

TABLE V.—Continued
Group 9. Fracture of Ulna in Upper Third: 2 Cases

Case	No. of Case Record	Sex		Age	Nature of Fall	Right	Left	Site	Greenstick	Complete	Remarks
		M	F								
95	34140	+	..	11	Upon hyperextended hand.....	+	..	Just below greater sigmoid cavity ..	+	..	Line runs from above and behind downward and forward.
96	40876	+	..	12	Playmate fell on forearm.....	+	..	Shaft.....	..	+	
	2	2	0			2	0		1	1	

Group 10. Fracture of Ulna in Middle Third: 4 Cases

Case	No. of Case Record	Sex		Age	Nature of Fall	Right	Left	Displacement	Greenstick	Complete	Remarks
		M	F								
97	35000	..	+	4	From couch.....	..	+	0	+	..	16 days old; brought because of persistence of pain. Diagnosed contusion elsewhere where violence preponderates in fracture of ulna. No luxation of head of radius in this series.
98	35153	..	+	7	From swing.....	..	++	++	..	++	
99	34654	..	+	14	Struck against log.....	..	++	+	..	+	
100	37920	+	..	9	From tree.....	+	..	+	..	+	
	4	2	2			1	3	3	1	3	

STATED MEETING, NOVEMBER 2, 1914.

The President, DR. JOHN H. GIBBON, in the Chair.

SARCOMA OF THE TONSIL TREATED WITH RADIUM

DR. NATHANIEL GINSBURG presented a man, forty-nine years of age, who was brought before the Academy of Surgery a month ago with a tumor of the right side of the pharynx. The condition had been diagnosed as an inoperable malignant tumor of the right tonsil. The case was apparently hopeless from the stand-point of further surgery and the patient was sent to Dr. Newcomet for the use of radium. The entire right side of the throat was filled by a mass which has now entirely disappeared.

DR. JOHN B. ROBERTS said that he wished Dr. Ginsburg could tell what the clinical characteristics of really malignant tumors of the tonsil are. There is difficulty in recognizing them with certainty. Three or four years ago a man in his ward at the Methodist Hospital said to him, "You don't recognize me, do you, Doctor? I am the man from whose throat you took the cancer of the tonsil." He then recollected that about ten years before he had operated upon him for malignant disease of the left tonsil. He supposed he was dead long ago. He had sawed his jaw apart, after chloroforming him by means of a tube passed through a tracheal incision, and took out the tonsillar growth and also a portion of the soft palate. No radium was applied and no X-ray. It was before we were familiar with radium and probably before the X-ray was used to any extent. Yet here was a man who lived something like ten years with no return of what was pronounced, by the pathologist making the microscopical examination, a malignant tumor. The man was sent to Dr. Walter Roberts, who could find nothing wrong, except a cicatricial condition where about ten years before there had been this mass. There is something peculiar about these tonsillar growths which is not understood and which the pathologists do not recognize as to the histological structure. Some years previously Dr. Roberts saw a tonsillar growth, which had been diagnosed by a renowned laryngologist as a malignant tumor. The family physician and the speaker believed it to be syphilitic. This, active treatment proved to be the true diagnosis.

DRAINAGE AFTER NEPHROSTOMY

DR. B. A. THOMAS presented a patient who had had two nephrostomies. One side was operated upon in last January; the other in February. The Watson apparatus did not work satisfactorily in this case. After taking the course of the fistula, he then devised two sterling silver drains to which tubes were attached to convey the urine around in front to a receptacle. The photographs (Figs. 1, 2 and 3) show the patient before and after the use of the Watson apparatus and also with the silver drains inserted. Inside the silver drains have bulbous extensions which prevent their displacement, also external flanges which prevent them from going in too far. It has been almost a year since the operations were done. The man has multiple recurrent polypi of the bladder and has been coming to the dispensary every other day for several months for dressings. In taking the drains out last week for washing and removal of contained phosphatic deposits considerable pain was caused. The man has gained ten pounds in weight since the operation, is in much better condition than before his nephrostomies, and insists upon his third promised operation—a cystectomy, which will be performed in a few days.

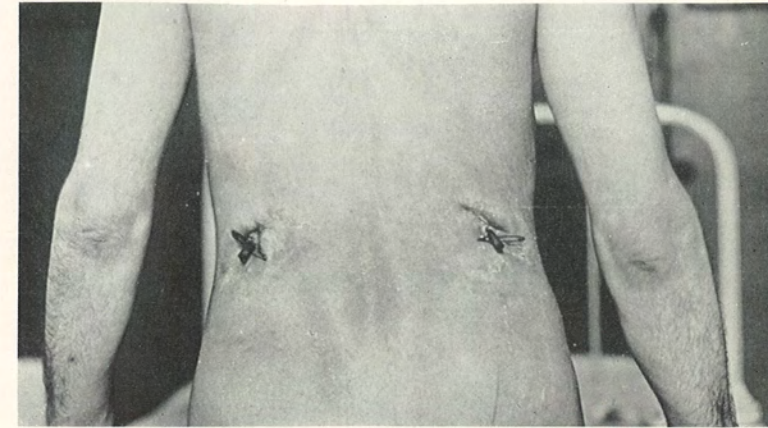


FIG. 1.—Bilateral nephrostomy, drains emerging in each lumbar region.

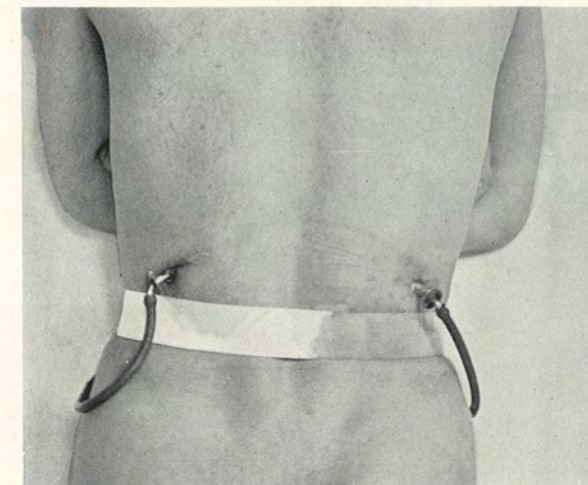


FIG. 2.—Tubes attached to carry urine to receptacle in front.

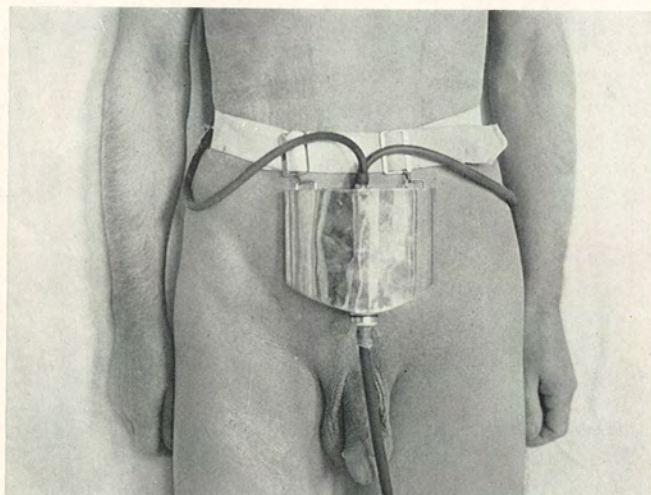


FIG. 3.—Nephrostomy. Urinary receptacle in front above pubis receiving tubes coming from drains emerging behind.

THE SURGICAL ANATOMY OF THE UPPER AND LOWER POLES OF THE THYROID GLAND WITH REFERENCE TO THYROIDECTOMY

BY NATHANIEL GINSBURG, M.D.
OF PHILADELPHIA

OPERATIVE procedures upon the thyroid gland are rendered difficult or simple in execution largely by the anatomical factors determining the disposition of the blood-vessels related to the upper and lower poles of this body. Accessibility of these vessels is not always easy, owing to the distortion of the gland mass by overgrowth, with consequent upward and downward extension, and displacement of the usual landmarks commonly noted to definitely localize the vessels entering the gland substance.

Severe hemorrhage not infrequently attends partial removal of the thyroid gland owing to retraction of the vessels (usually veins) after incision, or as the result of failure of a ligature to include all the vessels. The troublesome bleeding during the course of this operation is usually ascribable to the veins whose number and size are far greater than the standard text-book descriptions lead one to believe.

Close studies in the anatomical laboratory of the University of Pennsylvania over a number of years, with careful inspections of many hundreds of thyroid glands, dissected in normal position, has impressed the writer with the frequency of the anomalous distribution of the thyroid vessels, particularly the veins (Fig. 1). Clinical evidence to corroborate these views has also been found by the writer in operations upon the thyroid body in the living.

Isolation of the superior thyroid artery is always a simple matter because this vessel is invariably directly related to the upper apex of the lateral lobe, dividing, however, before it penetrates the substance of the gland. The distribution of the blood stream is over the ventral gland surface, a dorsal branch of some size, however, continuing down the dorsomesial surface of the lobe to form an anastomotic channel completed by an ascending branch of the inferior thyroid artery. It is from this anastomotic channel that the parathyroid glands hang and therefore derive their blood supply. Since the division of the superior thyroid into the two main stems often takes place at a distance of from two to three centimetres from the gland, the importance of grasping

both vessels in a circumscribing ligature having for its purpose complete pole ligation is significant. It is not by any means difficult to miss the dorsal stem of this artery in passing the ligature, and hence the explanation of a failure to realize an expected improvement in a patient with a toxic goitre after complete single or bilateral ligation of the superior thyroids was thought to have been accomplished.

The superior thyroid vein is usually a single vessel, but, as shown in the illustration, possesses an anatomical relationship to the internal jugular vein, which may give rise to severe hemorrhage after apparent ligation of the superior thyroid vessels has been practised. This short, thick venous trunk, passing transversely into the wall of the internal jugular vein, demands careful ligation, and this is safer than the application of a forceps. The writer was compelled during the past year to ligate the internal jugular vein in two patients, following the retraction of this vein which simulated a punctured wound of the vessel wall. This unusual procedure did not, however, in either instance, complicate the injury or offer any untoward cerebral effects.

The middle thyroid vein is fairly constant, short in length, and likely to be overlooked in lobectomy; especially since traction of the gland mass toward the median line often reduces this vessel to a collapsed thin cord which bleeds freely, if incised, when release of traction takes place.

Occasionally the inferior thyroid artery is wanting on one side, and a huge superior thyroid artery compensates for its absence. Obviously, this anatomical state would be ideal for polar ligation as a surgical procedure, and would rob the whole lobe of a large part of its blood supply. No example of an absent superior thyroid artery has been noted, although this vessel has been seen to arise from the common carotid artery. (This observation was made in the Anatomical Laboratory.)

