STATED MEETING, HELD DECEMBER 1, 1913.

DR. GWILYM G. DAVIS, the President, in the Chair.

ARTHROPLASTY.

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IT may be laid down as axiomatic that, where there are many cures for an evil or various remedies for a disease none is entirely satisfactory. Many standard operations, so to speak, are well nigh perfected, but a special method of operation for the relief of ankylosed joints has not been universally agreed upon. Failures as well as good results in such cases should be reported, as by such a course alone will we be able to reach a sound conclusion. Various methods have been used in attempting to mobilize ankylosed joints, and it is interesting to note the development of the operation.

In 1826, J. Rhea Barton[1] of this city performed an osteotomy for an angular true ankylosis of the hip-joint. He divided the bone through the great trochanter and a part of the neck of the femur; then prevented bony union by movements. In 1830, Rodgers[2] of New York modified Barton's operation by removing a disc of bone from between the trochanters, and in 1840, Carnochan[3] attempted to prevent bony union after he had accidentally fractured the maxilla while operating for ankylosis. He interposed a piece of wood between the bony surface. In 1860, Verneuil[4] interposed a piece of temporal muscle and fascia between the condyle and the glenoid in a case of ankylosis of the jaw. Twenty years ago, Helferich[5] performed a similar operation on a child one year old; and after resecting the condyle of the inferior maxilla inserted a flap from the temporal muscle between the articulating bones. Since that time, this operation has undergone various modifications. In 1895, Mikulicz[6] used practically Helferich's procedure but employed a flap from the masseter instead of from the temporal. In 1901, Cramer[7] operated upon ten cases of ankylosis of the patella by the interposition of a piece of vastus internus; of these ten cases six were successful. Orlow[8] in the same year attempted the use of metal plates and gold foil as the intermediate body and this procedure was followed by the use of other non-absorbable materials such as plates of celluloid, zinc, silver, cambric, collodion and rubber.

With these agents an occasional good result was obtained, but in the great majority of cases a few months after operation the foreign material was extruded from the joint and ankylosis returned.

In 1907, Weglowski[9] transplanted with success the cartilage of a rib in a case of ankylosis of the elbow. Chulmsky,[10] in 1902, tried to use decalcified bone, magnesium and ivory but they all became absorbed and ankylosis returned. He deduced, however, that as false joints or pseudarthroses in ununited fracture of long bones were formed of aponeurosis and fatty tissue, the same tissues could be used in the formation of a new joint in a case of ankylosis. In the same year Nélaton[11] operated upon two cases of ankylosis of the hip-joint by interposing a strip of fascia lata between the head of the femur and the acetabulum. In 1905, Murphy[12] reported twelve cases in which he interposed fascia and muscle covered with a layer of adipose tissue to produce, to quote him, "Normal movable joints with capsules and collagen intra-articular fluid." By this method hygroma-bursa formation is sought. The formation of hygroma being "the result of a degenerative or absorptive process in fatty tissues with hyperplasia of the connective tissue element, the segmentation of the collagen into solution, 'fibrinoid', a liquefaction of hypertrophied connective tissue." His first operation of this character was performed in 1901. In 1909, Baer[13] made a preliminary report on the use of animal membrane in securing mobility in ankylosed joints. He used pig's bladder "which is chromicized so as to remain intact about forty days." The pig's bladder is boiled in cumol. Osgood has reported several successful cases operated upon by this method. Baer also used Cargile membrane or the peritoneum of an ox, as the interposing agent but found that it was absorbed in a period of ten to fifteen days and therefore not useful. This method of using animal membrane had been attempted before by Foderl, who, in experimenting on animals, interposed between the bones pieces of bladder and also the wall of ovarian cysts.

This is but a partial list of those who have contributed to the development of the operation.

When should operation be performed in a case of ankylosis?

For practical purposes ankyloses may be divided into two main divisions: the false, periarticular or extra-articular, and the true, articular or intra-articular. Murphy sub-divides the periarticular into capsular and extracapsular; and the articular into synovial, fibrous, cartilaginous and osseous.

The main treatment should, of course, be preventive, that is, one should attempt to guard against ankylosis of a joint

which has been the site of an infectious or traumatic arthritis. There are exceptions, however, even to this rule, as in tuberculous affections of joints ankylosis is often most desirable. In such cases or in cases where ankylosis is inevitable the aim should be to obtain a position which will render the part most useful. Baking, massage, passive movements, brisement forcé with an anæsthetic, tenotomy, myotomy, tendoplasty or myoplasty, excision of tendon sheaths, or cicatrices, are all methods employed in relief of periarticular, extra-articular, or false ankylosis.

Should some form of open operation be attempted in intra-articular ankylosis? This naturally must depend upon the cause of the ankylosis, the joint affected and the present usefulness of the part. One hesitates to open a joint which has been the site of a tuberculous infection, because, although the infection may apparently be dormant, operation and the subsequent passive movements may cause the infection to take on renewed activity. Many such cases have, however, been successfully operated upon, among which is the case to be shown to-night. The X-ray is of course valuable, but not absolutely final, in showing if the infection is still active. Hesitancy is unnecessary if the ankylosis is due to trauma such as fracture or to infections such as rheumatism, gonorrhœa, etc.

The mandibular joint offers the best field for operation. First, because of the favorable prognosis, second, because of the immense importance to the individual of mobility in this joint. Fortunately ankylosis of this joint, which follows severe forms of stomatitis and noma, is usually extra-articular and mobility can be usually obtained by relieving the periarticular cicatrices. When ankylosis is intra-articular arthroplasty can be performed and either a flap from the temporal or masseter muscle or chromic pig's bladder can be used for the formation of a new joint. The latter has been successfully used by Brackett.[14]

From the reports of cases in literature it would seem that the future use of these interposing tissues may depend upon the joint involved. It would seem possible that the Murphy operation will continue to be used in the knee-joint and in the hip-

joint. In these joints, which are joints of locomotion, and which carry the weight of the body, hygroma formation is necessary or at least desirable and Murphy's operation leads to a hygroma or formation of a new bursa. On the other hand, in the elbow, shoulder and the mandible a wide range of mobility is desired; there is no weight born by the joint and it would therefore seem that the formation of hygroma is not essential; therefore, the use of Baer's membrane is the preferable material for interposition. The technic of the interposition of this membrane is considerably easier than the technic of the Murphy operation.

In the hip-joint any position of ankylosis must be not only an inconvenience but an actual interference with one's ability to earn a livelihood. It should, therefore, offer a good field for arthroplasty. The same may be said of ankylosis of the shoulder.

In ankylosis of the knee and elbow, however, it would seem in the light of our present knowledge and experience that one should not too hastily fly to operation.

Even according to Murphy's own statistics the elbow and the knee offer the poorest prognosis of any joints. Therefore, if a patient has intra-articular ankylosis of a knee-joint, the ankylosis being with the leg in extension, there being no pain and the man or woman being able to perform his or her occupation, it would not seem that arthroplasty should be attempted without a full explanation to the patient of the facts that the operation will be followed by considerable pain, and that, whereas some motion may be obtained, it may be slight and ankylosis may recur.

The same might be said of the elbow. If there is ankylosis of elbow with the forearm at right angles to the arm, and if, in spite of the ankylosis the patient is able to earn a livelihood and the extremity is not painful the pros and cons should be carefully weighed before deciding on operation.

On the other hand, given a knee ankylosed at or near a right angle, or an elbow ankylosed in extension, positions which must of necessity be a great handicap, then it would seem that operation is entirely justifiable. Preferably arthroplasty should be

FIG. 1.

Result of arthroplasty on an ankylosed knee-joint. Flexion after operation.

attempted, for, even if unsuccessful as to mobility, a better position can be obtained for possible subsequent ankylosis.

Illustrative Case.—A boy, now thirteen years old, was admitted to the Orthopædic Hospital on October 11, 1912, in the service of Dr. William J. Taylor. The history was that of a tubercular arthritis of the right knee. Several operations had been performed merely for draining the joint. The condition of the knee was that of ankylosis of tibia, fibula and patella. The knee-joint was ankylosed at an angle of 45 degrees. There was no pain; no inflammation; no fever; all sinuses were healed.

Operation was performed by Dr. Taylor, November 8, 1912. A U-shaped flap was made with convexity downward. The skin flap was turned upward. The patella was sawn obliquely from above downward, and the joint was opened. All adhesions between the tibia and femur were freely liberated, the surface of the tibia and surfaces of the condyles cleaned of fibrous tissue and the capsule was cut away. By means of curved and straight chisels new and fresh surfaces were made. Sufficient bone must be chiselled away to allow for the interposing flaps and yet too much bone must not be removed for fear of obtaining a movable but weak joint.

Murphy has pointed out the necessity of keeping the intercondyloid ridge on the tibia intact to prevent lateral slipping of the femur.

The two interposing flaps were then cut; one from the external side, the other from the internal. They were interposed between the bones and sutured with No. 3 chromic gut. Because of the inability to get a good surface on the under aspect of the patella, it was turned over so that the normal anterior aspect became the posterior aspect. The wound was closed without drainage and the limb placed in a plaster case. This case was not removed for four weeks and no passive nor active movements were made until that time.

He was discharged from the hospital ten weeks after admission. He wore a supporting brace steadily for 6 months, then intermittently until end of a year.

REFERENCES.

[1] North Amer. Med. and Surg. Journ., 1827, p. 290.
[2] Cited by Murphy, J. A. M. A., May, 1905.

[3] Murphy (*ibid.*).
[4] Archives de Medicine, 1860, p. 284.
[5] Cited by Murphy.
[6] Cited by Baer, Amer. Jour. Orthorp. Surg., August, 1909.
[7] Paper read before the 30th congress of the Deutsche Gesellschaft Chir. Berlin, April 13, 1901.
[8] Cited by Baer, *ibid.*
[9] Centrablatt fur Chirurgie, April 27, 1907.
[10] Centrab. f. Chir., September 15, 1900.
[11] Bull. et Mem. de la Soc. de Chirurg., 1902.
[12] Jour. A. M. A., May, 1905.
[13] Amer. Jour. Orthorp. Surg., August, 1909.
[14] Papers from the Orthop. Dept. of Mass. General Hosp., May, 1912.

DR. WILLIAM J. TAYLOR said that in this case there had been suppuration, the patella was worm-eaten on the under surface, and fixed to the articulating surface of the femur, so that in order to get movement it was necessary to turn it upside-down. Flaps of fascia and fat were made, taking them from above, bringing them down between the articulating surfaces, and as they were not quite long enough to go clear through they were lapped over about one-third and stitched. The boy has a better joint than had been hoped for. The patella was sawed through obliquely in order to get the largest possible surface, and each half turned upside-down, the sawn surfaces twisted in the opposite direction, then brought together again and united by catgut sutures. This made a perfectly good, strong, bony union, with the result that the patella is now perfectly movable.

In this case the condition of the bone was such and the angle was such that it was necessary to take off quite a considerable amount of bone, particularly from the end of the femur, to get the leg straight. It is essential to take off enough of the surfaces to make the apposition between the ends of the two bones comparatively easy.

As to the question of the other joints, some years ago he had a man under his care in whom both elbows were absolutely stiff, due to an infection from his tonsils. He resected his left elbow and gave him a perfectly useful and serviceable arm, so much so that he declined to have the other one operated upon, saying that he could get along with the one. Dr. Taylor had resected the shoulder-joint many times and the results are so satisfactory that this is the operation of choice, rather than arthroplasty.

DR. J. T. RUGH called attention to the method of arthroplasty originated by Dr. R. T. Taylor, of Baltimore, which consists in the shaping of the joint surfaces by the removal of a sufficient amount of bony material to allow free function, and then filling the joint cavity with a preparation of wax which has a rather high melting-point. The joint is then closed and movements are begun at the end of a week or ten days. He had seen some remarkable results in these cases from that procedure. It is comparatively easy of performance, the most difficult part being the removal of the joint surfaces.

DR. ASTLEY P. C. ASHHURST said that it seemed to him that a more important matter than the mere question of technic is the indication for the operation. He regretted very much that Dr. Owen cannot say whether or not this was really a tuberculous case. If he has made a tuberculous knee-joint movable with safety he would be accomplishing a great surgical feat. Dr. Ashhurst was one of those who believe arthroplasty to be contra-indicated in cases of tuberculous ankylosis. It is interesting to recall that Dr. John B. Murphy attempted arthroplasty on an ankylosed hip that was undoubtedly tuberculous, found an unsuspected abscess, and left the man, at last reports, with discharging sinuses.

Dr. Owen spoke with proper caution about the indications for arthroplasty, and though the patient he shows has a good motion (120 to 150 degrees), it would seem that in a child of twelve years supposed to have a tuberculous ankylosis in bad position, it would have been safer on general principles to have taken out a wedge of bone and thus made the knee-joint stiff and straight.

