, continued up to admission, and was then very marked. The vomiting was not repeated until April, and then she was in an infirmary for six weeks, where she had frequent attacks. After being in a convalescent home she went back to her situation, but the vomiting soon started again and took place at about weekly intervals. During the fortnight previous to admission she had vomited after every meal, and the pain was very much worse. Meat and vegetables caused pain, and there was a marked distaste for fatty foods; her diet had consisted of milk, bread, and boiled rice. There was considerable flatulence and eructations; no haematemesis, melaena, or jaundice; the bowels were natural. She had lost a lot of weight during her illness.

On admission the upper part of the abdomen in the median line was seen to be markedly full, and here could be felt a rounded elastic mass, moving slightly with respiration. Below the liver dullness and above the mass was a resonant area; no thrill could be obtained over it. Except for this lump the abdomen seemed normal. The pulse and temperature were normal. The tongue was furred. There was no other evidence of disease. A blood count was normal, and Cammidge's test C was positive. The x-ray report was that the greater curvature of the stomach was two inches below the umbilicus, and that some gas was present just below the left dome of the diaphragm.

She was transferred to my care, and on October 22nd I operated. A vertical incision was made through the left rectus just outside the median line when a cystic swelling presented. There were no adhesions of this to the abdominal wall, and it was quite free from the under surface of the liver. The swelling was pushing forwards the gastro-hepatic omentum, especially at its upper and right part, and here it appeared brownish, due to the colour of the fluid beneath; on the left side, adjacent to the lesser curvature, several vessels were seen, and the stomach itself was pushed downwards and to the left. On cutting through the gastro-hepatic omentum there was a gush of light-coloured, almost clear fluid under great tension, followed by a milky fluid

having a sediment. The main part of the wall of the cavity seemed entirely smooth, but just to the left of the spinal column there was a hernia of ragged pancreatic tissue coming through a hole the size of half a crown; of this, several pieces of a yellow-brown colour were removed. The cavity appeared on the right side to extend to the limits of the lesser sac, passed down behind the stomach, and went away on the left towards the spleen; here more of the pancreas and the left kidney could be defined in the posterior wall. No patches of fat necrosis were seen. The opening in the sac wall was stitched to the parietal peritoneum, and tubes with wicks were put in, one long one going to the left.

The smooth nature of the cyst wall and the relation of the necrotic area to the cyst suggested that the gland tissue bulged into a peripancreatic cyst which by gradual distension had come to be practically coequal with the median part of the lesser sac. That the sac was not lesser sac alone was shown by the absence of adhesions or lymph coagula in the cyst, and if it had been so one might have expected especially that the anterior surface of the gastro-hepatic omentum would have shown signs of inflammation, and probably been adherent to the under surface of the liver.

Examination of the fluid showed a few epithelial cells, but no digestive properties were demonstrated. The pieces of the gland removed showed necrosis, with areas of acute and chronic inflammation, with a large amount of golden brown pigment.

The next morning the wicks and plug were removed, and afterwards a good deal of haemorrhage occurred. As this was not efficiently controlled by plugging, an anaesthetic was given and the bleeding point sought for; this proved to be a branch of the coronary artery. Saline infusion was necessary, and eructin was injected. The same night the temperature went up to 102.2°, with pulse 136; but in the morning they were much reduced, and she seemed better.

On October 25th the plugs were removed without any further bleeding. Both legs were swollen. The temperature was 98.8° F. and pulse 96 in the morning, with rise in the evening to 100.2° and 104. Her subsequent progress may be summed up as follows: The temperature was irregular between the normal line and 102° for a fortnight, afterwards becoming normal, the pulse at the same time being on the average 90; the discharge from the wound gradually reduced, and by the end of the year was very slight, but its alkaline digestive character caused considerable irritation of the surrounding skin. The oedema of the lower limbs gradually reduced from above downwards, but for a while there remained a considerable amount about the ankles.

The patient has been seen several times since she left the hospital, and there has been no sign of any re-formation of the cyst.

Points that may be noted in this case are: (1) That the onset of the trouble was acute without any obvious cause, such as injury; (2) that there was pancreatitis, probably due to an infection, associated with some haemorrhage into, and subsequent necrosis of, the gland tissue, and accompanied by the gradual formation of a prepancreatic cyst; and (3) that the cystic collection from its tension had its own fibrous capsule and only occupied part of the lesser sac; it was not a collection in the lesser sac.

CASE III.—*Cyst Projecting between the Stomach and Transverse Colon: Drainage.*

A male, aged 48, was first seen by Dr. Crosby on September 29th, 1908, for acute pain in the epigastrium, associated with vomiting and constipation, and temperature 101° F., and pulse 150.