The inferior thyroid artery is considerably larger than the superior thyroid, and has a more direct origin from the parent vessel (subclavian). Owing to its greater size and glandular distribution, it delivers a greater blood supply to the thyroid gland than its fellow of the same side. It passes vertically upward and thence medianward behind the carotid sheath, and always divides into a number of large glandular branches before entering the gland tissue. The division is opposite the centre of the gland lobe, and this vessel is mistakenly thought by some to have a relationship to the lower pole of the lobe similar to the arrangement which the superior artery bears to the upper pole. The inferior laryngeal nerve (motor to the larynx) is intimately related to the main glandular branches as they pass across the lateral

tracheo-oesophageal sulcus, passing between two or more branches or lying dorsal to all of them.

Ligation of the inferior thyroid artery before division requires retraction of the carotid sheath either lateralward (Halsted), or medianward (Rogers), extending the dissection beyond the confines of the gland capsule, and cannot be easily accomplished through a small incision. Ligation of the main branches before they enter the gland is attended with danger, since the motor laryngeal nerve may be included in the ligature. The peripheral ligation of the vessels in the gland substance, with retraction of the lobe toward the median line, spares both the nerve and the parathyroids and has been the procedure adopted since advised by Kocher, Halsted and Mayo. This method does not ligate the inferior thyroid *en masse*, but makes possible the plastic resection of the lower pole, and is the theory upon which Mikulicz based his suggestion of plastic gland resection, which has been recently mentioned in an excellent paper by Balfour of Rochester, Minnesota.

Rogers of New York advocates quadruple ligation of the thyroid vessels, with nerves included in the ligatures, and reports thirty-six cases of typical exophthalmic goitre operated upon prior to January 1, 1913, by this method. He approaches the lower arteries through a vertical incision over the lower end of the posterior border of the sternomastoid muscle. "The approach exposes and passes in front of the phrenic nerve on the scalenus anticus muscle. The inferior thyroid can then be felt and reached behind the internal jugular vein and common carotid artery."

The conception of this procedure is fundamentally based upon a certainty of accomplishing a reduction of the glandular arterial burden, and no other operation upon the thyroid save total excision will equal it in this respect. The results reported by Rogers upon the thirty-seven cases offers incontestable proof of the value of his procedure. This writer also attempts to explain failure in two of his earlier cases, following quadruple ligation of the thyroid vessels and nerves, in which improvement became stationary, upon the operative findings at the second operation. He states, "exploration revealed a reformation of one or more collateral branches at the primary operation. It is technically difficult to be sure of securing all the twigs given off from the superior thyroid, especially in a nervous subject under local anæsthesia."

It is evident from these latter statements, that at the primary operations upon these two patients, Rogers may have missed in the superior pole ligatures the dorsal branches to the gland to which attention has

been previously directed. It must not be forgotten that in toxic goitres, of the exophthalmic or non-exophthalmic type, either single or multiple ligation at best only affects the conduction to and from the gland of both blood and gland elements, leaving the increased secretory surfaces still intact, since Wilson and Plummer have proven beyond all doubt that hyperplasia of the thyroid is complementary to hyperthyroidism.

The very free anastomoses of the arterial system, and the great numerical constancy of the veins leaving the thyroid gland, should make one pause and wonder that a single or double polar ligature can very materially reduce the blood supply to this organ. The clinical evidence is incontrovertible in a large percentage of cases (Kocher, Mayo and others), but there are patients in whom no evidence of improvement is noted, following this attempt to diminish the thyrotoxicosis, by reducing the blood supply to the gland and the coincidental delivery of the secretion into the blood system. It is likely that failure in these cases is dependent upon the anatomical factor involving the vessels entering and leaving the gland. Dr. Halsted resorts to ligation of the inferior thyroid in preference to the superior vessels. His technic undoubtedly makes possible successful occlusion of the inferior thyroid artery, since the vessel is secured behind the carotid sheath before division into terminal branches takes place. His ligature, however, does not circumscribe the veins related to the lower pole of the lobe and in this respect the operation only accomplishes one-half of the same procedure applied to the superior vessels. The value of ligation attaches as much to venous occlusion as to arterial interruption, and an examination of the large veins, related to the lobes and isthmus below, will at once prove the truth of this observation. Halsted states that in his clinic preliminary ligation is always practised as the first stage of surgical treatment in cases of toxic goitre to improve the patient's condition and to test the resistance to operation. He further states, "that in no instance have we found that the preliminary ligation of two, three, or even of the four arteries, sufficed to cure the patient seriously ill with Graves' disease, although we have observed that considerable improvement, for a short time at least, may follow the ligation of even a single artery."

The writer performed a double superior pole ligation upon a patient *in extremis* (Figs. 2 and 3), and following a stormy post-operative period, improvement was so marked that further surgical interference was refused and finally became unnecessary. In another case (Figs. 4 and 5), in which long continued medical treatment reduced the patient to almost complete disruption, double ligation of the superior vessels

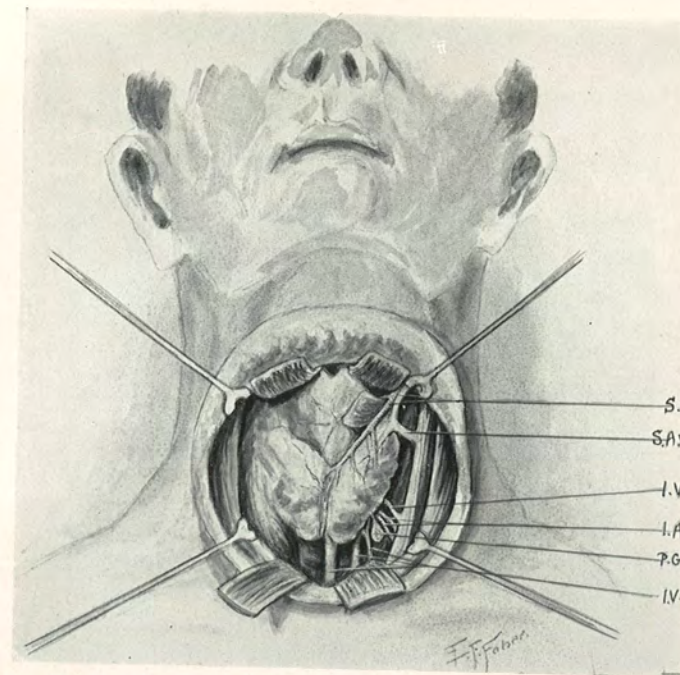


FIG. 1.—S. V., superior vessels; S. A. V., superior accessory vein; I. V., inferior thyroid veins; I. A., inferior thyroid arteries; P. G., parathyroid gland. Note the venous arrangement at the superior pole of the gland, the short vein passing outward at right angles to the gland to enter the internal jugular vein. The inferior vessels are numerous and the veins are very large. Note the large inferior median vein descending along the trachea. Ligation of the inferior thyroid artery before it breaks up into its branches does not affect the venous return from the gland.



FIG. 2.—L. K., aged fifty years. Toxic exophthalmus. Duration of goitre eight years. Weight at operation eighty pounds. Emaciation marked. Bilateral ligation of superior poles of thyroid. Recovery so marked that further operative treatment was unnecessary.

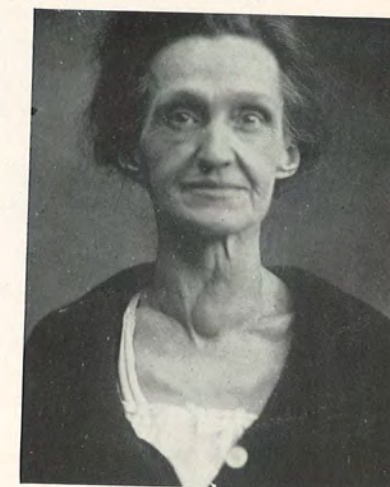


FIG. 3.—L. K., aged fifty years. Same as Fig. 2. Note large left lobe and isthmus.



FIG. 4.—E. M., single, aged twenty-seven years. Intensely toxic goitre. Bed-ridden for three months. Bilateral superior pole ligation had no effect. Secondary right lobectomy with marked improvement.

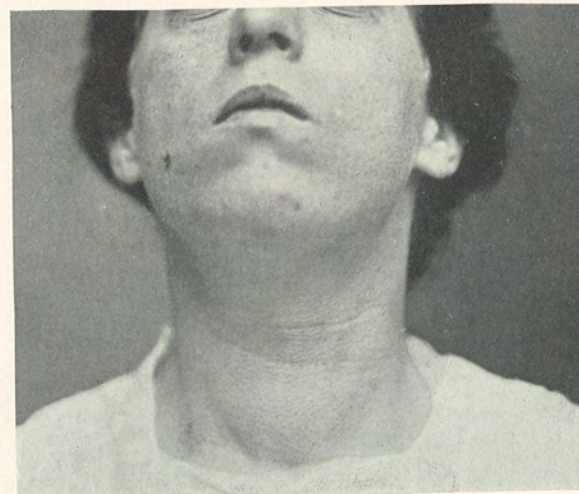


FIG. 5.—E. M. Note small size of goitre and moderate exophthalmus. Duration of symptoms sixteen months.

utterly failed to change the clinical picture. Seven weeks after this operation unilateral lobectomy was performed, and the reason for the failure of the first operation became clear. The blood supply, interrupted by closure of the superior vessels, was more than offset by the abundance of blood entering and leaving the gland by numerous and large inferior thyroid vessels. Examination revealed a completely ligated superior pole on both sides, since the linen ligature was examined, and had circumscribed all the vessels entering this portion of the gland.

In spite of the fact that enucleation should be subcapsular and all manipulations carried on close to the gland, troublesome hemorrhage will often arise, and the purpose of this communication is to direct attention to some anatomical factors the knowledge of which will render excision of a part of this organ easy or difficult. Operations upon the thyroid now constitute one of the safest of all surgical procedures, and if toxic cases are treated early surgically, before prolonged medical treatment exhausts the patient, this operation will be placed in the category of results of operations for acute appendicitis when done within the first twenty-four hours.

DR. A. P. C. ASHHURST said that several years ago as a result of elaborate experiments Delore and Alamartine pointed out that the circulation of the thyroid is much freer between the upper and lower poles of each lobe than across the midline. On this account they advised ligation of the superior and inferior arteries on the same side instead of both superiors, as had been done usually before. They also urged ligation of the inferior artery near its origin, exposing it by incision on the outer side of the sternocleidomastoid muscle. Dr. Halsted recently also has come to the conclusion that the inferior artery is best ligated, not close to the gland, but somewhere nearer its origin.

THE PREVENTION OF POST-OPERATIVE ADHESIONS IN
THE PERITONEAL CAVITY

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AND

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THE problem of checking or limiting intestinal adhesions following abdominal section is of such great practical importance that it has stimulated many suggestions for solution. It was considered advisable to undertake an experimental comparative test of some of these methods which have been advocated. The work was carried out upon dogs which were at the time of operation under complete surgical anaesthesia with ether, and which received both before and after operation the best possible care. In all operative work the strictest methods of asepsis were employed, such as are used in the operating rooms of modern hospitals.