DR. GWILYM G. DAVIS thought that in spite of the successful result in this case the introduction of drainage is decidedly of service as a precautionary measure. On two or three occasions he had not used drainage and had always regretted it; by this he meant drainage for 24 to 48 hours.

Apropos of the tuberculosis question, he operated once on a tuberculous knee, and while he got some motion he did not get as much as he desired and the knee remained painful for a long, long time, and he had been inclined to be conservative since then.

In relation to the elbow-joint it is one of the most satisfactory joints for arthroplasty as well as for resection, and the results from arthroplasty are so far more brilliant than are obtained by resection.

PARALYTIC TOE-DROP. PUTTI'S OPERATION FOR ITS RELIEF.

WITH REPORT OF A CASE AND SLIGHT MODIFICATION OF THE TECHNIC.

BY J. TORRANCE RUGH, M.D.,

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In a survey of the deforming results of anterior poliomyelitis so far as the various joints are concerned, probably the most difficult of mechanical control is the hip-joint and next to it may be placed the ankle-joint, because of the range of movements of the foot when deprived of muscle control. Whether the loss of power be confined to the anterior group of muscles, or to the posterior group, or to both, the resulting deformity presents in many instances, a problem difficult of solution either mechanically or surgically. The multiplicity of forms of braces and the varieties of operations employed from time to time are the best evidence of the inefficiency of any one, and the constant effort of orthopædic surgeons has been to devise a means of correction which should prove reliable and permanent.

It must not for a moment be considered that every case of toe-drop or of calcaneus or of flail-foot following an attack of infantile paralysis is a proper one for operation, for it is not. Many paralyzed muscles recover power years after the attack, when the strain of position or function is removed from them, and the earliest and most essential factor in the treatment of these cases of paralysis is to put the parts at rest and remove strain from the weakened and inert muscles. This will favor the subsidence of inflammation in the motor cells of the cord, will check or lessen degeneration in these cells, will prevent the onset of deformity and the stretching of structures, and will also frequently be followed by return of power in muscles thought to be dead. After about six years have passed, however, with careful supervision as to muscle strain, with massage and other local means to aid restoration of function, if paralysis

still persists in a muscle or group of muscles, it is quite proper to consider this the real, permanent or residual paralysis and to institute surgical measures which will preserve the normal balance of the part for the performance of its functions in the best possible manner. Without such means, the patient is doomed to a life of brace-wearing which is always troublesome and at times extremely disabling through breaking of the appliance and inability to have prompt repairs made.

The surgical correction of paralytic conditions of the foot may conveniently be considered under four divisions: (1) Operations upon the bony parts; (2) operations upon the tendons and muscles; (3) operations upon the skin; and (4) operation by silk inserts in tendons or ligaments.

Under the first group is included arthrodesis of the ankle, transtarsal or tarsal joints. These operations have proven only partially successful. Great difficulty is experienced at times in securing firm ankylosis and where this does obtain, the part ofttimes proves painful for walking and the gait is a stilted one.

The second group received earliest consideration through the work of Nicoladoni, who in 1881 first practised transplantation of live tendons to assist or replace the paralyzed ones, and this was the first really great impetus to the surgery of paralysis. Many varied types of operation have been suggested and performed on these structures since then, such as shortening by tucking, by cutting out a section, by changing the point of insertion and by changing the angle of pull, by passing the tendon through a subperiosteal groove and fixing it there (Dr. W. E. Gallie, Toronto, Can., ANNALS OF SURG., March, 1913, and *Amer. Jour. Orth. Surg.*, July, 1913). In all of these methods, the immediate results are good but in all excepting where the tendon of a live muscle is transplanted and where it is fixed in a subperiosteal groove, the deformity is extremely likely to recur, because the structures which stretch, viz.: the degenerated and paralyzed muscles, are still subjected to strain. Where they are eliminated as in the procedure reported by Gallie, the results are sure and certain, as the tendons are converted into ligaments and do not stretch.

In the third group, Robert Jones has had good results from the resection of a portion of skin and fascia on the elongated side and bringing the edges together to maintain correction. This procedure when used in conjunction with tendon work affords reinforcement and lessens strain.

The fourth group has been extensively employed and is to be very strongly recommended. The results of the inserts of paraffined silk appear to be permanent, whether the parts reinforced be tendon or ligament. The only criticism to be offered against it is that silk is a foreign body, and if the same results can be secured by the use of living structures which are already in position and which are unyielding, I believe the local tissues should be utilized even though it is urged that the silk inserts rarely cause trouble by suppuration or otherwise.

In August, 1913, Dr. V. Putti, of the University of Bologna, Italy, performed for the writer another method of fixing these permanently paralyzed tendons which he has been using for some time with excellent results. The underlying principle is the same as that used by Sangiorgi (quoted by Gallie) and Gallie, viz.: to convert the tendons of the paralyzed muscles into ligaments, but Putti eliminates absolutely the degenerated muscle tissues which are the structures that stretch and permit the recurrence of the deformity and in this respect renders results more certain.

The operation for toe-drop with paralysis of the tibialis anticus, dorsal flexors of the toes and the peroneus tertius as done by Putti is as follows:

The tendo achillis is first made long enough (if not already so) to allow a right-angled position of the foot. An incision four or five inches long is then made from above the ankle-joint upward along the tibial crest and the anterior tendons exposed. These are separated and all are severed from their muscle attachments as high up as possible. The tibia is then freed about the middle of this incision and an oblong hole of sufficient size to receive all the tendon ends is mortised through it. The periosteum is next lifted from the front surface to the tibia. A tendon end is passed through the hole from one side and drawn taut, the foot being held at a right angle. Another tendon is next passed through from the other side and the remaining tendons alternately until all are threaded. The ends are

next drawn under the raised periosteum and firmly stitched in place to tendons, periosteum and tendon ends (Putti uses silk-worm gut sutures for this and leaves them buried) and the wound is closed. The parts are fixed for a couple of weeks by a splint; but Putti expresses himself as favorable to treatment without any support, believing that union will be much more firm if a little strain is permitted on the operated tendons and that we weaken the attachments by long continued fixation.

The mechanical features of the operation are entirely correct in the elimination of the weak and easily stretched muscle structures and conversion of the tendons (which stretch but little when continuous) into a large strong ligament having a sufficiently long hold on the foot and leg to give firm fixation and withstand quite a degree of strain. On November 21, 1913, I operated by this method upon a boy, S. M. (patient shown to the Academy), aged thirteen years, who had an attack of infantile paralysis over eleven years ago. There was complete loss of all the anterior muscles of the leg and foot with slight power in the plantar flexors of the toes and in the tendo achillis. There is also good power in the hamstrings, very slight power in the rectus femoris, and flexion of the knee to 15°.

After fixing the proximal ends of the severed tendons, as above described, the foot was maintained perfectly in the right-angled position and a plaster splint was applied to the entire leg, the knee being first forcibly straightened preparatory to a transplantation of the external hamstring into the patella.

In one feature, however, the operation impressed me as lacking and I shall correct this at the subsequent operation on this case. When the dorsal flexors are drawn taut, the toes stand out straight and would probably remain so if the plantar flexors were also paralyzed, but with these muscles alive and in action during function of the foot, it will be but a short while until the toes will become flexed through dropping downward of the metatarsophalangeal joints (from stretching of the fibres holding the dorsal flexor tendons to the top of the metatarsals and proximal phalanges), and the flexion of the distal phalanges of the toes and a condition of hammer-toe will be established with dorsal dislocation of the toes upon the metatarsal ends.

To obviate this, I propose to engraft the tendons of the dorsal flexors into the distal end of the metatarsals, either by severing them well forward and drawing the end through a hole drilled in that part of the metatarsal, or by lifting a flap of periosteum and cutting a groove on the dorsal surface of the bone, laying the tendon in this groove and securing it by suturing the periosteal flap over and to it (as described by Gallie and Sangiorgi).[1] A bone-flap could also be used if desired, but I believe one of the others will be sufficient to focus the ligamentous pull on the distal end of the metatarsals and obviate the threatening deformity of the toes.

This procedure is simply a combination of two mentioned operations but it will, I believe, provide the solution of the treatment of this most troublesome condition. Putti's method of fixing the tendons in the bones of the leg is safe and sure and of course can be applied to any type of paralytic deformity about the foot, such as calcaneus (using the tendo achillis and plantar flexors of the toes or the tibialis posticus or the peronei), valgus (using the tibialis anticus or posticus or both), or varus (using any or all of the peronei).

DR. A. B. GILL (by invitation) said that he had observed four cases in which silk ligaments have been implanted to correct paralytic foot-drop. The ligaments are put through a hole drilled through the tarsus and then passed up the leg within the sheaths of the peroneus tertius and the tibialis anticus, and then passed through a hole drilled through the crest of the tibia and fastened there. Of the four cases, one is now of two years' standing, in which the silk is still holding the foot in good position with marked improvement in the gait. One silk ligament of the four broke, owing to weakening of the silk by too prolonged boiling in the bichloride of mercury. It was an easy matter to replace the silk. The other cases are in good condition. There has been no condition of flexion of the toes resulting from the operation. It will

[1] This operation was completed as above outlined on December 12, 1913, with very satisfactory immediate results and there is every reason to feel that the ultimate results will be as desired as this additional work has been thoroughly tried out by many operators and has received the stamp of approval.

be interesting to observe in the Putti operation when the tendon is severed above and below whether there will occur degeneration and stretching of the tendon.

DR. GEORGE ERETY SHOEMAKER expressed surprise at the use of buried silkworm gut sutures. This is a substance which was tried out very thoroughly years ago in this country and abandoned as a buried suture material, because it was absolutely unattacked by the cells of the body and always remained as a foreign body during the lifetime of the patient. A permanent suture does no more good than a temporary one, as under the slightest tension it cuts until it does no more holding. He had had occasion to take out a considerable number of silkworm gut sutures put in under perfectly sterile conditions, the sterility persisting for say two years, when the sutures would begin slowly to work their way out. He had buried many hundred worm gut sutures in aponeurotic tissue, and had seen probably one per cent. give trouble after long intervals.

DR. J. TORRANCE RUGH (in closing) said that he had mentioned the fact that Professor Putti used the silkworm gut, though he himself did not. He called his attention to its abandonment in America and he said he never had any trouble whatsoever from it. He had used it for a number of years and he claimed most excellent results. Dr. Rugh used chromicized catgut in this case as he does in all.

In regard to the silk ligaments, he was a firm believer in their use, but anything of that kind is a foreign substance, and if you have structures which are capable of preserving the position of the foot, why introduce a foreign substance? He had done quite a number of these cases of silk ligaments for this condition of toe-drop, for valgus and for varus and had had no trouble since using the paraffin silk, but he did have trouble with bichloride silk, as it came out by sterile suppuration. The paraffin silk remains in and is very good. But here are structures which are inelastic, and already in place and if you fix them you make ligaments out of the tendons. If any change takes place, even if they lose their identity as tendons, they are still ligaments.

This operation has been done for a couple of years by Putti, who claims that they were holding splendidly, and unless the tendons should stretch, it is the ideal operation for this condition.

RADICAL CURE OF AN INCARCERATED INGUINAL HERNIA IN AN INFANT TWENTY DAYS OLD.

DR. WALTER E. LEE reported the history of an infant who was admitted, January 20, 1912, to the service of Dr. James P. Hutchinson at the Children's Hospital.

It was by the courtesy of Dr. Hutchinson that the reporter operated upon the child and had the privilege of reporting the case.

Upon admission the right half of the scrotum was found enlarged and tense and the tumor emerged from the external inguinal ring. The scrotum became normal in size after taxis when a gauze pad over the external ring with adhesive plaster and spica bandage reinforcements were applied to secure the reduction. Following this the child had three normal bowel movements and seemed perfectly comfortable for twenty-four hours when the tumor reappeared and operation was decided upon.

The skin and subcutaneous tissues were anæsthetized by infiltration with thirty minims of a four per cent. solution of eucaine. On opening the sack about one drachm of bloody fluid escaped. One large loop of small intestine, ten inches in length, with its mesentery were found in the sack and the mesentery was twisted upon itself one complete turn. The bowel was very dark in color but the peritoneal coat lustrous, and after irrigating with hot normal salt solution, the color of the bowel improved and the circulation returned in the mesenteric vessels. The constriction was found at the internal ring and after dividing it the bowel was returned to the abdominal cavity. The aponeurosis of the external oblique and the internal oblique muscle were then sutured to Poupart's ligament with chromicized catgut, thus depressing the cord. The skin wound was closed with three silkworm gut sutures. At the close of the operation the infant vomited fecal matter and this was the first vomiting of which we had any knowledge.