On three separate occasions previously he had had acute attacks of pain with vomiting; the first attack was some three years before. The pain was always in the epigastric region, and the vomit contained food, mucus, and bile.

This fresh attack lasted for about four days, no food being retained at all. There was no obvious swelling over the seat of pain, but there was dullness on percussion; slight jaundice was noticed. The patient gradually improved until October 14th, when a swelling was found in the epigastric region. After a consultation operation was advised, and on October 22nd Dr. Crosby opened the abdomen.

A mid-line incision was made above the umbilicus, and the stomach immediately presented in the wound. It was found that the stomach was tightly stretched over a fluctuating tumour, pushing it upwards, and to which its posterior surface was adherent; the tumour obliterated the cavity of the lesser sac, and the collection of fluid was in it or behind it. As the cystic collection could not be separated from surrounding structures it was tapped, and 2 quarts of fluid were drawn off. The opening into the sac was brought up to the abdominal wall and stitched to the parietal peritoneum; a drain was inserted, and the rest of the wound stitched up.

He made a good recovery, and was able to get about and take walking exercise and eat his ordinary food until the middle of February. The sinus was kept open all the time, but only a small amount of fluid came away. There was a daily action of the bowels, and his urine was normal.

The report by the Clinical Research Association on the fluid removed was as follows: An opalescent fluid of neutral reaction to litmus with its opalescence due partly to finely emulsified fat and partly to the presence of abundant bacteria. Under the

microscope there are to be seen bacteria, minute fat globules, and cellular detritus.

The fluid is practically free from albumin. The fermentative action of the fluid has been tested upon fibrin, egg albumen, starch, and butter fat, with the following results:

1. There is slight but quite definite proteolytic action upon the fibrin and coagulated albumin.

2. There is marked diastatic action upon starch, which is converted into a reducing sugar which yields the osazone of iso-maltose.

3. Butter fat is emulsified, but does not undergo sufficient splitting within two hours to show any acid production by the litmus test.

From its general characters and reactions there is good reason for believing that the fluid is from a pancreatic cyst.

On February 17th, 1909, the patient was again seized with violent pain in the epigastrium with vomiting and constipation; the vomit consisted of bile-stained mucus. No food could be retained in the stomach. The pain, which was spasmodic, and passed through to the back, passed off in about three days, and the bowels were well opened by castor oil and magnesium sulphate. The ingestion of food was associated with discomfort about half an hour after, and there were occasional attacks of pain at other times. Some thickening was now made out to the right side of the middle line in the epigastrium, and more discharge had come from the sinus. His progress was not satisfactory; his general condition was not so good, his pulse was quick without elevation of temperature, there was loss of sleep, and the bowels did not act without drugs. He complained a good deal of acidity, and there were occasional attacks of retching with expulsion of mucus, at times bile-stained. He was not able to take anything beyond peptonized milk and some meat jelly.

On March 4th he came to London and placed himself under my care. He seemed very weak and considerably wasted, his pulse was 132, and temperature 99° F.; he was constipated and had frequent attacks of retching.

Examination of the abdomen showed no distension of the stomach. To the right of the old incision there was marked fullness behind the right rectus, passing up under the costal margin, and over this area it was comparatively dull, tender, and definitely elastic. His urine showed nothing abnormal. On the 5th a bismuth meal was given, and four hours later he was examined by Dr. Greal, who found that the bismuth was all retained in the stomach, mainly in two portions, one at the cardiac end and the other at the pyloric. The right dome of the diaphragm was distinctly raised. The diagnosis made was that there was a cystic collection on the right side, probably again in relation with the pancreas, and that pressure was taking place on the pyloric end of the stomach, interfering with the normal exit of the stomach contents.

The temperature on March 6th and 7th was subnormal, rising on the 8th to 100.2°; the pulse varied between 120 and 136.

On the afternoon of March 8th I operated on him, Dr. Crosby being present. The incision was made in the line of the former one, keeping to the right of the sinus. The lower border of the stomach was seen, and the gastro-colic omentum was divided vertically to expose the convexity of a large cystic collection to the right of the mid-line. Careful division over its greatest prominence opened a large cavity which passed away to the right and upwards to below the diaphragm. A considerable amount of dirty turbid fluid escaped which was not offensive, and from the cavity was withdrawn a necrotic piece of tissue, about 2 in. by 1½ in., which looked like pancreas. Into the cavity a tube with a wick was inserted, and this was loosely packed round with gauze. The old sinus was dilated up and a tube was inserted.

Examination of the fluid showed it to be swarming with bacteria, and it gave a pancreatic reaction; the necrotic tissue was pancreas.