The first work, done in a measure for a control series, was simple intestinal anastomosis. In these cases the abdomen was opened by midline incision about three inches in length, extending upward from the umbilicus. The gut was drawn out through the wound, protected by gauze pads, a section removed, and an end-to-end anastomosis performed. The gut was then returned to the abdominal cavity and the wound closed by the layer method. In all the following work the same type of incision was used, and the same method of closing the wound.

Two cases of simple end-to-end anastomoses were done. These animals were killed by gas at the end of six and eight weeks respectively. In both cases the abdomen was free from adhesions, the gut normal and no signs of peritonitis were present.

The next experiment in the series was performed to see what the effect of covering the operative area with an attached portion of omentum would be. In these instances two end-to-end anastomoses were performed on the same intestine, the first being left free without covering; the second being covered with the free border of the omentum. The omentum was carefully wrapped over the site of operation and held in position by a couple of silk stitches. This dog was killed and autopsied three weeks after the operation. The abdominal cavity was

free from exudate or any indication of peritonitis, and free of adhesions, save for the point at which the omentum had been attached to the site of anastomosis at the time of operation.

The next two dogs operated upon were treated in a similar manner with the intention of observing the effect of free omental and mesenteric grafts in the prevention of adhesions. In all of these cases three anastomoses were made—one left free without covering; one covered with a free piece of omentum, while the last was covered with a free piece of mesentery.

The strip of omentum was taken from the lower free border—the raw surface of the omentum being closed with a fine silk ligature. The strip of mesentery was taken from the redundant mesentery left after the removal of a section of the bowel. The grafts were held in place over the points of anastomosis by a few fine silk sutures.

In the first dog—autopsied two weeks after operation—the free uncovered anastomosis was the site of a few but rather dense adhesions, while both of the covered areas—the one being covered by omentum and the other by mesentery—were absolutely free from adhesions. There was no sign of peritonitis, adhesions about the free area being simply due to the attachment of the omentum to that area.

In the second dog, autopsied one week following operation, there was no trace of adhesions or peritonitis. In each case there was no free fluid in the abdominal cavity.

Following these experiments studies were undertaken concerning the effect of liquid paraffin in checking adhesions. In these cases some ten minutes before opening the abdomen, 100 c.c. of sterile paraffin oil was injected into the abdominal cavity by means of a large syringe and needle. This apparently large amount of oil was used because of the fact that during the operation a considerable amount of the oil would overflow through the wound.

The reason for the injection of the oil into the abdomen previous to operation was that the entire peritoneal surface would become thoroughly coated with a film of oil before being exposed to the air. All sponging at the time of operation was done with gauze saturated with the sterile oil. Four dogs were employed in this series, the operation in each case consisting of two end-to-end anastomoses. In each case, as will be noted later, there was an extensive exudation of leucocytes into the abdominal cavity. Because this exudation was so great, it was examined under the microscope and the granularity of the cells and their apparent fragmentation led us to believe that their functional

power as phagocytic agents might be diminished. The following method was adopted in the last two cases of this series, and in some of the cases of the following series, to test this phagocytic activity. Immediately after the abdomen was opened at autopsy about 25 c.c. of the exudate there found was collected in a sterile flask. This was then mixed with an equal amount of sterile, warm saline solution and centrifuged. This resulted in the throwing down of a considerable portion of the leucocytic cells which were again collected and rewashed until the leucocytic cream was freed from oil and of a uniform consistency. In these cases the animal was killed by ether and just before death the carotid artery was opened and 50 c.c. to 75 c.c. of blood obtained. This was defibrinated and centrifuged; a portion of the serum was decanted and placed in an incubator until the washing of the cells was complete.

The leucocytes from the blood were then washed simultaneously with those from the abdominal exudate, both samples of leucocytes being thus treated in the same manner so that there should be no difference in their activity because of variation in the mechanical manipulation. These two samples of leucocytes—one obtained from the exudate in the peritoneal cavity, the other from the blood of the same animal—were mixed with the blood serum from the same animal and a bouillon suspension of *Micrococcus aureus* in the proportions commonly used in obtaining the opsonic index for the blood serum, and incubated for half an hour. The leucocytes were the unknown factor in these cases and not the serum. The ratio of the number of bacteria taken up by the leucocytes from the abdominal exudate to the number of bacteria taken up by the leucocytes from the blood of the same animal is what we shall here call the phagocytic index of the given case.

The first animal died from a diffuse peritonitis nine days after operation. Autopsy showed no marked adhesions, though many fine fibrinous strands were adherent to the gut; the abdomen contained 125 c.c. of thick, oily and whitish exudate. The second animal was killed and autopsied ten days after operation. A local peritonitis was present about the operated areas with extensive adhesions matting the intestinal loops together, although these adhesions did not directly involve the operated areas; 200 c.c. of fluid was found in the belly, of the same character as that found in the previous case.

The third dog was autopsied seven days after operation, a general low grade peritonitis accompanied by fine plastic adhesions throughout the abdomen being found; 150 c.c. of the same characteristic exudate was present. The phagocytic index in this case was 3:14. The fourth dog was autopsied four days after operation and an extensive exuda-

tion with large amounts of sticky, fibrinous material generally spread over the gut but unorganized was found; 200 c.c. of exudate was present. The phagocytic index in this case was 4:15.

In considering the results in the foregoing experiments the question naturally arises as to whether the adhesions so constantly present were due to the presence of the oil or to some fault in technic. It was decided to inject the same amount of oil directly into the abdominal cavity and observe the result. In a series of three dogs 100 c.c. of sterile paraffin oil was injected directly into the abdomen by means of a large needle and syringe—the animals then being killed at intervals. The first dog, autopsied four days after injection of oil, showed exudate amounting to 200 c.c. with fine plastic adhesions throughout the abdominal cavity; the phagocytic index was 4:16. The second dog was autopsied eight days after the injection of oil, showed 125 c.c. of exudate and many plastic adhesions binding the gut generally in a mass; the phagocytic index was 3:17.

From the third dog, autopsied twelve days after injection, 160 c.c. of exudate was recovered and dense adhesions were found binding the gut into so firm a mass that it was impossible to separate the adhesions without tearing the serous surface; the phagocytic index was 0:16.

Because of the unsatisfactory results in our experiments thus far, it was decided to try in one case the injection of sterile olive oil. This was done in the same manner as before, the dog being autopsied eight days after the injection. Generalized adhesions throughout the abdomen were found, the exudate being extensive in amount. No attempt was made to determine the phagocytic index and nothing further was done with this substance.

At this time a question arose as to the purity of the paraffin oil used and, at the suggestion of Dr. Taylor, we determined to try the result of using glymol, a proprietary preparation, which he had found to be of a high grade of purity. This was used experimentally in three cases. In the first dog, the sterile oil was injected directly into the abdomen, no operative measures being employed. The animal was killed and autopsied three days later. The results were other than we had expected from our former work with paraffin oil. In this case only 80 c.c. of the oil had been injected because of the small size of the dog. At the autopsy only 60 c.c. of exudate was found in the abdominal cavity, the exudate presenting a clear, homogeneous appearance.

The leucocytes under the microscope appeared normal and the phagocytic index was 8:10. The gut was normal in appearance and no trace of adhesions was present. Because of this apparent good

result, the operative measures used in the earlier cases were again resorted to. In the second series, 110 c.c. of sterile glymol was injected into the abdominal cavity before making incision. The gut was carefully protected and all sponging done with gauze saturated with the oil. Two end-to-end anastomoses, as in the former instances, were performed. The animal died thirteen days later from peritonitis; 250 c.c. of exudate was found in the cavity. Marked plastic adhesions binding the entire gut together were present, also a localized abscess at the lower point of anastomosis. Cultures from the fluid in the general abdominal cavity were sterile. The peritoneum was generally opaque. The last dog of this series was handled in the same way, save that only 90 c.c. of glymol was injected previous to operation. At autopsy, four weeks later, adhesions to the abdominal wound and around the operative site were found. A general fibrinous peritonitis of low grade was also apparent and small fat or oil droplets could be seen in the broad ligaments and omental lymph spaces. The exudate was 25 c.c. in amount and of the same character as found in cases where paraffin oil had been used. The few leucocytic cells present showed marked granular change and the phagocytic index was 0:12.

While still working on the use of oils, it occurred to us, as we were bleeding a dog into citrate solution, that if citrate prevented the normal ferment action in blood whereby fibrinogen was changed to fibrin, the same might hold true if the solution were placed in the abdomen after operation, thus limiting the formation of adhesions. This would, however, seem to be an attempt to limit a function which is normally necessary in the repair of serous surfaces. Adami distinctly states in dealing with the process of healing of serous inflammation that the first step in the process is the outpouring of an uncertain amount of plastic lymph which tends to glue the surfaces together, later to become organized and remain as scar tissue. Thus, if the formation of this plastic lymph were prevented would not the liability of infection passing from intestinal tract to peritoneum be increased, especially in cases where the gut had been opened? Our attention to this mode of dealing with adhesions was further stimulated by the results which Pope published in the *ANNALS OF SURGERY*, reporting the use of citrate solutions in checking adhesions in rabbits in cases where the peritoneum was simply scarified, though the gut was not opened.

To gain some personal evidence, citrate solutions were employed in seven cases in the following manner. As before, end-to-end anastomoses were performed in two sites with the same aseptic care as before, but

just before closing the abdomen 50 c.c. of a 3 per cent. sodium citrate solution in normal salt solution was emptied into the cavity.

The major thing noted at the time of operation was that, even with this small amount, it was extremely hard to keep the solution from running slightly over the edges of the abdominal wound. This caused a very marked oozing in each case, making the closure of the wound more than normally difficult.

The first dog of the series, autopsied two weeks after operation, showed imperfect healing of the abdominal wound, a gap into the deep tissues at least three-eighths of an inch being present at one end. Inside there were extensive adhesions of the omentum to the gut about the operative areas and some adhesions were present between the adjacent loops of intestine. Only a very small amount of fluid was present, a culture from which gave what appeared to be pure colon bacillus growth. In the second dog of the series, autopsied a week after operation, while the peritoneal edges of the wound were healed, the skin and fascial layers were imperfectly healed. Within the abdomen adhesions were present both of the omentum to the gut and of the adjacent loops of gut. In the third member of the series the abdominal wound split open on the third day after operation and the dog had to be killed. The fourth dog died from general peritonitis four days after operation, two local abscesses being present near the operative points. The fifth, sixth and seventh members of the series, autopsied fourteen, nine and seven days after operation respectively, presented similar pictures. General adhesions were present of the omentum to the gut in the neighborhood of the operative areas, and adhesions were present between the adjacent loops of intestine to a considerable extent. In none of these cases was distention noted nor was fluid found within the cavity. In no instance was there perfect healing of the abdominal wound, a distinct contrast with the former cases.