The child nursed the following morning and this day there was a normal bowel movement. The convalescence was uneventful and the child was discharged with a firm wound on the twenty-first day.

Dr. Lee called attention to the satisfactory anæsthesia obtained by the local infiltration of a solution of eucaine. The anæsthesia seemed perfect during the entire operation, the infant busily sucking the thumb of the nurse.

RADICAL OPERATION FOR A HERNIA OF THE UMBILICAL CORD IN A NEW BORN INFANT.

DR. WALTER E. LEE reported the history of an infant who was brought to the dispensary of the Children's Hospital one hour after its birth. Dr. Edward B. Hodge saw the child and advised immediate operation. It was by his courtesy that the reporter operated and had the privilege of reporting the case.

The infant seemed perfectly formed except for a large cystic tumor which protruded from the anterior abdominal wall. The tumor was nearly as large as the infant's body. The circular opening in the abdominal wall, an enlarged umbilical ring, extended from the xiphoid cartilage to within one inch of the pubic bone. The skin of the abdomen was continued upon the pedicle of the sack for one-quarter of an inch, where it ended as a sharp border beyond which a transparent membrane as thin as paper covered the remaining portion of the tumor as far as its distal extremity, where the covering was drawn out like a funnel and became continuous with the ligated umbilical cord. The umbilical vessels could be felt as a cord on the lower surface of the tumor. The liver, the spleen and the large and small bowel could be clearly seen through the hernial covering floating in a clear transparent fluid. These organs were all outside of the margin of the umbilical ring.

The child was anæsthetized with ether and an attempt made to reduce the organs. This was unsuccessful and upon opening the sack, the bowel, liver and spleen were found adherent to the sack wall in many places. After ligating the umbilical vessels and breaking the adhesions the bowel and spleen were reduced, but it was necessary to enlarge the opening in the abdominal wall by an incision toward the pubes before it could be replaced. The hernial sack was excised and the abdominal wall united with ten chromicized catgut sutures which passed through the entire thickness of the wall. The tension upon these sutures was relieved with strips of Z. O. adhesive encircling the abdomen. The increased intra-abdominal pressure resulted in a large amount of meconium being expelled at the end of the operation. The child lived for five days. During this time the bowel moved three to four times daily and it regurgitated small amounts of mucus flecked with black particles which looked like meconium. It was fed with a weak mixture of condensed milk and an attempt was

made to bring some of the mother's milk to the hospital on the fourth day but the plans miscarried.

No autopsy was obtained and the cause of death remains uncertain.

Dr. Lee added that congenital herniæ of the umbilical cord should be classified as malformations since the peritoneum and viscera are not abnormally protruded but lie in front of the anterior abdominal wall as in the early stage of intra-uterine life, the normal closure failing to take place. It is really an ectopia.

The outer covering of the sack is formed by the distended tissues of the umbilical cord, a thin layer of the jelly of Wharton, and behind this is the hernial sack, corresponding in its position to the peritoneum and continuous with the abdominal peritoneum.

As the circulation in the umbilical cord ceases immediately after birth the stump of the cord becomes necrotic, shrinks up and is cast off after several days; the covering of the hernia of an umbilical cord naturally undergoes the same fate, exposing the abdominal viscera, the consequent suppurative peritonitis usually causing death.

Radical operation was first advocated by Lindfors in 1881. Hansson published a collection of 73 cases treated in the antiseptic method, 1900. Mortality of 32.8 per cent.

OBSTRUCTIVE PELVIC LESIONS ASSOCIATED WITH CHRONIC DIVERTICULITIS.

BY GEO. ERETY SHOEMAKER, M.D.,
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THE attention of surgeons has been directed of recent years to diverticula of the intestine as a cause in certain previously very obscure chronic indurated conditions. Suspicions of tuberculosis or syphilis, but especially of carcinoma, have led to exploratory operation, the pathology being finally determined as that of chronic diverticulitis. Often after most difficult dissection drainage of a small abscess in the centre of a rigid induration has been the only treatment possible. Curative treatment has required excision or resection of the bowel, a matter of much technical difficulty at times. Among the last 800 intra-abdominal operations by the writer five cases of various forms of diverticulum have been encountered, some of minor consequence, others of much gravity. They were as follows:

CASE I.—*Meckel's Diverticulum.* Incidentally observed while operating for extra-uterine pregnancy. It was a cone-shaped offshoot of the lower ileum. As its opening was large and there was no danger of subsequent strangulation it was treated by inversion and suture. Probably it had not caused symptoms. Patient was delivered normally a year later.

CASE II.—*Meckel's Diverticulum.* Acute obstruction of ileum. Boy of twelve years. Subsequent to recovery from typhoid fever two attacks of partial obstruction in previous months had been spontaneously relieved. The existing attack had gradually developed into complete obstruction and paresis which caused death thirty-six hours after operation, which was done too late and under unfavorable conditions. A strong broad adhesion band had strapped down an inch or more of small intestine to the root of the mesentery at a point immediately below the origin of a Meckel's diverticulum. The latter was enormously swollen as was the

nearby gut above. The diverticulum had apparently participated in the production of the obstruction due to kinking above the broad adhesion.

CASE III.—*Multiple Diverticula of Sigmoid Bowel.* Mrs. X., aged sixty, presented symptoms suggestive of pelvic carcinoma. In addition to benign uterine hyperplasia the lower sigmoid bowel was rigid and leathery. After resection the gut was shown to be pierced by numerous diverticula. Inflammation had extended from these to surrounding tissues (see ANNALS OF SURGERY, vol. lvi, p. 661).

CASE IV.—*Diverticulitis of Rectum.* Mrs. B., aged sixty-three, had suffered from pelvic inflammatory attacks, for years, and at times had been treated by various specialists, receiving the rest cure, etc. Operation showed broad ligaments, very small ovaries and tubes buried in very firmly organized old adhesions which also surrounded the rectum. While the entire rectum had not the rigidity and leather-like feel at times noted, there was a diverticulum readily accessible resembling a thick short epiploic appendage with a firm club-shaped head as large as a cherry. This contained a movable mass, continued pressure on which caused it to be extruded into the lumen of the rectum. The offshoot from the bowel then collapsed, showing it to be diverticulum. Deeply situated in the cellular tissue surrounding the rectum were several firm bean-sized indurations which probably represented other diverticula, though only the one was clearly demonstrable. Diverticulitis was doubtless the cause of old obscure pelvic symptoms.

CASE. V.—At intervals of several months during the past year I have operated for recurring intestinal obstruction under conditions which interested me greatly. The patient presented a most baffling and formidable combination of pelvic conditions, at first supposed to be carcinomatous but which were finally shown to be associated with one or more diverticula lying in an inextricable mass of indurated tissues and organs against the sacrum.

The extensive destruction and disarrangement of pelvic anatomy was remarkable. The patient, aged forty-three, short, muscular, fat, weighing 190 pounds, was admitted for an attack of intestinal obstruction which proved to be incomplete. Owing to distention little could be learned by examination above the pubis; below the pelvis was found blocked by a large rounded fixed mass. apparently incorporating both uterus and rectum high up. There

was a history of menorrhagia, and at long intervals slight discharge of mucus, so-called, but no blood from the rectum. There had been occasionally wire drawn stools for five years.

Operation was most unsatisfactory; an irregular, very hard pelvic mass inextricably incorporated the rectum and uterus with adherent coils of small bowel. After patient dissection nothing was accomplished except the release of a few adhesions, and in the apparent presence of malignancy the colon was attached to the left parietes, to be opened later when necessary. Strange to say, obstructive symptoms entirely disappeared following this operation, and large, well-formed stools were passed. All appearance of wire drawing disappeared, doubtless due to rectal drainage of a fluid sac and release of external pressure on the rectum. This relief continued for four months, the patient becoming apparently well. Wassermann test was negative and full doses of iodide of potassium used experimentally had no effect on the tumor. Then obstruction occurred gradually, became complete, and the colostomy was completed with immediate relief. Again she resumed the use of the rectum intermittently. The colon opening might be unnecessary for weeks, when it would again come into play. There was no valve action and no slack in the attachment of the colon. Six months later and nine months after the first operation, as the general condition seemed absolutely to negative the presence of carcinoma, I yielded to the solicitation of the patient to again try to remove the obstructive mass and make possible the closing of the colostomy. The attempt was again very disappointing and unsatisfactory. After the most difficult dissection a rounded pus sac with walls half an inch thick and very firm was traced behind the rectum, but it could not possibly be dissected out and had to be abandoned to drainage. Before opening it pressure did not cause it to drain into the rectum, though doubtless this occurred at times. The rectum where it emerged above the extremely hard mass was stiffened and the local vessels were deeply engorged. The microscope afterward showed no mucous membrane lining this pus sac, but it might have been destroyed by suppurative processes during years. I consider this sac to have been a diverticulum holding about three ounces of mucopus, and so surrounded except on the rectal side by absolutely rigid tissue that when full it produced obstruction by compression, relieved spontaneously or otherwise at intervals. A second focus

was isolated from very hard tissue and finally detached, almost by fracture. It was found to be lined with mucous membrane. Its site was closed in by celluloid thread. No determination could be made of the kind of intestine from which it sprang but from its situation it was supposed to be also a diverticulum from the large bowel. The laboratory examination by Dr. Pfeiffer showed it, however, to contain glands unquestionably from the small intestine. It was, therefore, a Meckel's diverticulum, lying deep in the pelvis and caught in the general mass. With the greatest difficulty could the uterus be found, well in front. Large cigarette drains were placed in the diverticular pus cavity and another at the suture site of the Meckel's diverticulum. There was a troublesome oozing of indefinite origin which set in after reaction and which contributed more or less to the death by exhaustion after three days. Gas was passed by the colostomy.

The occurrence of five diverticula in such a small group of abdominal operations as 800, while probably only a coincidence, would seem to indicate that the abnormality may be more frequent than is supposed. Detection of short diverticula is difficult and when buried in dense, inflammatory tissue may only be possible after resection of the intestine. Certain it is that the lesion has been often overlooked in the past, especially in the sigmoid and rectum.

Device for Temporary Gas-Tight Plugging of Colostomy During Operation on the Abdomen Elsewhere.—Owing to the recurrent attacks of obstruction and the uncertainty of being able to remove the cause, it was necessary to operate without permanently closing the colon in the last case cited. The opening was therefore plugged by a finger cot of heavy type, passed part way in, then loosely packed with gauze both within and without the fistula so as to make a retention button. The cot was then tied to a catheter and inflated with air. This made a perfectly gas-tight valve, not affected by fluids or gentle manipulation. I reported the use of the same device to the Academy of Surgery in 1909 (see ANNALS OF SURGERY, vol. li, p. 425), when it was applied to a vesicovaginal fistula. Before removing a bleeding kidney tumor it was necessary to prove the function of the other kidney, which was impossible with a bladder collapsed by the presence of the fistula.

The distended rubber cot, however, made a watertight joint and made the cystoscopy perfectly easy. Unless a little gauze is put inside the cot before inflation, the air may all go into one end of the device, which would then slip out.

THROMBO-ANGIITIS OBLITERANS (BUERGER'S DISEASE).

Dr. Penn G. Skillern, Jr., said that thrombo-angiitis obliterans of the lower extremity is the designation proposed by Buerger (*Am. J. M. Sci.*, 1908, N. S. cxxxvi, 567) for the condition formerly known as "endarteritis obliterans," "arteriosclerotic gangrene" and "Spontan-gangræn" of the Germans, and is based upon conclusions drawn from pathological studies of the vessels obtained from nineteen amputated limbs. In brief, we are dealing with a thrombotic process in the arteries and the veins, followed by organization, and not with an obliterating endarteritis. Most of the larger arteries and veins of the amputated limbs were found obliterated over a large extent of their course. The veins share equally with the arteries in the lesion of occlusion, and may even be more extensively involved. The distal parts of the vessels, rather than the proximal, are closed. At times, 2 to 4 inches of a vessel's length is closed, while the portions above and below are apparently normal. There is often an involvement of some of the smaller branches, such as the tarsal and the metatarsal, but the smallest arteries are free. The process involves the intima, the media, the adventitia, and the perivascular tissues. The periarteritis is a fibrous agglutinative process that binds together the artery and its collateral veins, and sometimes also the accompanying nerve, so that the liberation of the individual vessels by dissection is difficult. The cause is probably partly static and partly toxic.