The operation was followed by immediate reduction of the temperature to about or below the normal line, and this was maintained; reduction in the pulse-rate took place very gradually, and was probably due to the irritation of the sympathetic nerve plexuses in relation with the cavity. During the first few days there was coughed up at times some blood-stained sputum, unexplained by any physical signs in the chest, though it seemed it might be due to small emboli. Vomiting and nausea ceased after the operation, and the appetite gradually returned, and was inclined to be excessive. With the increase of food the discharge from the tube was very much increased, and considerable irritation of the surrounding skin was produced. As this increased flow was due to the active secretion of the pancreas, on the 16th it was decided to limit the secretion by stopping carbohydrates, reducing the albuminous food, and increasing fats; at the same time 15 grains of sodium bicarbonate were given every four hours. The effect of this treatment immediately bore fruit, and the discharge gradually lessened so that the tubes were able to be left out. On leaving the home on April 14th there was a small sinus left from which there was a very little discharge.

On April 13th he had an attack of pain in the old region, nausea and rise of temperature. He certainly had not eaten discreetly, but he thought he had caught cold. He was re-admitted to the home on the 20th with local tenderness and slight jaundice—temperature 100° and pulse 116. In two days he was practically all right again, and he left on the 25th.

About a fortnight afterwards some localized thrombosis of the right saphena vein appeared, which with rest soon subsided. In all other ways he was very much better, except for the persistence of a small sinus.

On June 29th, 1909, he reported that he could not get about much as the leg still swelled. The sinus discharged from a tablespoonful to less than a teaspoonful in twenty-four hours. There had been no return of pain since leaving the home.

The report on November 26th, 1909, was that there was a very small amount of discharge. The diet was still very carefully attended to, and there had been no attacks of pain. His condition was so much improved that he was able to attend to his business.

For the purpose of this paper Dr. Crosby has kindly sent me the following up-to-date report:

The patient is in good health, and is able to play golf. There is still a sinus from which a small amount of thin glairy fluid exudes. He is careful with his diet, but does not keep up such rigorous restrictions as at first. About a year or more ago there was slight loss of weight, but this was regained, and he expresses himself now as feeling very well, and is able to do a full day's work at his business. When I last examined his abdomen there was nothing abnormal to be noted; the liver was normal in size, and there was no tenderness over the region of the pancreas.

This case was also acute in origin, the early symptoms suggesting some acute intestinal obstruction. From what was found at operation it was obviously due to an inflammation of the pancreas, attended by rapid cyst formation, but whether this was in the lesser sac or behind it was not determined; it may be assumed, I think, that it was not in the lesser sac. The development of the second collection illustrates a very likely sequel in these cases. Whether this was into the old cavity or not could not be made out; it was, however, quite separate from the track of the sinus, and much more to the right. I was inclined to view it as a fresh cystic collection altogether, not in the lesser sac, although its position would have done well for a localized collection in the upward extension of the latter to the right above the pancreas.

Attention may be drawn to the marked benefit of the dieting in reducing both the amount of the discharge and lessening its irritating character.

A RENAL CYST CAUSING CHRONIC INTES-TINAL OBSTRUCTION.

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I HAVE been unable to find record of a case similar to the following:

History.

The patient, a woman 52 years of age, stated that for the past three years she had noticed a lump on the left side of her abdomen, which had been getting larger, and seemed to move about. During these three years she had suffered from intermittent attacks of abdominal pain and vomiting. The attacks were associated with constipation, and she had been unable to get her bowels open without the constant use of aperients. Of late they had become more frequent and severe.

State on Examination.

Marked intestinal peristalsis could be seen going on in the neighbourhood of the umbilicus; the abdomen moved well on respiration, and there was no tenderness on palpation. In the left iliac fossa was an elastic swelling the size of a large cocoa nut, which moved slightly with respiration; it could be pushed without difficulty over to the right side of the abdomen, and on turning the patient on to that side the tumour also fell across. The latter always returned to its original situation in the left iliac fossa, and appeared to have a pedicle or point of attachment in the left lumbar region. The left flank was resonant and there was no bulging here.

Operation.

A 6-inch incision was made to the inner side of the left linea semilunaris, the rectus sheath was opened, and the left rectus muscle pulled towards the middle line. On opening the peritoneal cavity a large pedunculated tumour of a cystic nature was seen, which was springing from the posterior abdominal wall in the angle between the transverse and descending colons; several large vessels were seen encircling the neck of the tumour. The transverse colon was hypertrophied and dilated, while the descending colon was small and contracted. Obstruction was being caused by pressure on the splenic flexure of the colon, where it passed round the pedicle of the tumour.

On dividing the posterior peritoneum round the neck of the tumour and pulling strongly on the latter the lower pole of the left kidney was brought into view, and it was seen that the tumour was growing from this organ. Removal necessitated