In discussing the above results we note that in five cases where no other means than simple careful technic and covering of the operative area with omentum or mesenteric strips were used, adhesions resulted in only one case, this being one where adhesions were found to the uncovered area, the covered areas in the same case being free. In eleven cases where some type of oil was used in the endeavor to limit adhesions, these were formed in nine cases. In one of the cases where adhesions were absent peritonitis caused the death of the animal, only a single case being free from adhesions or peritonitis. In all of the eleven cases more or less extensive exudation was present. In seven out of the eleven cases in which oil was used the phagocytic index was

tested, and in all save the first experiment with glymol the index was markedly reduced, and even in this case it was not normal. This is shown more markedly by the accompanying chart, a study of which shows that in no case was the index higher than 8:10, once as low as 0:16, while the average index was about 4:17. From this work it can be deduced that oil in any form causes an intense exudation of leucocytes into the abdomen and these are inhibited from their normal physiological function by the presence of the oil, as indicated by the low phagocytic index. Thus it can be stated that oil is contra-indicated, if for no other reason than that anything which causes local migration of these cells and then checks their action simply increases the bulk of foreign material with which the tissues have to deal.

Substance Injected	Amount Injected	Amount of Exudation	Phagocytic Index	Time Autopsy
	<i>c.c.</i>	<i>c.c.</i>		<i>Days</i>
Paraffin oil	100	150	3:14	7
Paraffin oil	100	200	4:15	4
Paraffin oil	100	200	4:16	4
Paraffin oil	100	125	3:17	8
Paraffin oil	100	160	0:16	12
Glymol	80	60	8:10	3
Glymol	90	25	0:12	28

Another interesting fact in respect to oil is noted in that during the first four days following the injection of oil there is an excessive amount of exudation of fluid into the cavity, then in the next four days there seems to be a decrease in the amount of fluid, followed in the last four days of a twelve-day period by again increasing amounts. The explanation of this, of course simply a theory, is that the presence of the oil in the abdomen primarily calls forth an intensive cell exudation. In the process of adjustment absorption begins and the amount is temporarily decreased, but as soon as absorption begins, the lymphatics become plugged with oil and cell detritus and the further increase in the exudation is held within the cavity. This condition then remains for a long period, extensive exudation being present three weeks to a month after operation. That the oil is gradually absorbed by the lymphatics is shown by the presence of oil droplets in the lymphatics of the mesentery and broad ligaments in cases allowed to go for a long period.

From our experiments with the use of citrate solutions involving seven cases, there is not a single satisfactory result. Two deaths

occurred, one resulting from peritonitis, the other from the splitting open of the abdominal wound.

In all the other cases, five in number, the results are surprisingly similar, adhesions being noted in all instances, while a minor grade of peritonitis was present in one. In none of these cases was there satisfactory wound healing. This would certainly contra-indicate the use of such solutions in clinical work. Our results with the use of citrate solution in dogs are just opposite from the results which Pope obtained with the same solution in rabbits; in his work adhesions were limited and wound healing normal.

This we take to be due to the fact that we were working in areas where the gut had to be opened, thus exposing the area to the chance of infection, a factor not to be unconcernedly thrown aside. It is also probable that this procedure limits the normal production of plastic lymph so that seepage takes place through the lines of intestinal sutures, and a minor degree of infection follows which results later in the production of adhesions, though there is not enough infection present in all cases to give a definite peritonitis. The disagreement of our results with those of Pope's may be due to the fact that he did his work on rabbits, the peritoneum of which is generally known to be very resistant to infection, and that he was working under the artificial condition of the exclusion of possible infection. While we are not inclined to draw final conclusions, we would say that citrate solution is not indicated in cases where infection may be present, though it may have a field in those cases where infection can certainly be excluded; we would call attention in such cases, *i.e.*, where the adhesions are broken up without opening a certainly infected area—such as an abscess or the intestine—to the great danger which would follow if a focus of even mild latent infection were opened in the presence of a citrate solution. This statement is based upon the experimental evidence that the first step in the removal of infection from the peritoneal cavity consists in a gluing of the bacteria to the omentum—a process with which the citrate would certainly interfere.

These conclusions are almost identical with those reached by Mom-burg after using injections of oil in 16 clinical cases. Coffey also has lately expressed the same views in the use of oil.

The process underlying the formation of adhesions is a part of the process of the normal repair of all wounds of serous surfaces consisting, as pointed out above, in the outpouring of a plastic lymph which seals the lips of the wound. The problem therefore is not the prevention of adhesions, but the limitation of adhesions; if the outpouring

of this plastic lymph be entirely prevented, the wound is not sealed and the entrance of bacteria from the intestinal lumen into the peritoneal cavity is unhindered.

This problem of limiting adhesions therefore becomes the somewhat delicate problem of permitting the necessary adhesions and preventing the unnecessary ones. It does not seem to us that this delicate line can be drawn by the use of any chemical or physical method such as citrate or oil, and we return to the point so often reached by the surgeon, after some new idea has fostered false hopes, that all wounds of the peritoneum must heal by a process of lymph formation, which when carried too far means adhesions; therefore the only method of limiting adhesions is to limit the wounds of the peritoneum. The results of the work we here report show that this can be done by careful technic and by covering the necessary wounds with freed or attached portions of the omentum or mesentery.

The most practical method for limiting adhesions consists in the clear understanding of the operator that the peritoneum is not a structure which can be cut and sewn, but a single layer of delicate endothelial cells; that the biologist obtains these cells for study by gently wiping the peritoneal surface with a gauze sponge, then pressing this sponge on a cover glass; and that every wound of this layer of cells begins to heal by the fundamental process of adhesion formation—the outpouring of a plastic lymph.

DR. GEORGE G. ROSS said that it seemed to him very evident that the formation of adhesions is a beneficent act of Nature to prevent the spread of infection, and that prevention of adhesions is not always an advantage to the individual. The excess of adhesions is a different problem, and a most serious one in surgery. When adhesions become a menace to the patient by causing obstruction, changing the position of, or interfering with, the mobility of organs and by recurring after being broken up, they form a problem which is still unsolved, and one of vast importance. The paper, however, does not seem to throw any light upon the immediate solution of this problem. I should like to ask how we may prevent this type of adhesions.

DR. A. BRUCE GILL called attention to another class of cases in which intestinal adhesions occur that may lead to the death of the patient. When a general peritonitis follows the rupture of a gastric or duodenal ulcer, adhesions are formed between the loops of gut and between the gut and the parietal peritoneum. Thus localized collections of pus are formed that are not drained by gravity. Such collections

may be found beneath the spleen while the patient has been kept in the sitting posture and suprapubic drainage maintained. Death occurs from absorption from these peritoneal abscesses that are undrained. The problem seems to be to prevent the formation of such collections of pus by preventing peritoneal adhesions during the acute stage of general peritonitis. With this object in view, in his last case of ruptured duodenal ulcer with evidence of general peritonitis he flushed out the peritoneal cavity with a solution of sodium citrate, 1 per cent., and sodium chloride, 2 per cent., at the time of operation; and proposed to repeat this procedure at intervals by pouring the solution into the upper abdominal wound and allowing it to escape from the suprapubic wound. However, the patient was in such degree of shock on his admission to the hospital that he died an hour after the operation was completed.

It seemed to him that the objections to the use of citrate solution mentioned by Dr. Sweet do not hold in cases of general peritonitis, where free drainage is essential to the recovery of the patient and where adhesions prevent such drainage in spite of the force of gravity.

If the closure of the perforation in the gut should be delayed by the presence of the citrate, this would not be an insuperable difficulty.

DR. A. P. C. ASHHURST inquired whether Dr. Sweet employed a 3 per cent. solution of citrate in normal salt solution, or if he used the 2 per cent. solution of sodium citrate in a 3 per cent. (hypertonic) salt solution, as advised by Saxton Pope himself.

DR. CHANEY, in closing, said that they used the 3 per cent. citrate in normal saline because that was the solution used by Koch in his work upon rabbits and with which he found very satisfactory results.

ARTERIOVENOUS ANEURISM OF THE FEMORAL ARTERY AND VEIN

DRS. EDWARD B. HODGE and J. E. SWEET reported the following case because of the relative infrequency of the condition present and the favorable result so far obtained by modern surgical methods.

C. M., aged twenty-nine years, was referred to the service of Dr. Hodge at the Presbyterian Hospital, May 19, 1914, by Dr. E. H. Goodman with the diagnosis of arteriovenous aneurism of the left femoral artery. In May, 1898, while cleaning a revolver, he accidentally shot himself, a .32-calibre bullet entering the inner side of the left thigh about its middle, and being later removed from beneath the skin on the outer aspect.

There was free bleeding, spurting to a height of 12 inches. He

walked downstairs, fainted, and soon the hemorrhage ceased. With no ligatures and simply an occlusive dressing, the wound healed after two weeks in bed. A year later, he noticed a pea-sized lump at the point of entrance and also began to have a sensation in the leg described as "buzzing." Two years ago—14 years after the accident—the leg began to swell and in the last year this has increased markedly. With the enlargement has gone an increase in the "buzzing" sensation. The latter is noticed only at night and, with the marked pulsation and throbbing now present, keeps him awake. There is no actual pain or tenderness present.

The general physical examination by Dr. Goodman reveals nothing abnormal except a slight apical systolic murmur transmitted to the angle of the scapula.

The left thigh is somewhat full. From about 5 cm. above Poupart's ligament to the small scar at mid-thigh is an irregular, soft swelling following the line of the vessels. Over this swelling is noted a strong, expansile pulsation, a marked thrill and a loud to-and-fro murmur.

The latter is conducted well into the leg, being heard distinctly half way to the ankle. Pulsation is present in both tibials. The right thigh measures 42 cm.; the left 46 cm. The Wassermann was negative.

It seemed a good opportunity to have the benefit of the skill in vascular surgery possessed by Dr. J. E. Sweet, Professor of Experimental Surgery in the University of Pennsylvania. Dr. Sweet kindly saw the patient and, with Dr. Hodge's assistance, operated as described below. It is to be noted that at operation both artery and vein were found enlarged, the vein much more so. To the dilatation of the latter is to be ascribed the swelling of the thigh in the last two years finally involving the external iliac.

Convalescence was marked only by a rather higher temperature range than might be expected. There was aseptic healing. From the time of operation, the patient had no trouble with the leg, sleeping well. Pulsation, thrill and murmur were absent. On June 5, the left thigh measured only 0.5 cm. more than the right. When last observed, August 27, the patient felt perfectly comfortable and local conditions were as noted in June.

DR. SWEET added that the choice of the method to be followed in an operation for arteriovenous aneurism will depend upon the peculiarities of the given case, and may indeed depend upon the condition there found after more or less extensive dissection on the operating table. In the present case a pulsating tumor existed, extending from a little below the scar of the traumatism at the middle of the thigh to

well above Poupart's ligament. An extirpation could not be considered and the quadruple ligation of classic recommendation would have to be undertaken upon diseased vessel walls.

The only tenable suggestions were the separation of the vessels with sutures of the resultant longitudinal wounds, or simply closure of the connecting channel with no attempt at separation. There seemed to be no reason for the extended dilation of the vessels except the mechanical disturbance of the blood current; the patient was young, did not show any evidence of general arteriosclerosis, gave a negative history as to syphilis and alcohol. It was therefore argued that since no other explanation could be found for the enlargement of the vessels than the disturbed course of the blood stream, the correction of this disturbance would result in the healing, or at least marked reduction in size, of the enlarged vessels. After the vessels had been dissected out and the communicating channel found, a small clamp was applied to this channel (Fig. 4); the thrill immediately ceased and pulsation in the vein was no longer felt. The vessels were adherent for about $1\frac{1}{2}$ inches. The actual communication appeared to be about $\frac{3}{4}$ inch in length.