The disease usually attacks Polish and Russian Jews between the ages of twenty and thirty-five or forty years, so that the names juvenile and presenile gangrene have been employed. After longer or shorter periods, characterized by pain, coldness of the feet, ischæmia, intermittent claudication, and erythromelalgic symptoms, evidences of trophic disturbances appear which finally pass over into a condition of dry gangrene. The left leg is usually the first to become affected, and when simultaneously bilateral the diagnosis of Raynaud's disease is often made. In the pendent position a bright red blush comes on the toes and foot. Soon a blister, hemorrhagic bleb, or ulcer develops near the tip of one of the toes, usually the big toe, and frequently under the nail, and when this condition ensues the local pain becomes intense. Even before the gangrene, at the ulcerative stage, amputation may become imperative because of the intensity of the pain.

The following case illustrates with great fidelity most of the features described by Buerger.

M. L., male, Hebrew, aged forty-two, sheet-metal worker, presented at the Surgical Out-patient Department of the University Hospital, service of Dr. B. A. Thomas, July 17, 1913, complaining of intense pains in both legs of a year's duration. The pain in the left leg is greater, and is constant, night and day. It is chiefly burning in character.

Examination revealed both feet involved in ischæmia, obliteration of pulse or dorsalis pedis on both sides, and a dusky blush involving both great toes. A trophic ulcer beneath the nail of the left great toe exposes the end of the ungual phalanx.

Nerve-stretching had been performed in another city without relief, and everywhere the patient went amputation was advised as the only method of relief from the wearing pain. Examination of the distribution of the pain showed that it was confined chiefly to the area presided over by the cutaneous filaments of the musculocutaneous nerve. It was figured out that if this nerve were resected, amputation could be postponed indefinitely, and the patient allowed to retain the otherwise useful limb—at least until extensive development of gangrene indicated amputation. Accordingly, using a solution of novocaine two per cent., with adrenalin 1 to 3000, intradermic infiltration along a transverse line 2 inches broad with centre over antero-external border of fibula, was made 4 inches above the base of the fibular malleolus. The cutaneous division of the musculocutaneous nerve was exposed at its emergence from the deep fascia, and a section one inch long was excised. The relief from the burning pain was *immediate*. The wound was drained by a folded strand of silkworm gut. It was closed by 4 silkworm gut sutures, and a dilute alcohol dressing applied.

The day after operation there was no pain in the foot. Reports upon the blood and the urine, which had been previously collected, showed that the Wassermann reaction was negative and that there was no sugar. The patient was given 5 drops of a saturated solution of the iodide of soda and one one-hundredth of a grain of nitroglycerin three times a day after meals.

Owing to the impoverished circulation of the limb, the operative wound remained indolent for several weeks, but was eventually stimulated to heal by the application of Bier's powder of nitrate of silver and powdered clay.

A month after operation the patient complained of pain in the distribution of the anterior tibial nerve to the adjacent sides of the great and of the second toes. This nerve was reached in the first interosseous space by a hypodermic needle, and was blocked with alcohol. This sufficed to relieve the pain.

Dr. Morris Booth Miller said that he had had some experience with Buerger's disease and had been very much interested in Dr. Skillern's account of the relief of pain by the severance of the musculocutaneous nerve. These cases are most distressing, the patients suffering at all times, especially during cold weather. He was surprised at so much benefit having resulted from cutting a single nerve; his observations would have made him believe that the severance of the whole nerve trunk would be necessary. Within the last ten days he had seen another complication which may occur, a man upon whom he had operated at different periods for Buerger's disease was stricken with a cerebral embolus. The diseased condition is one of vascular change involving all parts of the blood-vessels, both arteries and veins, and of the structures outside of the vessels, thereby affecting the nerves. This process is not a continuous one; it seems to show periods of rest, when the patient will be nearly free from pain though showing distinct objective symptoms, and then there will be an increase of all symptoms corresponding to new and further vascular change. In the case mentioned of cerebral embolus the man had just suffered an augmentation of this phenomenon.

Dr. Duncan L. Despard said that he had had an opportunity of operating on a number of these cases and then following them by microscopic examination of the vessels. In regard to the cause of the condition he had been struck by the proliferation in the intima and the elastic tissue which takes place in these vessels and frequently without obliteration of the lumen of the artery. He did not think that the obliteration by a thrombus is entirely to be accepted as the cause. He had a case last summer, of a man who suffered greatly. Since June applications of X-rays, two or three times a week, had been made. As a result he has obtained a great deal of relief from his pain. It has passed entirely from his toes and legs and he now complains of pain in the region of the knees, which have not been subjected to the X-rays. Strange to say, the temperature of the legs has increased. They were cold

during the summer and the other day there was a perceptible increase in the local temperature to the hand. Whether he will have continued relief or that this is simply a temporary improvement, remains to be seen.

Dr. George P. Müller said that he had seen a great many of these cases, mostly in Dr. Frazier's Clinic in the University Hospital. A number of years ago the affection seemed to be limited to the great toe, and was commonly known as Mitchell's disease, but in recent years they have observed more cases in which the entire foot or even the leg was involved. He did not know that they had obtained any permanent relief by any method of treatment short of amputation. They have stretched, injected, and cut the internal saphenous or external cutaneous nerves, and have had X-ray treatment used, and high frequency current, etc. In two cases he performed arteriovenous anastomosis and in another he tried to do so but found the femoral artery a solid cord. He was not an advocate of this method of treatment and cannot agree with the enthusiastic claims of Wieting, Bernheim, and others. They have resorted in at least two cases to amputation. These amputated limbs were examined in Dr. Speese's Laboratory and there was distinct evidence of thickening of the femoral vessels and more or less thrombosis in the veins.

Dr. Nathaniel Ginsburg (by invitation) said that for some time he had been interested in this subject, because of the almost sole limitation of this affection to a single race—the Jews.

Continued observation of young Russians, who have recently come to this country, with the idea of determining whether it is a purely peripheral condition, has convinced him that this disease possesses a symptom complex of which the peripheral state is only a part. As an example, he has been observing now for the past five years a young man of about twenty-four years of age, who presents marked disturbance of the circulation in his hands and feet. Examination of his surface blood-vessels reveals very feeble pulsation in his brachials, axillary and femoral arteries, indicating a general vasomotor constriction of all these blood-vessels. The maximum effect is first felt in the digits of both upper and lower extremities, which become the seat of trophic changes, very often necessitating amputation of the part. While Buerger has established the pathology of this condition as far as the peripheral ves-

sels are concerned, possibly Dr. Mitchell was correct, when many years ago he suggested the spinal cord as primarily the seat of the trouble, since theoretically stimulation of the sympathetic motor neurons of the cord will produce marked peripheral vasomotor constriction of the blood-vessels.

The relationship of this condition largely confined to a single class of people may be explained upon the basis which Dr. Crile has enunciated in his theories underlying the production of shock. This disease is found in a highly emotional class, subject to tachycardia, and neuroses of every description, and who suffer postoperative shock to a greater degree than any other class of patients. They are more subject to sensory stimulus, and therefore react to a greater corresponding degree; hence the great variations in blood-pressures observed in the same patients at different times. It would seem that an important predisposing factor in the production of this condition is something in the physiological make-up of these patients, not any previous article of diet, but perhaps an unusual sensitiveness of their cerebral or spinal motor neurons acting upon the blood-vessel wall.

DR. PENN G. SKILLERN (in closing) said that in regard to the entire relief from pain in this case it might be explained by the pain being confined to the distribution of the cutaneous division of the musculocutaneous nerve. The process described by Buerger involves the intima, the media, and the adventitia together with the perivascular tissues, one huge cicatricial mass from the lumen out to the muscles. The veins are equally involved and that is why any attempt at arteriovenous anastomosis fails. This condition is not to be confused with Raynaud's disease, which is a *functional* disturbance. The kinetic theory of Crile, suggested by Dr. Ginsburg, does not explain in any way this cicatricial mass of blood vessels. The cause is most likely a toxæmia somewhere in the body, and the predilection of the disease for the vessels of the lower extremity is determined by the static strain to which they are constantly subjected.

EPIPHYSEAL-METAPHYSEAL FRACTURES.

DR. PENN G. SKILLERN, JR., called attention under the above heading to partial fracture of an epiphysis or of the adjacent portion of the shaft, latterly designated the metaphysis. This injury is not to be confused with the well-known epiphyseal injuries that

have been classified by Ollier as paraepiphyseal strains, paraepiphyseal sprains, and disjunction of epiphyses.

Illustrative of partial epiphyseal fracture is the following case:

M. E., male, aged four and a half years, while riding a bicycle was run into the curb by a coal wagon and fell off, injuring the right knee. Skiagram (Fig. 1) shows the separation of a small unciform fragment from the tibial side of the lower epiphysis of the femur. Gypsum case was applied. This fragment shows equally well in lateral view (Fig. 2). It will be noted that it was caused by *direct* violence, and therefore is not a true tear-fracture.

Illustrative of partial metaphyseal fracture is this case:

W. G., male, aged five, fell off the porch, injuring the right elbow. Examination 4 days later revealed swelling, tenderness and lemon-yellow ecchymosis about the external condyle. Skiagram (Fig. 3) showed partial fracture of the external corner of the lower metaphysis of the humerus, with but trifling displacement. The arm was dressed on an internal right-angle splint. This injury was also produced by direct violence.

In addition to these epiphyseal and metaphyseal fractures by direct violence, it is conceivable that tear-fractures of the metaphysis might arise from overstretching of a part of the articular capsule, or of one of its specially thickened bands, or ligaments. Tear-fractures of certain epiphyses, to which ligaments are attached, could also occur, in which event the epiphyseal bond of union is stronger than the ligamentous.

EXTENSIVE COMMINUTED FRACTURE OF THE LOWER THIRD OF A HUMERUS STUMP.

DR. PENN G. SKILLERN, JR., presented the following case more as a surgical curiosity than for any other reason.

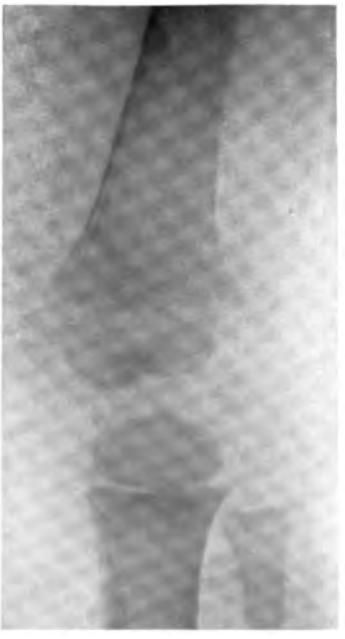
C. W., male, aged thirty-three, clerk, fell backward, landing on the lower end of the stump of the left humerus. Clinical examination revealed swelling, preternatural mobility, crepitus and tenderness in the lower third of the humerus. Skiagram (Fig. 4) revealed comminution of the shaft of the left humerus, just above the lower end, into a dozen small fragments, with vertical splitting of the shaft. This was dressed upon an anterior and a posterior splint.

Sixteen years previously disarticulation at the left elbow-joint was performed for a gunshot injury to the forearm. Two years ago he fell, and had a clean transverse fracture of the same stump.

FIG. 1.

Partial fracture of lower epiphysis of femur. Anteroposterior view.

FIG. 2.

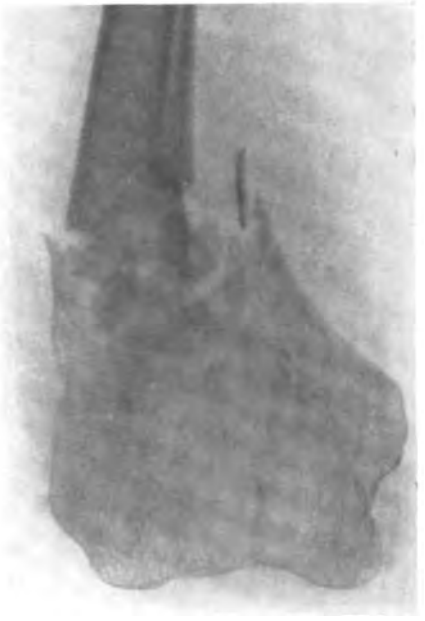


Partial fracture of lower epiphysis of femur. Lateral view.

FIG. 3.

Partial fracture of lower metaphysis of humerus.

FIG. 4.



Extensive comminuted fracture of lower third of humerus stump.

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that the vast majority of these conditions were acquired and that they must be due to some low grade inflammation of the peritoneum. Just what the most common cause is he had not been able to find out; although he had felt for some time that the appendix was responsible for a great many of them. A localized peritonitis of low grade without perforation of the appendix would seem a plausible explanation. He could understand how an intussusception which has been reduced and which stays reduced may produce a slow forming adhesion, the result of a low grade of localized peritonitis.

Dr. Walter Estell Lee said that in the sixth case reported he was the operator, and he could corroborate Dr. Allen's feeling that many of these intussusceptions relieve themselves. This child was seen by Dr. Howard Carpenter three days before operation, with symptoms of acute obstruction, and he advised it being sent to hospital but the parents refused. The next morning the child seemed perfectly well, the bowels moved normally and continued to do so for 48 hours, then the previous symptoms suddenly recurred and the child was brought to the hospital. At the operation the intussusception was very easily overcome, with the slightest traction the bowel was restored, and it was then sutured to the parietal peritoneum.

THE FREQUENCY AND SIGNIFICANCE OF INJURIES TO THE ACROMION PROCESS.

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RECENT studies of the etiology and pathological anatomy of certain injuries to the shoulder-joint have done much to make clear the causes of severe symptoms often found when gross lesions of the tissues are not demonstrable by examination. Such facts, however important, should not make us lose sight of that great class of cases in which some lesion to the bony structures of and about the joint may be shown, by X-ray if in no other manner.

The work of Ross and Stewart has called attention to the importance of sprain fractures in the causation of severe symptoms and has made it plain that the extent of a bony lesion by no means determines its immediate symptoms or sequelæ.

In acromial injuries we find a group of conditions often apparently trifling which, nevertheless, are of importance both as to the symptomatology of the lesion itself and because of the significance which a lesion may have in indicating the occurrence of other injuries.

Fracture of the acromion is a very common injury. An examination of the records of the German Hospital for eight years, from 1905 to 1912 inclusive, resulted in finding 89 cases of acromial fracture.

When there is a fracture of the acromion it is one of three classes: (1) A well-marked fracture of a considerable portion of the process; (2) a separation at the epiphyseal line; (3) a sprain fracture.

Of the cases mentioned it was impossible to determine definitely to which class the fractures belonged, except in those

occurring during 1911 and 1912. Of the 40 cases demonstrated by X-ray in 1911 and 1912, 8 were fractures of a considerable portion of the process, 1 was an epiphyseal separation or separation at the epiphyseal line, 25 were sprain fractures, 6 could not be traced.

It is at once evident that fractures including a considerable portion of the process are few compared with the sprain fractures.

It must be apparent also that such fractures present no features as to diagnosis, etc., in any way differing from fractures in general. A typical example is shown in Fig. 1.

The separations at the epiphyseal line are, as far as causation and symptomatology go, merely a subdivision of the fractures of the first class (see Fig. 2).

The sprain fractures furnish the most numerous and in many ways the most interesting subdivision. True sprain fractures, by tearing due to ligamentous pull, are found in three locations: (1) most often at or above the acromio-clavicular junction; (2) at the insertion of the coraco-acromial ligament; (3) the upper surface of the acromion—usually the location of the smallest of the sprain fractures.

These sprain fractures have been noted in the order of frequency of their occurrence. Some of them are quite easily evident on the X-ray plates; others again are most minute. In several instances in which a sprain fracture was noted the diagnosis according to the X-ray plate seemed to me to be doubtful indeed. But a very minute sprain fracture cannot be demonstrated by X-ray, certainly not when only a few hardly perceptible fragments of the bone are pulled loose. It is beyond question that in the majority of instances the diagnosis was based upon substantial grounds.

The fourth variety of sprain fracture or at least fracture of a very small portion of the acromial tip are due very evidently to a force exerted directly either (*a*) by the pressure of the humerus from below, or (*b*) by direct violence to the acromion process.

Some of them in extent and appearance are such that I find them in my records noted as "bruises of the tip of the acromion."

Of the total of 89 cases of fracture of the acromion, 18 were found with other lesions also demonstrable by X-ray. These were 3 instances of associated injury to the clavicle at its acromial end, 3 instances of fracture of the acromion with luxation of the acromial end of the clavicle, 3 instances of old luxation of the humerus, 2 instances of subluxation of the humerus, 1 instance of fracture of the greater tuberosity of the humerus, 1 instance of luxation of the head of the humerus and of the clavicle, 1 instance of luxation of the humerus with fracture of the clavicle, 1 instance of fracture of the head of the humerus with luxation of the clavicle, 1 instance of fracture of the "upper end" of the humerus, 1 instance of comminuted fracture of the surgical neck of the humerus, 1 instance of fracture of the coracoid process and of the head of the radius.

It will be seen at once that these injuries associated with acromial fractures, sprain fractures or otherwise, group themselves into two great classes.

1. Conditions affecting the acromio-clavicular junction.

2. Associated injuries indicating a violent trauma involving the upper end of the humerus and producing either a luxation of the humerus or a fracture.

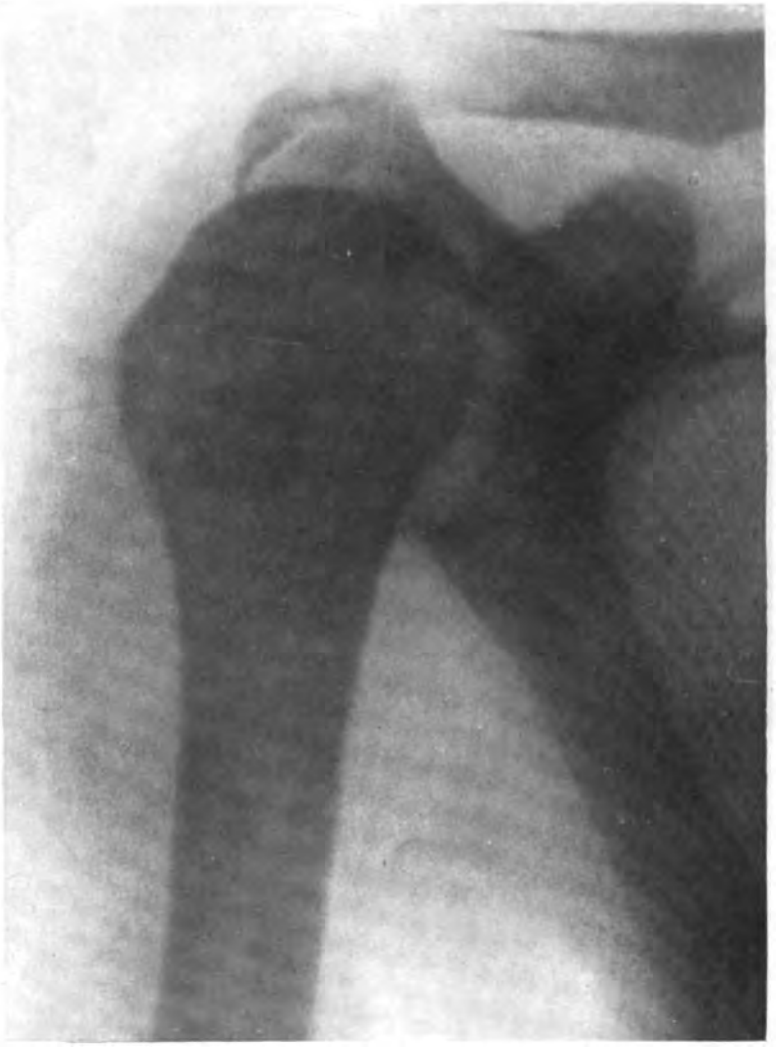
Since sprain fractures of the acromion are by far more common than any other form of fracture of this part, and since most of the sprain fractures involve the acromion at the acromio-clavicular junction, it is not surprising that at times there should be a similar lesion of the acromial end of the clavicle. And, luxation so-called of the acromio-clavicular articulation, as shown by the X-ray, is but one step further in an acromio-clavicular disjunction. I have never seen such an occurrence in which this separation, accompanying merely a sprain fracture of the acromion, was clinically demonstrable.

Those cases of injury to the acromion in which we have, as in the old or unreduced luxations of the head of the humerus or the fractures of the humerus, evidence of great force ex-

FIG. 1.

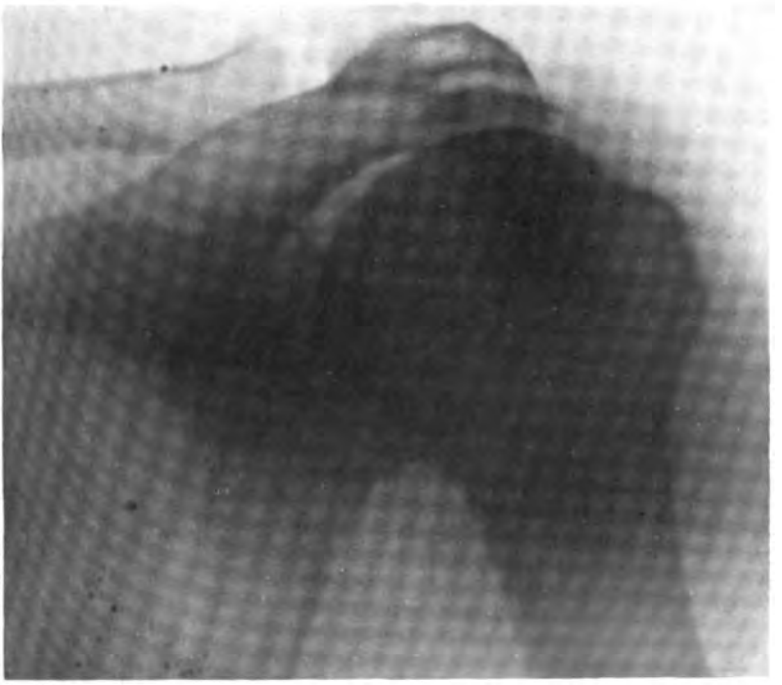
Fracture involving whole acromion process.

FIG. 2.



Injury to epiphyseal line of acromion with sprain fracture of upper surface of acromion.

FIG. 3.



"Chipping" of outer and lower portion of acromion process by force exerted through the humerus.

erted upon the upper extremity of the humerus are of great interest because they furnish us probably with an explanation of the severe symptoms often accompanying what seem to be very insignificant acromial injuries.

Before considering these conditions we must take into account the method of causation of acromial injuries.

In all but a few instances in which there is some history of the injury, to be correct, in 8 of the total number of 89, a fall is given as the cause of the acromial lesion. In a considerable proportion of the cases the history stated that a "fall on the shoulder" took place. I believe that these histories are generally incorrect. Codman, who is in this supported by Thomas, has drawn attention to the unreliability of such statements as to shoulder injuries. It is no easy matter to fall in such a way that the first impact is upon the tip of the shoulder.

The only other explanation possible is that, where the acromial injury is not a direct one, it is caused by a force transmitted or applied by the humerus. The possibility of this I have seen mentioned by Dr. G. G. Davis. It is the frequency of this sequence of events that I wish to emphasize. Now since in a fall the arm is practically always thrown away from the body—abducted—we find that the force is applied to the acromion by the greater tuberosity of the humerus, the shaft of the humerus acting as the long end of the lever. It may be possible for a direct upward push on the humerus to do the same thing, the scapula being fixed. One of the series of cases I studied sustained the acromial injury while cranking an automobile and this may be such a case.

The force applied to the acromion may then (*a*) clip its outer end (as Fig. 3), (*b*) "spring" the acromio-clavicular junction, or (*c*) put too much strain upon the coraco-acromial ligament.

In any of these conditions, the acromial fracture or sprain fracture results.

It is evident, therefore, that a minor degree of acromial injury may be the net result in damage to the bony structure of considerable violence.

The association of acromial fracture with luxation of the head of the humerus gives rise to several questions of importance. I was very much interested in Dr. Thomas' explanation and demonstration of acromial injuries associated with the birth palsies of children, which he has found to be the result not of nerve lesions but of injury to the bony and ligamentous structures of the shoulder.

The fact that we occasionally find injuries to the acromion with luxations at the shoulder leads us to consider two possibilities: (1) That many cases of acromial injury are associated with luxations of the shoulder which become spontaneously reduced; (2) that the giving way of the acromion or of the structures attached to it accompanies trauma not quite sufficient to cause complete luxation, yet sufficient to injure the capsule of the joint and thus produce subsequent symptoms.

The spontaneous reduction of a shoulder luxation is beyond a doubt possible but in the majority of instances of acromial injury the examination fails to reveal evidences that actual luxation has occurred. We are thus thrown back upon the second possibility. It seems to me most likely that the application of a force in abducting the shoulder sufficient to produce a fracture of the acromion must be such as to produce an accompanying injury to the contiguous soft parts.

The symptomatology of acromial injuries, even of the sprain fractures apparently most insignificant, bears us out in this view.

A certain proportion of these cases show immediately after injury only the two symptoms referable directly to the acromial condition, *i.e.*, localized tenderness over the acromion at the seat of injury and pain on abduction. After the lapse of three or four weeks these cases recover, occasionally, however, requiring active massage and passive motion for an equal length of time before recovering full function. Most cases of such injury, however, run a more severe and protracted course. Tenderness over the acromion is persistent and pain here and throughout the shoulder is complained of. Abduction is limited and in at least two cases that have come to my notice but which

I was not able to examine, an apparently permanent disability of the shoulder resulted.