The channel was permanently closed by a row of fine silk interrupted sutures, passed through and through at the side of the clamp, and the clamp was removed. This was done without attempting to control the blood current except by placing an Esmarch bandage in position to meet any possible accident. The last suture cut through at the upper angle and a slight hemorrhage occurred, which was controlled by proximal digital pressure and stopped by placing another suture. This incident emphasizes a point not made sufficiently clear, if even mentioned in the articles on aneurism, namely, the difficulty of suturing the walls of a diseased artery or vein. It is not difficult to obtain beautiful experimental results on normal vessels; but it is positively dangerous to transfer these results to diseased blood-vessels. This tissue will not hold the fine sutures nor can it be depended upon to hold sutures for any length of time, even when the sutures may seem to be successful at first; secondary hemorrhages have often occurred.

These remarks do not necessarily apply to the Matas method of dealing with a true aneurism, where layer after layer of sutures can be applied to the diseased vessel wall. Excision of the vessels and direct anastomosis of their ends might well be possible, and was indeed done by Murphy in 1897. The cases where this idea is practicable are rare, and the method can only succeed where the vessel walls are relatively normal, as they were in Murphy's case—a recent gun-shot injury. Lateral suture of the vessels is likewise not promising because of the

friability of the vessel walls, except perhaps in a case in which a large sac existed between the vessels which could be pleated over the lateral sutures of the vessel walls.

In this case the vessel sheaths and all the available surrounding tissue was brought over the vessels in several layers to bring pressure upon the vessels as far as exposed. Stewart, of New York, had succeeded in one case with a similar technic.

The order of choice of method to be decided for each individual case, perhaps not until the operation can disclose the exact relations of the vessels, is (1) the simple ligation of the connecting channel, if this be small enough to permit a closure by ligation, if not, its closure by one or more rows of sutures passed through both walls of the intercommunicating channel; (2) in the presence of a definite sac between the vessels, or as a part of one vessel, to restore the contour of the

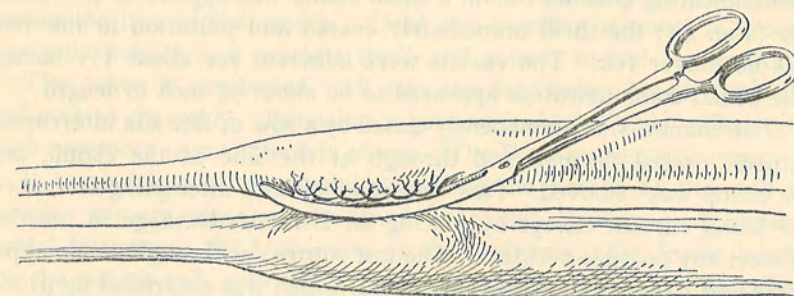


FIG. 4.—Clamp and suture of anastomotic ridge between artery and vein.

vessels by rows of sutures placed from the outside and plicating the sac over these sutures for support; (3) if the vessels show little evidence of disease, resection and end-to-end anastomosis, although this type of case would probably be the most suitable for the method first described, and (4) as a measure of last resort, quadruple ligation.

DR. GWILYM G. DAVIS said that he saw a case some years ago in a child in which, while a physician was doing a circumcision, a movement of the child threw the knife on the thigh, puncturing the vessels. Subsequently an arteriovenous aneurism occurred and he was brought to him at the age of nine or ten on account of marked difference in length of the two extremities. The leg in which the arteriovenous aneurism had occurred was much longer than the other. In other words, apparently the arteriovenous communication had increased the growth very much. Of course, when a person is in the period of growth, a difference in the nutrition of the two limbs would tend to make a difference in their length. Beyond the period of growth, how-

ever, it is not to be expected that there should not be any difference in length. It is interesting to know that the transference of arterial blood into venous channels has a marked effect on the growth of a limb. If this could be done at will it would be a desirable means of increasing the length of the shortened limb in certain cases, such as occur after hip disease and various other disabilities.

DR. JOHN B. ROBERTS said that it had seemed to him for many years that "arteriovenous fistule" was a better term for this condition than arteriovenous aneurism. His experience was limited to one case years ago, in which he had the whole leg slough after an operation done by the then ordinary method of arterial ligation. Amputation was necessary, and death occurred.

DR. HODGE, in closing, said that the condition could very accurately be described by the term suggested by Dr. Roberts. The communication between the two vessels looked like a gastro-enterostomy opening. The opening was too large to ligate and the suggestion made by Dr. Sweet seemed to be the better method.

DR. SWEET added that the two vessels which were uniformly enlarged were joined together toward the lower end of the enlargement by a channel about one and a half inches long. The vessels were dissected out until he could pass his finger behind the channel, and then the little clamp was placed as shown in the diagram; the pulse immediately returned in the arteries below the site of operation, even in the arteries of the foot. Then he made this closure permanent by inserting a row of interrupted sutures. From Dr. Davis's description of his case he inclined to the idea that one leg grew more than the other because of better blood supply, although he was not able to understand under the conditions how there would be a better blood supply.

SOME EXPERIMENTS ON THE SURGERY OF
THE PANCREAS

BY JOSHUA EDWIN SWEET, M.D.

AND

I. H. SIMONS, M.D.

OF PHILADELPHIA

(From the Laboratory of Surgical Research, University of Pennsylvania)

IN 1909 Coffey¹ published a series of experimental operations designed to prepare a new exit for the external secretion of the pancreas applicable to cases in which the pancreatic ducts are occluded because of some pathological process in the head of the organ. The pancreas is not infrequently attacked by the pathological processes common to such glandular structures, notably benign and malignant tumor growths and by inflammation; the diagnosis of these conditions has made noteworthy progress, but the actual surgery of the pancreas seems to be limited to either indirect drainage through the gall-bladder, or, more rarely, direct drainage of the gland. The laboratory worker has little respect for the pancreas, and the fact that so much of our knowledge concerning the function of the organ is based on the experimental surgery of physiologists justifies the thought that the pancreas is able to withstand as much surgical maltreatment as any other vital organ.

Our studies were undertaken at the suggestion of Dr. Edward Martin without at first a knowledge of Coffey's previous work. Our conception was far more simple than the extended and elaborate procedure of Coffey, and our results seem worth communicating, because they fully support Coffey's conclusions concerning the surgical possibilities of the pancreas and because they offer a technic so simple that it could be executed with a trivial loss of time.

The condition in which such an operation would be indicated is in general that of a blocking of the pancreatic duct; in particular as seen in (1) carcinoma of the head of the pancreas; (2) carcinoma of the ampulla of Vater and the lower part of the common duct; (3) adenoma and chronic interstitial pancreatitis of the head of the pancreas; (4) cysts of the head.

The ducts of the pancreas are valveless. The direction of flow of

¹ Coffey, *ANNALS OF SURGERY*, 1909, i, 1238.

the pancreatic juice can be reversed in the larger ducts, as is seen in the attempts to form a permanent pancreatic fistula in the dog. The pancreas of the dog always possesses two ducts opening into the intestine, a major duct, opening apart from the bile duct and draining the greater part of the organ, and a minor duct, opening at or near the ampulla of Vater and draining an independent island of tissue, but both systems anastomosing, so that a cannula placed in the major duct will not supply the investigator with pancreatic juice unless the minor duct be tied.

The pancreas of the dog corresponds in a general way to the human organ, with the addition of a process extending down the intestine from the head, called the *processus uncinatus*.

Our first experiments were to determine if a part of the pancreas could be separated from the remainder of the organ and successfully implanted in the gut. The *processus uncinatus* was cut off from the head of the organ, the duct in the proximal stump ligated, and the end of the uncinuate process simply implanted in the intestine by dropping it through a longitudinal slit in the gut, which was then carefully closed by fine sutures. The best technic for this procedure appears to be in detail as follows: The pancreas is fastened to the intestine by a continuous suture placed about one-half inch from the cut end of the pancreas. This suture is carried around that half of the circumference which will lie beneath the organ, since that part is most difficult of access.

The intestine is then opened by a longitudinal slit, one-half of which would lie within the area enclosed by this continuous suture. The pancreas is inserted into the lumen of the gut and the continuous suture completed about the remaining half of the pancreas, or in other words the technic corresponds to the first and fourth rows of sutures in a gastro-enterostomy. The three animals in this series were autopsied after six, five and four weeks. In all three cases the duct in the implanted portion was patulous and of normal size. In two there was no apparent atrophy of the pancreatic tissue. One had atrophied to one-third of the original size; microscopic study of the tissue showed no abnormalities. There was no fat necrosis, perfect anastomosis, and a very few adhesions. The other part of the pancreas was of course entirely normal.

In the second series of three animals an artificial obstruction was attempted by ligature of the ducts with implantation into the intestine of the proximal end of the pancreas after cutting off the uncinuate process.

The first dog was autopsied after five weeks, and it was found that the new opening into the gut had closed, while a new duct had formed around the ligature of the major duct. The second dog died a week after the operation, from distemper pneumonia, and even in this short time a new duct had formed around

the ligature of the duct. The third dog, autopsied after five weeks, showed the same result—a new duct circumventing the ligature of the duct. None of these cases showed any gross changes in the organ, no pancreatitis, fat necrosis, or atrophy.

In the third series the pancreatic ducts were cut between ligatures and the omentum was interposed between the ends of the ducts in an attempt to prevent the re-formation of these ducts. The proximal stump, after excision of the uncinata process, was anastomosed with the intestine by the same simple procedure outlined above. This operation was tried in two cases which were autopsied four weeks after operation. The implanted duct was patulous. The ducts had not re-formed and there was no evidence of pancreatitis, nor fat necrosis, nor atrophy.

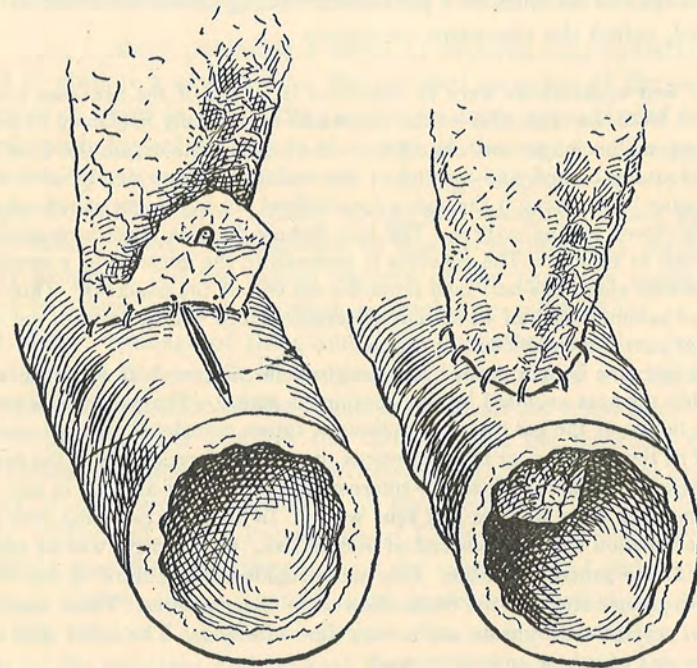


FIG. 1.—Diagrammatic representation of the method of inserting pancreas into bowel.

The persistency with which the pancreatic ducts reestablished themselves in the second series, and the well-known digestive action of pancreatic juice on the edges of a fistula led us to vary our technic in the third animal of this series in that the cut end of the pancreas, after blocking the ducts by interposition of omentum, was implanted in an opening of the gut which extended simply to the mucosa. We wished to see, in other words, if the pancreatic juice would provide an opening for itself through the mucous membrane. This animal died at the end of a week, the autopsy showing acute necrotic pancreatitis with fat necrosis and occlusion of the duct at the site of implantation.

The results of experimental studies can be judged either on the basis of the perfect uniformity of the results obtained in a relatively small series, or on a percentage basis of a large series. The number of the experiments described here is small, but the results are so entirely uniform, if we disregard the last animal, in which because of the modification of technic an entirely new problem was introduced, that we may safely conclude, first, that the pancreas can be anastomosed to the intestine by a simple technic; second, that there is little probability of pancreatitis, with its immediate dangers or its final result of atrophy; third, that the new opening into the gut will functionate, provided the normal openings are effectively obstructed.

EGGSHELL FRACTURE (INFRACTION) OF HEAD OF SECOND METATARSAL

DR. PENN G. SKILLERN, JR., reported the case of a woman, aged forty years, who stubbed the second toe of her right foot against the floor. Clinical examination revealed swelling and "wincing" tenderness at the head of the second metatarsal bone. Skiagram (Fig. 5) revealed a loss of the normal convexity of the articular surface of the head of the second metatarsal bone, there being instead an irregularly flat surface with broadening of the head. The lateral view (Fig. 6) clearly reveals an oblique indentation, which resembles that of the proverbial egg of Columbus. There were no loose fragments. Treatment consisted in the application of a pad to the sole of the foot behind the head of the second metatarsal bone so as to keep the involved area clear of the ground, and thus free from the pressure of the body.

Dr. Skillern said that this is the seventh case of this injury on record. Freiberg (*Surg., Gynec., and Obstet.*, 1914, xix, 191) first called attention to the injury and reported six cases, all occurring in women. These patients had stubbed their toes in some manner, in two while playing tennis. They complained of pain in the ball of the foot in weight-bearing only. Freiberg suggests the following mechanism: "Under normal circumstances the second metatarsal bone is slightly longer than the first. In the presence of a diminished power of toe flexion, especially of the great toe, it is apparent that forcible impact against the ground of the ball of the foot, which is not sufficiently guarded by the flexor power of the toes, will cause the exposed distal end of the second metatarsal to bear the brunt of the blow."

The diagnosis must be made from metatarsal pain due to static weakness, and this is probably the reason why more cases have not been discovered. The rule is that in static weakness both feet are

involved. Metatarsalgia or Morton's toe usually concerns the fourth metatarsal, and is paroxysmal in nature. There may be a history of having stubbed the toes. By reason of its close proximity it seems to the writer that fracture of the external sesamoid of the hallux must also be ruled out, but the mechanism of this injury is quite different.

The treatment consists in the use of a pad applied to the plantar surface of the foot by means of adhesive plaster, so that its anterior end is placed just back of the injured point. If there are loose bodies their removal by arthrotomy is necessary, unless few in number and very small.

It seemed to the reporter that the term "infracion" is undesirable. We are in reality dealing with an impacted fracture. In the mechanism and in the effect upon the oval head of the bone one is forcibly reminded of the proverbial manner in which Columbus solved the problem of making an egg stand on end, and for this reason, as well as the similarity of the compact layer of bone of which the periphery of the head is composed, he suggests the term "egg-shell fracture" as being more appropriate and descriptive.

FRACTURE OF PROCESSUS POSTICUS TALI WITH FRACTURE OF CALCANEUM

DR. SKILLERN reported the case of a man, aged thirty-eight years, who fell in a tank, injuring his right foot, for which he was admitted to the University Hospital, service of Dr. Charles H. Frazier. Clinically, bony landmarks were obscured by great swelling, but there was "wincing" tenderness along the fore part of the calcaneum, a fracture of which was suspected. Skiagram (Fig. 7) revealed a comminuted fracture of the antero-inferior portion of the calcaneum. It also showed a fracture of the processus posticus of the astragalus, probably from the impact of the dorsum of the calcaneum. The usual treatment of fractures about the foot was instituted.

According to Stimson (*Fractures and Dislocations*, 7th ed., 1912, 459) fracture of processus posticus tali was first mentioned by Cloquet, in 1844. Liliensfeld (*Archiv. f. klin. Chir.*, 1905-1906, lxxviii, p. 945) says the combination of fracture of the calcaneum with fracture of the processus posticus tali, as in this case, is by no means rare, and that isolated fracture of the processus posticus tali occurs more frequently than is diagnosed. Of 600 fractures observed by him at the Zander-Institut, there were 7 isolated fractures of the processus posticus tali and 5 in conjunction with fracture of the calcaneum.

The cause of fracture of the processus posticus tali is a fall upon

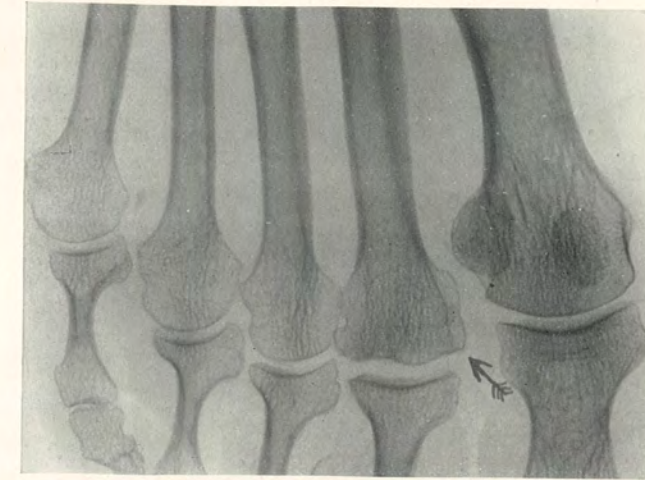


FIG. 5.—Infracion (egg-shell fracture) of head of second metatarsal. Note flattening of articular surface, and compare with normal convexity at heads of uninjured metatarsals (antero-posterior view).

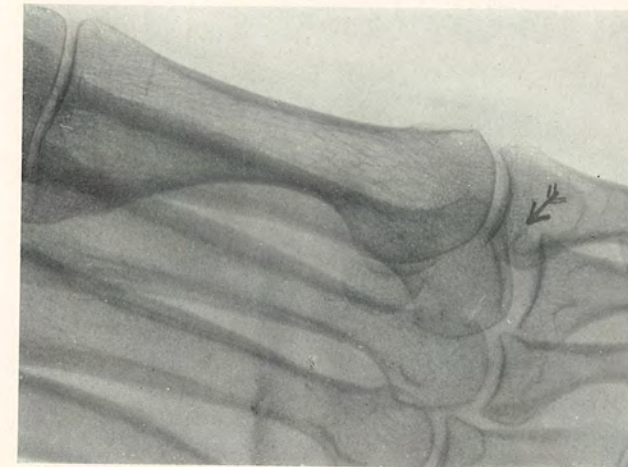


FIG. 6.—Lateral view of Fig. 5. Note oblique indentation.

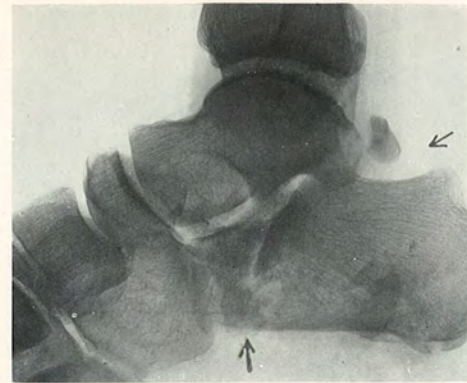


FIG. 7.—Fracture of processus posticus tali with fracture of calcaneum. Note diminished density of that part of astragalus from which process is separated (lateral view).

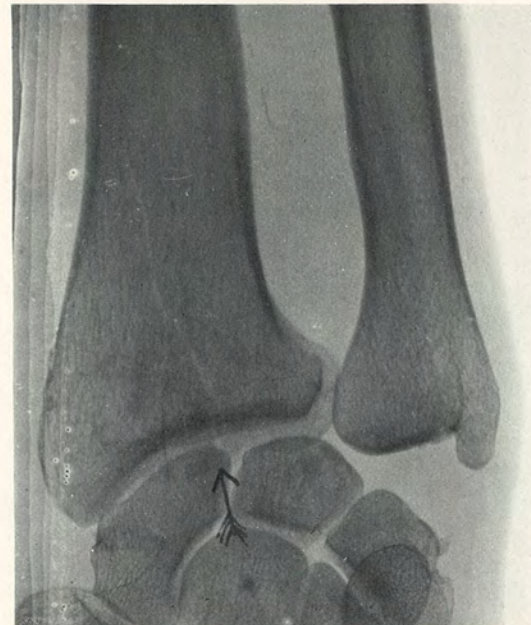


FIG. 8.—Longitudinal fissured fracture of lower extremity of radius. Beginning at ridge on inferior articular surface between the quadrilateral and triangular facets the line extends obliquely upward and outward 4 cm., to disappear .5 cm. internal to outer border of radius.

the heel with the foot in plantar flexion, thus impacting the calcaneum against the process. The clinical diagnosis is made by the history of the injury and localized tenderness elicited by deep pressure with the finger above the external attachment of the tendo achillis. There may also be a slight concavity of this tendon just above its insertion.

Stimson and others confuse fracture of the processus posticus tali with the inconstant os trigonum. Thus, Stimson quotes Lilienfeld as having observed 12 fractures of the os trigonum, whereas a reference to his article shows that it was the processus posticus tali that was fractured. The same error had been made in the case that I report.

The processus posticus tali is the posterolateral projection of the astragalus, the lateral tubercle of anatomists, which bounds externally the sulcus for the tendon of the flexor longus hallucis muscle.

The os trigonum, or intermedium cruris, on the other hand, lies in the second month of fetal life as an anlage of hyaline cartilage between the distal ends of the tibia and fibula, and has the shape of a triangle with the apex directed proximally and the base distally. Normally it remains independent for only a short time, uniting to the astragalus. In 3 per cent. of cases it persists as an independent bone. Aside from man it is found among mammals only in the wombat. When persisting it is always situated behind the astragalus, from which it is separated by a slight fissure, and is oval in form, measuring 20 by 15 mm. It is present on both sides, and has the peculiarity of being usually rudimentary on one side. It was first described by Rosenmuller in 1804.