It must be evident that while a fracture or sprain fracture of the acromion should and does cause localized tenderness and pain, and pain upon abduction, these symptoms should cease with proper treatment, at a time when bony or fibrous union has taken place. The persistance of symptoms points to the existence of a concomitant shoulder condition. There has been much said concerning subacromial bursitis as causing stiff and painful shoulders. I have never seen any case in which I could make this diagnosis.

We must then consider the accompanying lesion as being, as has before been stated, a luxation of the head of the humerus, spontaneously reduced, or an injury just short of producing luxation but with similar injury to the joint capsule.

In the clinic at the German Hospital we have been fortunate in avoiding bad end results in cases showing fracture of the acromion, because we treat every case, however slight, of injury to the acromion by rest for three weeks, with early massage and later, if necessary, by vigorous active and passive motion.

In conclusion, then, I believe we may safely state:

1. That injuries to the acromion process are not infrequent.

2. That they are important not only because the injuries themselves cause more or less pain and discomfort, but especially because practically all acromial injuries are caused by indirect force applied by the humerus acting as a lever and therefore an injury of this kind to the acromion is evidence that there has been either luxation spontaneously reduced or, as is more often the case, a lesion nearly approaching luxation with a corresponding injury to the joint structures.

I am indebted to Drs. G. G. Ross and A. D. Whiting, my chiefs in the German Hospital Out-Patient Department, for permission to report these cases and to Dr. A. G. Miller, the radiographer of that institution, for his kindness in furnishing the plates I have brought and his many demonstrations on this subject to me, and to the Fellows of the Academy for the opportunity to present this paper.

DR. T. TURNER THOMAS said that if there is one thing about injuries to the shoulder that he would be glad to aid in establishing it is the importance of hyperabduction. It is to the shoulder what the twist of the foot is to the ankle. The great mass of injuries in the ankle region are due in the main to the turning of the foot inward or outward. That is not so obvious in connection with hyperabduction of the shoulder because the limb practically never remains in the position to which it is forced because gravity draws it down again.

If the arm is carried into abduction it is resisted first by the capsule, that is the capsule offers the inelastic resistance and gives way first because it is to the skeleton at the shoulder what the bone is to the skeleton between the joints. In adults it is weaker than the bones, in children it is stronger, as shown by the relative frequency of dislocations of the shoulder and fractures of the clavicle in adults and children. When the arm goes into abduction the capsule binds and turns the scapula outward; it reaches a point where it cannot go further and when abduction is carried beyond that point something breaks and it is the capsule in the great majority of cases. When it tears it constitutes a break in the skeleton at the joint which means either a sprain or a dislocation, the sprain being a tear or break in the skeleton at the joint without displacement, and dislocation with displacement. In most cases the capsule tears. It is after the capsule tears that this contact takes place, that is the leverage and fulcrum effect from the contact of the humerus with the acromion, and it is right there occurs the crucial movement in these injuries to the shoulder region.

Hyperabduction is responsible not only for dislocations of the shoulder, but perhaps also for other conditions such as fracture of the surgical neck or a break in the lever at the fulcrum, fracture of the acromion, or a break in the fulcrum, and the upward dislocation of the outer end of the clavicle, the articuluting surface of which favors the forcing inward, by the lever, of the acromion under the clavicle. Nothing is more difficult to prove than the actual mechanism of injuries to the skeleton.

MODERN LABORATORY METHODS IN THE DIAGNOSIS OF SURGICAL DISEASES OF THE GENITO-URINARY TRACT.

BY A. THEODORE GAILLARD, M.D.,

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THE universal tendency in modern medicine is to rely more and more upon the assistance afforded by the laboratory in the prophylaxis, diagnosis, and treatment of disease, and of all the specialties surgery is perhaps the one most in need of this aid.

In those diseases of the genito-urinary tract either distinctly surgical at the beginning, or ultimately demanding such interference, much may be learned by the clinician from the microscopist. Every surgeon when confronted with a difficult case naturally welcomes every suggestion that will aid him in arriving at a diagnosis, and the purpose of this paper is to call attention to methods that are of distinct value if pursued with persistent care and careful attention to detail. The various pathological and bacteriological tests long ago accepted as conclusive, and concerning which there is no dispute, will not be referred to, but I wish to emphasize as strongly as possible the value of a properly conducted microscopical examination of the urine. In nearly every disease of the genito-urinary tract the urine offers to the trained eye more diagnostic information than can be learned by any single manifestation or any group of subjective symptoms. Carrying with it as it does unmistakable evidences of the source, severity, character, and comparative duration of the inflammation, there remains only the necessary time and care in its examination to yield definite and conclusive results. That a trust-worthy diagnosis may be made without previous knowledge of the age, sex, or clinical history of the patient is undoubtedly true, but ordinarily it is safer not to be too positive in the interpretation of the findings without some understanding of the symptoms exhibited. Only

the modest and conservative claim is made that the methods to be described will invariably result in confirming a diagnosis already made, or in giving valuable aid to clear up a case presenting many elements of doubt.

Accompanying every inflammatory condition of the genito-urinary tract are varying numbers of pus-corpuscles and red blood-cells, and always to be seen with them are epithelia of various shapes and sizes, desquamated as the result of the inflammation and which never appear in normal urine. Upon the ability to differentiate these epithelia and to say with certainty from what part of the genito-urinary tract most of them are derived the location of the inflammatory disturbance is dependent. It is not proposed to enter into a long discussion as to the views of various authors on this disputed point. It is enough to say that the claims of Louis Heitzmann in his book on "Urinary Analysis and Diagnosis" are enthusiastically accepted by many specialists, and that these claims cannot successfully be refuted by those who offer only a refusal to acknowledge them, unaccompanied by scientific argument to sustain their opinion. Heitzmann's views are extensively quoted by most modern authors, and will be, must be, eventually concurred in by all.

By a long series of experiments, covering many thousands of cases, it has been found that epithelia of a certain shape and size appear in the urine at the inception and during the progress of certain inflammatory conditions. Careful study of the urinary sediment in cases where the clinical symptoms admitted of no doubt as to the diagnosis, led to the belief that the epithelia always found in the given disease were directly derived from the organ affected. Following these observations to their natural and logical conclusion it has been demonstrated that certain epithelia appear in certain inflammations and are never seen in normal urine. On such an argument the differentiation of urinary epithelia is based, and it should be as convincing and as susceptible of proof as the diagnosis of the clinician in a case of pneumonia, where long observation of the symptoms manifested allow of no hesitancy in the verdict.

At this point it should be understood that the claim is not made to label by a specific name every single epithelium appearing in the urine, but any inflammation of sufficient intensity to produce clinical evidences will result in the desquamation of a number large enough to warrant positive opinion as to their source. Many cases naturally present the difficulty of multiple involvement, necessitating careful study, but the embarrassment, if temporary, is never unsurmountable, the comparative number of the various epithelia present offering a sure guide as to the organ most affected.

It is hardly necessary to state that of all the epithelia found in urine those derived from the kidney are of the greatest practical significance, and fortunately at the present time there exists no difference of opinion as to the certainty with which they may be recognized. Many authors persistently refused even this concession until the study of specimens obtained by ureteral catheterization proved conclusively that these epithelia, always of a definite shape and size, appear in all diseases of the kidney. From the convoluted tubules the shape is round or oval, and in size one-third larger in diameter than the pus-corpuscle. Of about the same size, only columnar in shape, are those derived from the straight collecting tubules, and their presence in moderate or large numbers is usually indicative of a severe inflammation.

By reason of their importance, and for convenience of description, surgical diseases of the kidneys will be considered first, and perhaps one of the commonest is calculus. According to Keyes calculus in the kidney or its pelvis is the most frequent cause of renal suppuration, but I cannot agree with this author when he adds that "catarrhal inflammation is not encountered with calculus." As is well known to the clinician the symptoms vary greatly—all the way from an almost complete absence of subjective signs to a combination of intense renal colic, pressure and reflex pains, hæmaturia, and finally, suppuration and abscess.

The importance of careful X-ray study must be given great emphasis, and of course a positive shadow offers reliable in-

formation as to the presence and location of the stone, but as about 75 per cent. of all calculi are composed of uric acid the findings are frequently negative or doubtful. Examination of the urine in these cases will often clear up the diagnosis, and the microscopical picture will vary with the extent and duration of the inflammation. Some observers lay great stress upon the presence of a moderate or large number of red blood-cells in the urine, but if the source of the trouble is to be positively determined they must be accompanied by characteristic epithelia from the kidney, and ureter. Crystals of uric acid gravel in large numbers, particularly the rarer forms of stellate and needle-like concretions, together with renal epithelia, pus-corpuscles, and red blood-cells, offer, if not positive evidence, at least a strong possibility of the presence of a stone.

Suppurative pyelitis caused by calculus in the pelvis of the kidney, may be diagnosed by the above features, accompanied by a large number of pus-corpuscles and the presence of a preponderating number of epithelia from the pelvis of the kidney and the ureter. The former (pelvic epithelia) are characterized by round, oval, or lenticular shapes, are much larger than those derived from the kidney, while smaller than those of bladder origin; and the latter (ureteral epithelia) are usually round and twice the diameter of the pus-corpuscles.

Strongly suspicious of calculus in the pelvis or an impacted stone in the ureter is the sudden change from features pointing markedly in that direction to an almost complete absence of the same. This calculous anuria is by no means uncommon, and the features shift from time to time as the urine flow is obstructed or released. I saw this beautifully illustrated not long ago in a case operated upon by a prominent surgeon of this city. I had the privilege of following the case for some time before operative interference was decided upon. Repeated X-ray examinations always produced a shadow on the left side three inches above the bladder, and the ureteral catheter was arrested at that point. The microscopical picture of a possible calculus was not as pronounced as is sometimes depicted in these cases, but my diagnosis of calculus was based

on the fact that the features appeared and disappeared at intervals, two specimens in one day showing totally different findings. The patient was operated upon, extensive incisions being made, the bladder opened, and no stone found. Three weeks later he had another attack of renal colic, returned to the hospital and acted as his own surgeon by passing a stone so large that meatotomy was necessary for its final delivery.

Another important factor in the diagnosis of renal calculus is the appearance of the epithelia when the pressure of a foreign body exerts itself, or hypertrophy of the organ affected is co-existent with other symptoms of inflammation. This pressure results in the production of so-called endogenous new formations or inflammatory corpuscles within the epithelia, and these formations are never present in large amount except in pressure of some kind.

Pyonephrosis of tubercular origin offers in the urine both macroscopic and microscopic points of diagnostic value. The urine is usually heavily turbid, and if allowed to stand the pus separates itself into a thick creamy layer at the bottom of the glass, the supernatant fluid being clear. This is in marked contrast to the persistently turbid appearance of urine voided in ulcerative cystitis, or the residual urine in a case of prostatic hypertrophy where the bacteria of decomposition will not allow of such a separation.

At first glance it would seem that the clinician should not long remain in doubt over a suspected case of renal tuberculosis, but there are many where the family and personal history, and the objective and subjective symptoms offer little or no help. Particularly difficult is the diagnosis between renal tuberculosis and an ascending colon bacillus infection. Often the only prominent feature is pyuria, and the laboratory is invoked to ascertain the cause. Search for the tubercle bacillus, while so often unproductive, often fails because the proper technic is not observed. The urinary sediment should be as concentrated as possible, obtained first by sedimentation, then by the added power of the centrifuge, and many slides should be examined before the search is abandoned and the findings de-

clared negative. The next procedure is usually the inoculation of a guinea pig, this of course frequently making the diagnosis positive, but even before these methods are indicated by the gravity of the case, microscopical examination of the urine will often yield valuable information, at least in pointing the finger of suspicion toward a possible tubercular process. Tubular casts are sometimes present, though not often, the chief features being a large number of pus-corpuscles, few red blood-cells, connective-tissue shreds, fat globules free in the field and studding the epithelia, and epithelia from the convoluted tubules, straight collecting tubules, and pelvis of the kidney.