He had not been able to find an instance of fracture of the os trigonum. The question is whether the fragment found is a fractured processus posticus tali or a normal, though inconstant, os trigonum. A study of the skiagram shows a definite vertical plane of fracture, with diminished density of that part of the astragalus from which the processus posticus was broken off.

LONGITUDINAL FISSURED FRACTURE OF LOWER EXTREMITY OF RADIUS

DR. SKILLERN presented a skiagram which he said was obtained in the Surgical Out-Patient Department of the University Hospital, but the patient did not report after visiting the Receiving Ward, probably because of slight symptoms, and therefore no history was obtained. It shows a fissure beginning at the ridge on the inferior articular surface of the radius between the quadrilateral and triangular facets and extending obliquely upward and outward 4 cm. to disappear 0.5 cm. internal to the outer border of the radius (Fig. 8).

This is the ninth case of the injury on record, if we wish to include that reported by Wilhoit (*Jour. A. M. A.*, 1913, lxi, 770) as a longitudinal fracture, but which in reality cuts off the ulnar corner of the radius. Writing in 1910, Cotton states: "So far as we know this fracture is the result of direct violence by crushing. It is very rare; three specimens constitute the total of the evidence." As in other longitudinal fractures it may be suspected clinically by a line of "wincing" tenderness.

DISJUNCTION OF EPIPHYSES OF FOURTH AND FIFTH METACARPALS

DR. SKILLERN reported the case of a boy, aged fourteen years, who struck another lad with his right fist and reported at the Surgical Out-Patient Department of the Polyclinic Hospital on August 5, 1914. The heads of the fourth and fifth metacarpals were prominent on the dorsum, there were localized œdema and "wincing" tenderness. Skiagram (Fig. 9) shows separation of the epiphyses for these bones. Unfortunately a lateral view was not taken. Treatment consisted of reduction with immobilization by a straight palmar splint.

This injury is described by White in Piersol's Anatomy as follows: "Falls upon or striking with the closed fist tend to produce forward displacement. As the metacarpal bones of the index, middle, and ring fingers are the longer, their epiphyses are more likely to be separated in this manner. A fall on the extended fingers and metacarpophalangeal region may cause backward displacement, though this is rarer.

"The diagnosis from dislocation of the proximal phalanges is not easy. It is aided by the recognition of 'muffled crepitus' (Poland) and by the greater tendency of the deformity to recur, due partly to the small articular areas of the separated bones and partly to the action of the flexors and the interossei." Muffled crepitus was obtained in this case during the process of reduction. It was not sought as a diagnostic sign, because the diagnosis was made without this painful manipulation. The injury should not be overlooked, and reduction must be effected, lest the growth of the metacarpal be interfered with.

Coues (*Bost. M. and S. J.*, July, 1913) calls attention to epiphyseal disjunction at the base of the first metacarpal.

INCONSTANT EXTRA EPIPHYSIS AT BASE OF SECOND METACARPAL

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FIG. 9.—Disjunction of epiphyses of fourth and fifth metacarpals. Displacement shown at distal end of diaphyses.



FIG. 10.—Inconstant extra-epiphysis at base of second metacarpal. Union with diaphysis beginning at centre (anteroposterior view).

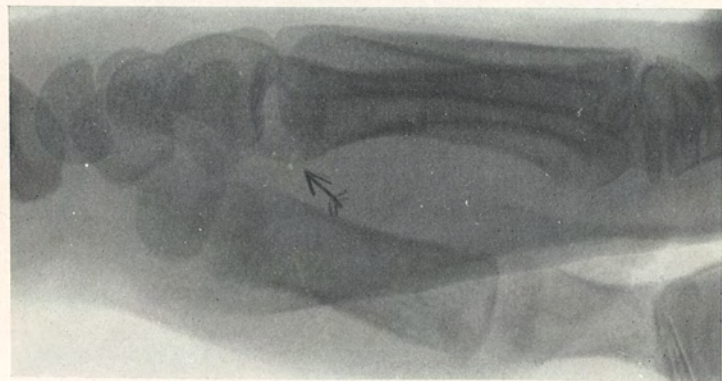


FIG. 11.—Lateral view of Fig. 10.

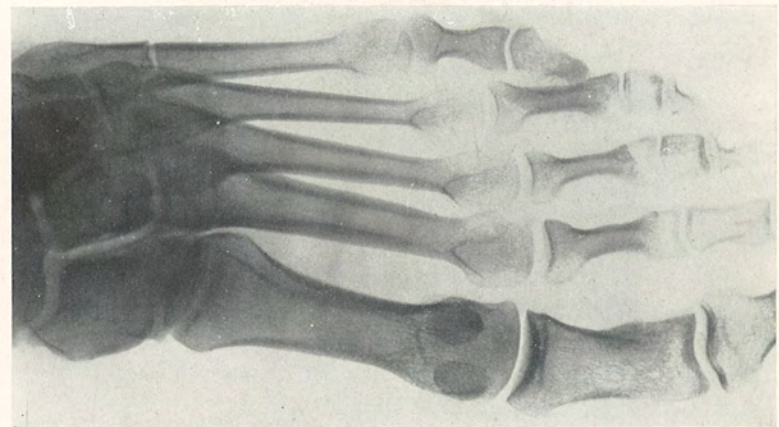
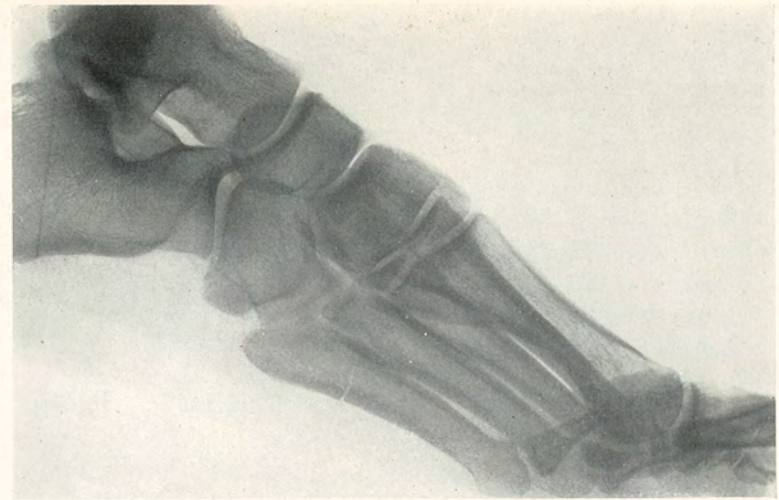


FIG. 12.—Case I.

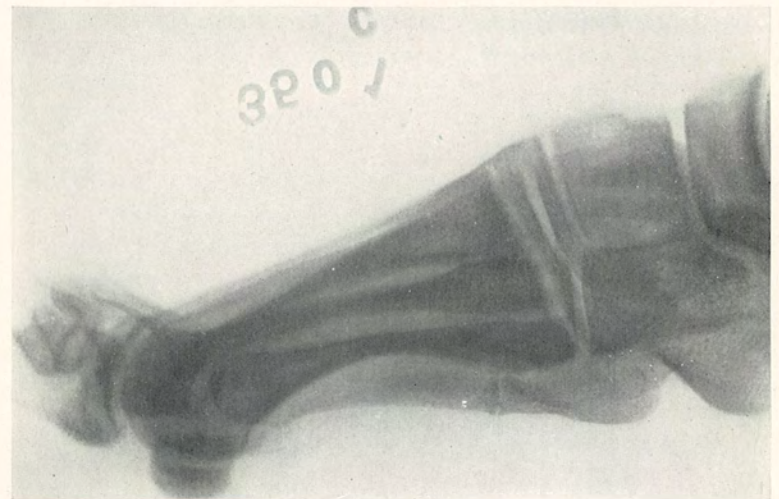


FIG. 13.—Case II.

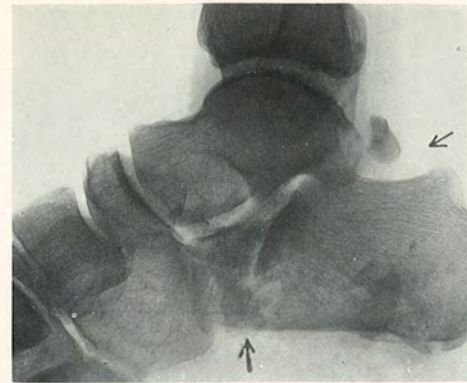


FIG. 7.—Fracture of processus posticus tali with fracture of calcaneum. Note diminished density of that part of astragalus from which process is separated (lateral view).

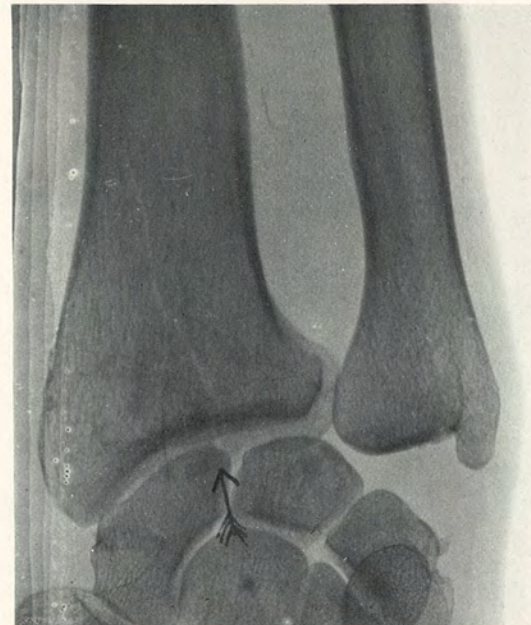


FIG. 8.—Longitudinal fissured fracture of lower extremity of radius. Beginning at ridge on inferior articular surface between the quadrilateral and triangular facets the line extends obliquely upward and outward 4 cm., to disappear .5 cm. internal to outer border of radius.

the heel with the foot in plantar flexion, thus impacting the calcaneum against the process. The clinical diagnosis is made by the history of the injury and localized tenderness elicited by deep pressure with the finger above the external attachment of the tendo achillis. There may also be a slight concavity of this tendon just above its insertion.

Stimson and others confuse fracture of the processus posticus tali with the inconstant os trigonum. Thus, Stimson quotes Lilienfeld as having observed 12 fractures of the os trigonum, whereas a reference to his article shows that it was the processus posticus tali that was fractured. The same error had been made in the case that I report.

The processus posticus tali is the posterolateral projection of the astragalus, the lateral tubercle of anatomists, which bounds externally the sulcus for the tendon of the flexor longus hallucis muscle.

The os trigonum, or intermedium cruris, on the other hand, lies in the second month of fetal life as an anlage of hyaline cartilage between the distal ends of the tibia and fibula, and has the shape of a triangle with the apex directed proximally and the base distally. Normally it remains independent for only a short time, uniting to the astragalus. In 3 per cent. of cases it persists as an independent bone. Aside from man it is found among mammals only in the wombat. When persisting it is always situated behind the astragalus, from which it is separated by a slight fissure, and is oval in form, measuring 20 by 15 mm. It is present on both sides, and has the peculiarity of being usually rudimentary on one side. It was first described by Rosenmuller in 1804.