A clue of great value is supplied by the appearance of the pus-corpuscles, which in a tubercular infection indicate with unfailing accuracy an impaired constitution. This diagnostic point was first announced and demonstrated by Carl Heitzmann and one has only to study a sufficient number of cases to be convinced of its soundness and practical value. Pus-corpuscles indicative of a good constitution appear in freshly voided urine as coarsely-granular, rather highly-refractive cells with no visible nucleus. As the constitution becomes impaired the granulation appears finer, the refraction diminishes, until finally the regular contour is lost, the edges are ragged, and one or more nuclei come into view. A combination in a given case of two or more of the varieties described, for example, a number of coarsely-granular, highly-refractive corpuscles in company with others of pale, finely-granular, irregularly-shaped, nucleated appearance would indicate an originally good constitution now impaired by disease. Because I have touched upon this point while discussing tuberculosis it must not be understood that its diagnostic value is applicable only to this disease. The same information is at our disposal in any inflammation of the genito-urinary tract of sufficient severity to produce pus-corpuscles in numbers large enough for comparative study.

Before leaving the subject of renal tuberculosis I wish to refer with great emphasis to the extreme importance of obtaining by the ureteral catheter specimens from both kidneys so

that both may be studied before surgical relief is attempted. The reasons are obvious, (1) to avoid the catastrophe of removing one kidney in the congenital absence of the other; (2) to ascertain positively whether the disease is unilateral or bilateral; (3) to estimate through the chemical and microscopical findings the degree of functional activity exhibited by one or both kidneys.

Estimation of the renal function has been attempted by means of chemical tests over and over again, each new process attracting for a time more or less enthusiastic attention, but one after the other all have been discarded as practically valueless. Cryoscopy, always cumbersome in the technic, has been proven entirely worthless, as in many cases where one kidney known to be badly diseased and the other performing the functions of both, it has been shown that the freezing-point varied little or not at all. Much was expected of the numerous forced elimination tests with urea, sodium chloride, water, and the dye-stuffs, but the consensus of opinion now is that they are of no value in estimating the functional activity of the kidneys. The injection of phloridzin, setting up an artificial diabetes, with the appearance of sugar in the urine in about one-half to one hour in normal kidneys, and its failure of elimination in nephritis indicates only that the renal function is somewhat disturbed, and the results are never uniform. More promising in its accuracy than any other is the phenolsulphonepthalein test, recently devised by Rowntree and Geraghty, but it can hardly be carried out by the general practitioner, and even in the laboratory involves the employment of much time and work to obtain results more easily arrived at in other ways. These tests have been briefly referred to only to be condemned, for it is difficult to understand why time should be wasted on them when microscopical examination affords such positive proof of all that we desire to know regarding renal sufficiency or insufficiency. As already stated the urine from each kidney must be collected by the ureteral catheter, simultaneously and for the same period of time. Chemical and microscopical examination of the two specimens

will indicate conclusively the extent and location of the disease, and the constitution of the patient being determined at the same time by a study of the pus-corpuscles, the surgeon has at his disposal all the information necessary to a prompt decision as to the advisability or contra-indication of operation.

Malignant disease of the kidneys may often be diagnosed by microscopical examination of the urine, and aids the surgeon considerably when the clinical symptoms are either vague, or confused by the severity of some co-existent infection.

Sarcoma may occur at any age, and at its inception, before the ulcerative process is established, is difficult of diagnosis. To admit of a positive opinion there must be present in the urine large masses or shreds of connective-tissue and the characteristic sarcoma corpuscles in large numbers. Connective-tissue in the urine does not receive the attention it deserves, probably because it is so often confounded with mucus or extraneous matters such as cotton and linen fibres. It consists of wavy, moderately-refractive fibres, having a tendency to form into bundles, and is found in ulcerative, suppurative, hemorrhagic, and traumatic inflammations. Especially marked in ulcerative processes of malignant origin, these shreds, filling as they sometimes do an entire field, and studded as they occasionally are with inflammatory corpuscles, are enough of themselves to warrant a diagnosis of malignant tumor. In combination with sarcoma corpuscles, which present the appearance of small, round, highly-refractive, even glistening cells, without nuclei, larger than red blood-corpuscles and smaller than pus-corpuscles, the diagnosis of sarcoma is positive.

Cancer of the kidney is difficult of diagnosis from the urinary findings alone, but when large masses of connective-tissue, filled with large multi-nucleated epithelia are seen, accompanied as sometimes occurs by typical cancer nests, the suspicion of cancer is usually confirmed by the ultimate clinical history of the case.

Surgical diseases of the bladder due to tumor are not susceptible of positive diagnosis until the ulcerative process has begun, but when desquamative shreds of the tumor are voided

in the urine no difficulty should be experienced. What has been said of sarcoma and cancer of the kidney applies equally to similar growths in the bladder. Hæmaturia is one of the first and most prominent symptoms, and even before the disease has advanced to the stage where connective-tissue shreds, sarcoma and cancer corpuscles, and evidences of a chronic inflammatory process contribute to a positive conclusion the characteristic bladder epithelia are always present. With the exception of those from the vagina, bladder epithelia are the largest seen in urine. From the upper layer, a few of which appear in normal urine, the shape is the familiar pavement or squamous form. This changes to a spherical or oval contour (from the middle layer) when the inflammation becomes more intense, and the columnar variety (from the deepest layer) is the product of deep-seated infection or ulceration. In diseases of the bladder, as of the kidney, prostate, or any other part of the genito-urinary tract, the location of the inflammation and the ultimate diagnosis are absolutely dependent upon the differentiation of the epithelia always accompanying the other features in the case.

Papilloma of the bladder should especially be mentioned, because of its comparative frequency, and the striking microscopical evidences in the urine when this benign tumor is present. Hemorrhage, of course, is a prominent symptom, sometimes so profuse as to obscure more or less the other features, but rarely absent are the peculiarly-shaped connective-tissue shreds, once seen never forgotten, and of themselves almost pathognomonic. These shreds are very long, very irregular, having a tendency to coil or knob-like formations, and frequently contain fat globules or inflammatory corpuscles. With these features are pus-corpuscles and epithelia from the various layers of the bladder, particularly the columnar, many of them containing fat globules and the endogenous new formations indicative of pressure.

Intimately associated with the bladder is the prostate gland, and diseases of this organ requiring surgical interference are common enough, and the diagnosis at times sufficiently obscure

to demand whatever assistance the laboratory affords. Acute and chronic prostatitis, usually gonorrhœal in origin, seldom necessitates actual surgical aid, but abscess formation is of frequent occurrence and often goes unrecognized until rupture occurs. The diagnosis of such a condition is dependent upon the presence in the urine of a large number of pus-corpuscles, sometimes entirely filling the field, connective-tissue shreds, red blood-corpuscles, and epithelia from the prostate gland and its duct. These epithelia are about twice the size of pus-corpuscles, larger than those from the convoluted tubules of the kidney, and cannot be differentiated from those of ureteral origin, which are of the same shape and size. In prostatic abscess, however, the bladder and urethra are also involved, and the presence of epithelia characteristic of these organs will easily locate the inflammation, as in renal disease epithelia from the convoluted and straight collecting tubules and pelvis of the kidney enable us to eliminate the prostate as entering into the situation. The diagnosis of the majority of prostatic inflammations is rendered more simple by the presence in many cases of epithelia from the seminal vesicles and ejaculatory duct, but their surgical importance being negligible detailed description of them is omitted.

The urine in prostatic hypertrophy, especially of the senile type, presents another opportunity for positive diagnosis, oftentimes extremely valuable in hypertrophy of the so-called median lobe which has escaped the touch of the surgeon's examining finger. When the condition has reached the stage where urinary flow is obstructed and residual urine is always present, the bacteria of decomposition, of course, point strongly toward the prostate as being responsible. The epithelia from the prostate in such a case are always more or less filled with fat globules indicating chronicity, and endogenous new formations due to pressure of the enlarged gland. Epithelia from the neck of the bladder and those from the deeper layers of the bladder itself are always present, as there is naturally an accompanying secondary cystitis.

It follows logically that this bacterial invasion and infection of the bladder cannot be long continued without an extension of the process through the ureters into the kidneys, and many cases of pyelonephritis are of such origin. This possibility, at times a dangerous complication of prostatic hypertrophy, necessitates careful study of the urine before operation is advised or attempted. Too many of these cases die shortly after operation, the mortality being ascribed to any but the real cause, *i.e.*, functional insufficiency of the kidneys. There should be no difficulty in making the diagnosis, and at the same time the surgeon is accurately informed as to the resistance apt to be exhibited by the patient.

The prostate is at times the seat of malignant disease, and such a diagnosis is made in the same manner as previously described when the kidney or the bladder becomes the host of this unwelcome visitor.

Stricture of the urethra presents a typical urinary picture, but is of no practical importance, as the clinical symptoms are clear, and routine examination by the surgeon leaves no doubt as to the diagnosis.

In conclusion I must ask your indulgence for the necessarily rough outline of the subject presented. Its importance is vital enough to deserve better and more detailed treatment, but I hope I have sufficiently accentuated the need of employing every modern laboratory test in the diagnosis of surgical diseases of genito-urinary origin, and the absolute necessity of determining before operation the functional power of the kidneys by microscopical examination of the urine.

DR. B. A. THOMAS said that he was not as enthusiastic as Dr. Gaillard over the value of the microscope in diagnosis of diseases of the genito-urinary tract, although giving it due credit for its great worth. Other procedures can aid in the diagnosis, and many of them are of more value than is the microscope alone. Dr. Gaillard said the radiogram left in doubt about 75 per cent. of diagnoses of calculus of the kidney, and that 50 to 75 per cent. are due to uric acid. It had been his experience that radiography will definitely determine renal or ureteral calculi, if present, in

at least 95 per cent. of cases, and we have never yet, with the best radiogram obtainable, found it impossible to make a correct diagnosis of stone in the kidney or ureter. In the case of a very soft urate, assuredly, the skiagram might not show the lesion. In his opinion the skiagram is the measure of greatest value in diagnosis of calculus of the kidney or ureter. Moreover, he could not see that urinalysis alone will diagnose the lesion so far as calculus is concerned, whether of the kidney parenchyma or of the pelvis or ureter when judged from the cytology; it may suffice to locate the inflammatory site, but does not specify that the real lesion is calculus. The cystoscope cannot be superseded by cytological examination in the diagnosis of many of these conditions, particularly in lesions of the bladder, where it is better for the patient to make a definite diagnosis by the cystoscope than to subject him to the lengthy process and uncertainty of repeated urinary examinations. Then again with all due respect to cytology of the urine, it is impossible except by making serial sections of certain tumors of the bladder to tell whether the condition is benign or malignant, because true malignancy may depend upon the disintegration of the base of the tumor, that is, whether or not the basement membrane has been broken through and the underlying tissues infiltrated by the proliferating epithelial degeneration.

STATED MEETING, HELD DECEMBER 1, 1913.

DR. GWILYM G. DAVIS, the President, in the Chair.

ARTHROPLASTY.

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IT may be laid down as axiomatic that, where there are many cures for an evil or various remedies for a disease none is entirely satisfactory. Many standard operations, so to speak, are well nigh perfected, but a special method of operation for the relief of ankylosed joints has not been universally agreed upon. Failures as well as good results in such cases should be reported, as by such a course alone will we be able to reach a sound conclusion. Various methods have been used in attempting to mobilize ankylosed joints, and it is interesting to note the development of the operation.

In 1826, J. Rhea Barton[1] of this city performed an osteotomy for an angular true ankylosis of the hip-joint. He divided the bone through the great trochanter and a part of the neck of the femur; then prevented bony union by movements. In 1830, Rodgers[2] of New York modified Barton's operation by removing a disc of bone from between the trochanters, and in 1840, Carnochan[3] attempted to prevent bony union after he had accidentally fractured the maxilla while operating for ankylosis. He interposed a piece of wood between the bony surface. In 1860, Verneuil[4] interposed a piece of temporal muscle and fascia between the condyle and the glenoid in a case of ankylosis of the jaw. Twenty years ago, Helferich[5] performed a similar operation on a child one year old; and after resecting the condyle of the inferior maxilla inserted a flap from the temporal muscle between the articulating bones. Since that time, this operation has undergone various modifications. In 1895, Mikulicz[6] used practically Helferich's procedure but employed a flap from the masseter instead of from the temporal. In 1901, Cramer[7] operated upon ten cases of ankylosis of the patella by the interposition of a piece of vastus internus; of these ten cases six were successful. Orlow[8] in the same year attempted the use of metal plates and gold foil as the intermediate body and this procedure was followed by the use of other non-absorbable materials such as plates of celluloid, zinc, silver, cambric, collodion and rubber.

With these agents an occasional good result was obtained, but in the great majority of cases a few months after operation the foreign material was extruded from the joint and ankylosis returned.