He had not been able to find an instance of fracture of the os trigonum. The question is whether the fragment found is a fractured processus posticus tali or a normal, though inconstant, os trigonum. A study of the skiagram shows a definite vertical plane of fracture, with diminished density of that part of the astragalus from which the processus posticus was broken off.

LONGITUDINAL FISSURED FRACTURE OF LOWER EXTREMITY OF RADIUS

DR. SKILLERN presented a skiagram which he said was obtained in the Surgical Out-Patient Department of the University Hospital, but the patient did not report after visiting the Receiving Ward, probably because of slight symptoms, and therefore no history was obtained. It shows a fissure beginning at the ridge on the inferior articular surface of the radius between the quadrilateral and triangular facets and extending obliquely upward and outward 4 cm. to disappear 0.5 cm. internal to the outer border of the radius (Fig. 8).

This is the ninth case of the injury on record, if we wish to include that reported by Wilhoit (*Jour. A. M. A.*, 1913, lxi, 770) as a longitudinal fracture, but which in reality cuts off the ulnar corner of the radius. Writing in 1910, Cotton states: "So far as we know this fracture is the result of direct violence by crushing. It is very rare; three specimens constitute the total of the evidence." As in other longitudinal fractures it may be suspected clinically by a line of "wincing" tenderness.

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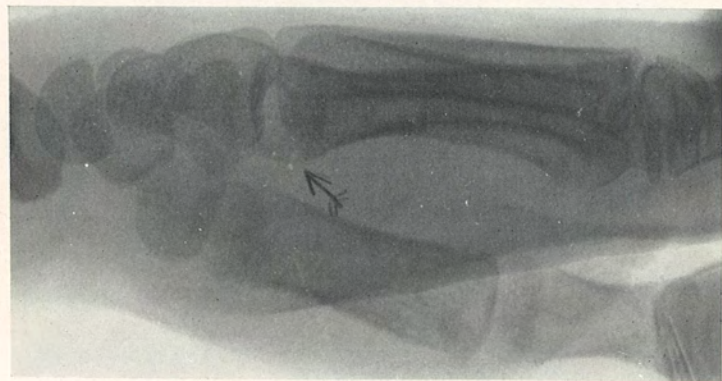


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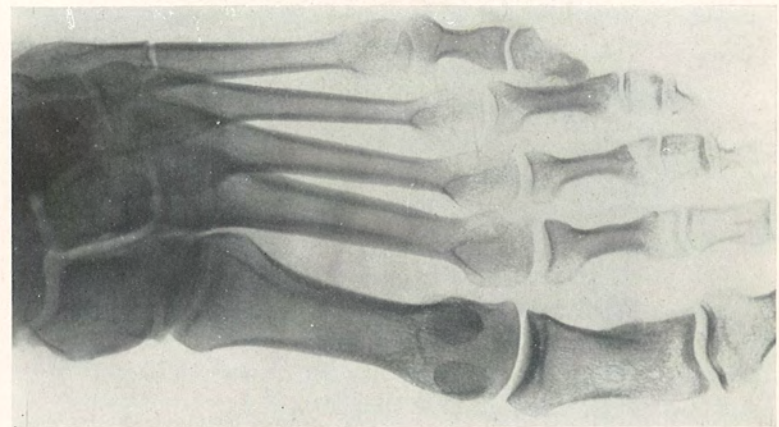
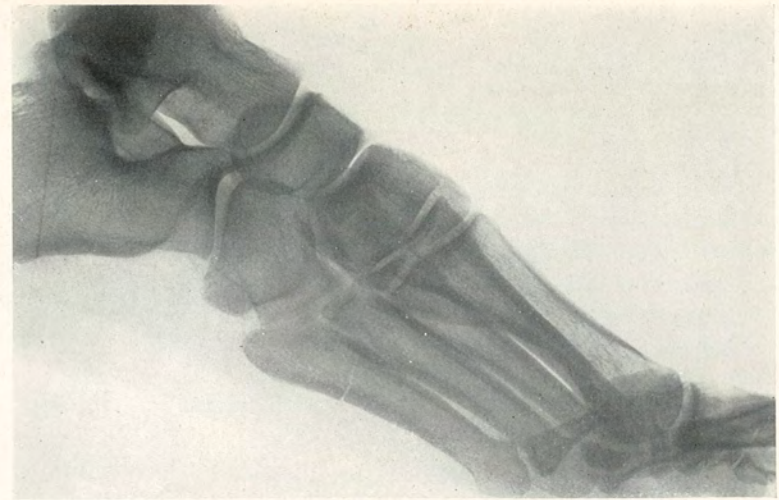


FIG. 12.—Case I.

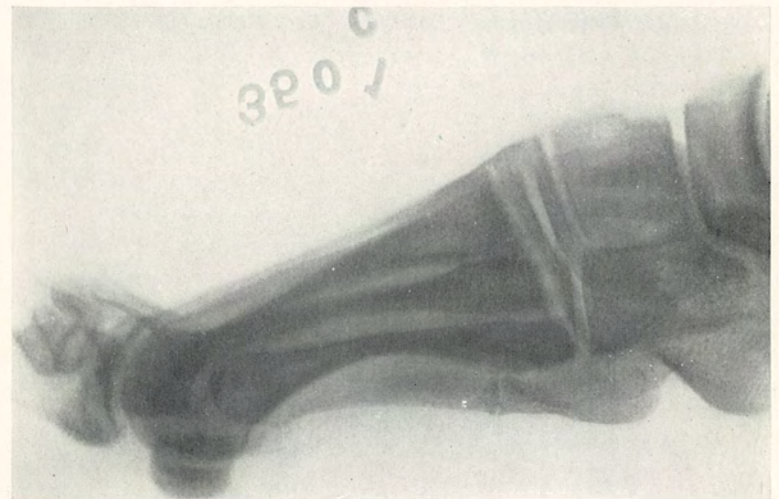


FIG. 13.—Case II.

The epiphysis may also be made out in the lateral view (Fig. 11). The writer's attention was called to this anomaly by Dr. H. K. Pancoast.

The first is the only metacarpal that has an epiphysis at its base normally, and for this reason it is considered by some as a phalanx, in which the epiphyses are always at the base. There is usually a scale-like epiphysis on the head of the first metacarpal, which makes its appearance about 8 or 10 and rapidly unites with the head. Rarely smaller epiphyses appear at the bases of the other metacarpals, as in mammals generally. There may be an independent centre for the styloid process at the base of the third metacarpal.

This epiphysis must not be confused with the occasional fusion of the trapezoid with the base of the metacarpal.

A similar case is pictured and described by Dwight in his work on "Variations in the Bones of the Hands and Feet."

FRACTURE OF BASE OF FIFTH METATARSAL

DR. MORRIS BOOTH MILLER presented skiagraphs of two patients with fracture of the base of the fifth metatarsal. In each the injury was due to indirect violence, the sudden imposition of the body weight while the foot was inverted and the heel raised. In this they are in accord with the cases previously reported by Robert Jones, Wharton, Coues, Cotton, Sylvester, and others, which show without exception that indirect stress is the responsible factor in all fractures of this type.

I. W. McC., aged twenty-five, while driving quickly stepped out of his carriage to avoid an accident. He stated that he was anxious to reach his horse's head and hence he was in the act of turning when his foot touched the ground. He felt a pain on the outer side of the foot but it was not severe and he was able to walk with very little discomfort. Diagnosis was by skiagraph which showed a fracture 3 cm. from the base. (Case I, Fig. 12, A and B.)

II. S. F., aged thirty-two, stepped from a ladder upon a hammer, which caused his foot to turn in, while at the same time he made a sudden effort to prevent a fall. Pain and partial disability caused him to seek hospital treatment. (Case II, Fig. 13.)

DR. PENN G. SKILLERN, JR., said the cause of this fracture by indirect violence is a sudden, sharp adduction of the foot, whether by dancing, jumping, or missing the last step of a ladder or staircase. Thus, the weight of the body comes down upon the outer border of the foot, turning the head of the metatarsal inward, and bringing a cross-strain to bear just in front of the broad basal portion of the bone, which is held firmly apposed to the similarly broad base of the fourth meta-

tarsal by very strong ligaments. Near the front of the broad base the metatarsal gives way (Cotton). There may be a fissure of the outer side only or a clean break across. Pain is not great, and the immediate disability is only partial. By pressing the neck of the bone inward pain is caused at the base. The alternative of fracture of the fifth metatarsal bone near its base by indirect violence is a luxation at its proximal articular surface, the avulsion showing as a distinct cleft in the skiagram.

The tuberosity at the base may be avulsed by the pull of the tendon of the peroneus brevis muscle. In 600 fractures Lilienfeld (*Archiv. f. klin. Chir.*, 1905-1906, 78, 929) found isolated fracture of the tuberosity but 5 times. This fracture must not be confused with the presence of an *os vesalianum*, first described by Vesalius in 1555. This is either an extra tarsal bone or a persisting epiphysis situated at the proximal and external part of the tuberosity. It is a shell-like bone, marked off by a groove on the plantar surface. It is not present beyond puberty. Like the *os trigonum*, it is exceedingly rare, and occurs on both sides. Coues (*Bost. M. and S. J.*, May, 1904) reports a case in which the *os vesalianum* was present.

BULLET LOCALIZER

DR. DAVID R. BOWEN presented a new bullet localizer which he said, to be precise, was a new attachment to a localizer now in use.

The idea of using cross threads to replace the course of Röntgen rays and thus localize a foreign body originated with Mackenzie-Davidson of London.

Later, Mr. Edwin Kelly added the pointer rod which is now in general use.

Given a surgeon and a röntgenologist used to working as a team this has served well. Many, indeed very many, cases have arisen, however, in which, after the localization was made, the rod was found to point through an undesirable site for operation. The fact that this was usually due to faulty team work or inexperience in nowise lessened the annoyance. The device here exhibited aims to remove entirely the personal equation and to make the localization a matter of precision.

It is original, I believe, in that from a single Mackenzie-Davidson localization variations can be made at will without further röntgenization. It is also original in that an actual probe is a part of the apparatus.

The instrument consists of a series of aluminum bars joined together by thumb nuts so as to make a four-jointed bar, fifteen inches in length, capable of universal motion in a single plane. At one end is

a clamp which fits the Kelly pointer rod, while the opposite end carries a tubular probe carrier.

To use, the clamp is fitted to the rod at a distance above a permanent mark on the rod equal to the distance of the F. B. below the end of the rod, as determined by the usual method. The joined bar is then adjusted so that the probe will just touch the end of the pointer rod.

It is obvious that if, now, the clamp is moved down to the mentioned permanent mark, then the probe will point directly at the foreign body; that an indicator attached to the probe will indicate the depth of the F. B. in that direction just as does the indicator on the Kelly pointer; and also that the direction of the pointer can be changed repeatedly at will (see Fig. 14, A and B).