In 1907, Weglowski[9] transplanted with success the cartilage of a rib in a case of ankylosis of the elbow. Chulmsky,[10] in 1902, tried to use decalcified bone, magnesium and ivory but they all became absorbed and ankylosis returned. He deduced, however, that as false joints or pseudarthroses in ununited fracture of long bones were formed of aponeurosis and fatty tissue, the same tissues could be used in the formation of a new joint in a case of ankylosis. In the same year Nélaton[11] operated upon two cases of ankylosis of the hip-joint by interposing a strip of fascia lata between the head of the femur and the acetabulum. In 1905, Murphy[12] reported twelve cases in which he interposed fascia and muscle covered with a layer of adipose tissue to produce, to quote him, "Normal movable joints with capsules and collagen intra-articular fluid." By this method hygroma-bursa formation is sought. The formation of hygroma being "the result of a degenerative or absorptive process in fatty tissues with hyperplasia of the connective tissue element, the segmentation of the collagen into solution, 'fibrinoid', a liquefaction of hypertrophied connective tissue." His first operation of this character was performed in 1901. In 1909, Baer[13] made a preliminary report on the use of animal membrane in securing mobility in ankylosed joints. He used pig's bladder "which is chromicized so as to remain intact about forty days." The pig's bladder is boiled in cumol. Osgood has reported several successful cases operated upon by this method. Baer also used Cargile membrane or the peritoneum of an ox, as the interposing agent but found that it was absorbed in a period of ten to fifteen days and therefore not useful. This method of using animal membrane had been attempted before by Foderl, who, in experimenting on animals, interposed between the bones pieces of bladder and also the wall of ovarian cysts.

This is but a partial list of those who have contributed to the development of the operation.

When should operation be performed in a case of ankylosis?

For practical purposes ankyloses may be divided into two main divisions: the false, periarticular or extra-articular, and the true, articular or intra-articular. Murphy sub-divides the periarticular into capsular and extracapsular; and the articular into synovial, fibrous, cartilaginous and osseous.

The main treatment should, of course, be preventive, that is, one should attempt to guard against ankylosis of a joint

which has been the site of an infectious or traumatic arthritis. There are exceptions, however, even to this rule, as in tuberculous affections of joints ankylosis is often most desirable. In such cases or in cases where ankylosis is inevitable the aim should be to obtain a position which will render the part most useful. Baking, massage, passive movements, brisement forcé with an anæsthetic, tenotomy, myotomy, tendoplasty or myoplasty, excision of tendon sheaths, or cicatrices, are all methods employed in relief of periarticular, extra-articular, or false ankylosis.

Should some form of open operation be attempted in intra-articular ankylosis? This naturally must depend upon the cause of the ankylosis, the joint affected and the present usefulness of the part. One hesitates to open a joint which has been the site of a tuberculous infection, because, although the infection may apparently be dormant, operation and the subsequent passive movements may cause the infection to take on renewed activity. Many such cases have, however, been successfully operated upon, among which is the case to be shown to-night. The X-ray is of course valuable, but not absolutely final, in showing if the infection is still active. Hesitancy is unnecessary if the ankylosis is due to trauma such as fracture or to infections such as rheumatism, gonorrhœa, etc.

The mandibular joint offers the best field for operation. First, because of the favorable prognosis, second, because of the immense importance to the individual of mobility in this joint. Fortunately ankylosis of this joint, which follows severe forms of stomatitis and noma, is usually extra-articular and mobility can be usually obtained by relieving the periarticular cicatrices. When ankylosis is intra-articular arthroplasty can be performed and either a flap from the temporal or masseter muscle or chromic pig's bladder can be used for the formation of a new joint. The latter has been successfully used by Brackett.[14]

From the reports of cases in literature it would seem that the future use of these interposing tissues may depend upon the joint involved. It would seem possible that the Murphy operation will continue to be used in the knee-joint and in the hip-

joint. In these joints, which are joints of locomotion, and which carry the weight of the body, hygroma formation is necessary or at least desirable and Murphy's operation leads to a hygroma or formation of a new bursa. On the other hand, in the elbow, shoulder and the mandible a wide range of mobility is desired; there is no weight born by the joint and it would therefore seem that the formation of hygroma is not essential; therefore, the use of Baer's membrane is the preferable material for interposition. The technic of the interposition of this membrane is considerably easier than the technic of the Murphy operation.

In the hip-joint any position of ankylosis must be not only an inconvenience but an actual interference with one's ability to earn a livelihood. It should, therefore, offer a good field for arthroplasty. The same may be said of ankylosis of the shoulder.

In ankylosis of the knee and elbow, however, it would seem in the light of our present knowledge and experience that one should not too hastily fly to operation.

Even according to Murphy's own statistics the elbow and the knee offer the poorest prognosis of any joints. Therefore, if a patient has intra-articular ankylosis of a knee-joint, the ankylosis being with the leg in extension, there being no pain and the man or woman being able to perform his or her occupation, it would not seem that arthroplasty should be attempted without a full explanation to the patient of the facts that the operation will be followed by considerable pain, and that, whereas some motion may be obtained, it may be slight and ankylosis may recur.

The same might be said of the elbow. If there is ankylosis of elbow with the forearm at right angles to the arm, and if, in spite of the ankylosis the patient is able to earn a livelihood and the extremity is not painful the pros and cons should be carefully weighed before deciding on operation.

On the other hand, given a knee ankylosed at or near a right angle, or an elbow ankylosed in extension, positions which must of necessity be a great handicap, then it would seem that operation is entirely justifiable. Preferably arthroplasty should be

FIG. 1.

Result of arthroplasty on an ankylosed knee-joint. Flexion after operation.

attempted, for, even if unsuccessful as to mobility, a better position can be obtained for possible subsequent ankylosis.

Illustrative Case.—A boy, now thirteen years old, was admitted to the Orthopædic Hospital on October 11, 1912, in the service of Dr. William J. Taylor. The history was that of a tubercular arthritis of the right knee. Several operations had been performed merely for draining the joint. The condition of the knee was that of ankylosis of tibia, fibula and patella. The knee-joint was ankylosed at an angle of 45 degrees. There was no pain; no inflammation; no fever; all sinuses were healed.

Operation was performed by Dr. Taylor, November 8, 1912. A U-shaped flap was made with convexity downward. The skin flap was turned upward. The patella was sawn obliquely from above downward, and the joint was opened. All adhesions between the tibia and femur were freely liberated, the surface of the tibia and surfaces of the condyles cleaned of fibrous tissue and the capsule was cut away. By means of curved and straight chisels new and fresh surfaces were made. Sufficient bone must be chiselled away to allow for the interposing flaps and yet too much bone must not be removed for fear of obtaining a movable but weak joint.

Murphy has pointed out the necessity of keeping the intercondyloid ridge on the tibia intact to prevent lateral slipping of the femur.

The two interposing flaps were then cut; one from the external side, the other from the internal. They were interposed between the bones and sutured with No. 3 chromic gut. Because of the inability to get a good surface on the under aspect of the patella, it was turned over so that the normal anterior aspect became the posterior aspect. The wound was closed without drainage and the limb placed in a plaster case. This case was not removed for four weeks and no passive nor active movements were made until that time.

He was discharged from the hospital ten weeks after admission. He wore a supporting brace steadily for 6 months, then intermittently until end of a year.

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DR. WILLIAM J. TAYLOR said that in this case there had been suppuration, the patella was worm-eaten on the under surface, and fixed to the articulating surface of the femur, so that in order to get movement it was necessary to turn it upside-down. Flaps of fascia and fat were made, taking them from above, bringing them down between the articulating surfaces, and as they were not quite long enough to go clear through they were lapped over about one-third and stitched. The boy has a better joint than had been hoped for. The patella was sawed through obliquely in order to get the largest possible surface, and each half turned upside-down, the sawn surfaces twisted in the opposite direction, then brought together again and united by catgut sutures. This made a perfectly good, strong, bony union, with the result that the patella is now perfectly movable.

In this case the condition of the bone was such and the angle was such that it was necessary to take off quite a considerable amount of bone, particularly from the end of the femur, to get the leg straight. It is essential to take off enough of the surfaces to make the apposition between the ends of the two bones comparatively easy.

As to the question of the other joints, some years ago he had a man under his care in whom both elbows were absolutely stiff, due to an infection from his tonsils. He resected his left elbow and gave him a perfectly useful and serviceable arm, so much so that he declined to have the other one operated upon, saying that he could get along with the one. Dr. Taylor had resected the shoulder-joint many times and the results are so satisfactory that this is the operation of choice, rather than arthroplasty.

DR. J. T. RUGH called attention to the method of arthroplasty originated by Dr. R. T. Taylor, of Baltimore, which consists in the shaping of the joint surfaces by the removal of a sufficient amount of bony material to allow free function, and then filling the joint cavity with a preparation of wax which has a rather high melting-point. The joint is then closed and movements are begun at the end of a week or ten days. He had seen some remarkable results in these cases from that procedure. It is comparatively easy of performance, the most difficult part being the removal of the joint surfaces.

DR. ASTLEY P. C. ASHHURST said that it seemed to him that a more important matter than the mere question of technic is the indication for the operation. He regretted very much that Dr. Owen cannot say whether or not this was really a tuberculous case. If he has made a tuberculous knee-joint movable with safety he would be accomplishing a great surgical feat. Dr. Ashhurst was one of those who believe arthroplasty to be contra-indicated in cases of tuberculous ankylosis. It is interesting to recall that Dr. John B. Murphy attempted arthroplasty on an ankylosed hip that was undoubtedly tuberculous, found an unsuspected abscess, and left the man, at last reports, with discharging sinuses.

Dr. Owen spoke with proper caution about the indications for arthroplasty, and though the patient he shows has a good motion (120 to 150 degrees), it would seem that in a child of twelve years supposed to have a tuberculous ankylosis in bad position, it would have been safer on general principles to have taken out a wedge of bone and thus made the knee-joint stiff and straight.

DR. GWILYM G. DAVIS thought that in spite of the successful result in this case the introduction of drainage is decidedly of service as a precautionary measure. On two or three occasions he had not used drainage and had always regretted it; by this he meant drainage for 24 to 48 hours.

Apropos of the tuberculosis question, he operated once on a tuberculous knee, and while he got some motion he did not get as much as he desired and the knee remained painful for a long, long time, and he had been inclined to be conservative since then.

In relation to the elbow-joint it is one of the most satisfactory joints for arthroplasty as well as for resection, and the results from arthroplasty are so far more brilliant than are obtained by resection.

PARALYTIC TOE-DROP. PUTTI'S OPERATION FOR ITS RELIEF.

WITH REPORT OF A CASE AND SLIGHT MODIFICATION OF THE TECHNIC.

BY J. TORRANCE RUGH, M.D.,

OF PHILADELPHIA, PA.

In a survey of the deforming results of anterior poliomyelitis so far as the various joints are concerned, probably the most difficult of mechanical control is the hip-joint and next to it may be placed the ankle-joint, because of the range of movements of the foot when deprived of muscle control. Whether the loss of power be confined to the anterior group of muscles, or to the posterior group, or to both, the resulting deformity presents in many instances, a problem difficult of solution either mechanically or surgically. The multiplicity of forms of braces and the varieties of operations employed from time to time are the best evidence of the inefficiency of any one, and the constant effort of orthopædic surgeons has been to devise a means of correction which should prove reliable and permanent.

It must not for a moment be considered that every case of toe-drop or of calcaneus or of flail-foot following an attack of infantile paralysis is a proper one for operation, for it is not. Many paralyzed muscles recover power years after the attack, when the strain of position or function is removed from them, and the earliest and most essential factor in the treatment of these cases of paralysis is to put the parts at rest and remove strain from the weakened and inert muscles. This will favor the subsidence of inflammation in the motor cells of the cord, will check or lessen degeneration in these cells, will prevent the onset of deformity and the stretching of structures, and will also frequently be followed by return of power in muscles thought to be dead. After about six years have passed, however, with careful supervision as to muscle strain, with massage and other local means to aid restoration of function, if paralysis

still persists in a muscle or group of muscles, it is quite proper to consider this the real, permanent or residual paralysis and to institute surgical measures which will preserve the normal balance of the part for the performance of its functions in the best possible manner. Without such means, the patient is doomed to a life of brace-wearing which is always troublesome and at times extremely disabling through breaking of the appliance and inability to have prompt repairs made.

The surgical correction of paralytic conditions of the foot may conveniently be considered under four divisions: (1) Operations upon the bony parts; (2) operations upon the tendons and muscles; (3) operations upon the skin; and (4) operation by silk inserts in tendons or ligaments.

Under the first group is included arthrodesis of the ankle, transtarsal or tarsal joints. These operations have proven only partially successful. Great difficulty is experienced at times in securing firm ankylosis and where this does obtain, the part ofttimes proves painful for walking and the gait is a stilted one.

The second group received earliest consideration through the work of Nicoladoni, who in 1881 first practised transplantation of live tendons to assist or replace the paralyzed ones, and this was the first really great impetus to the surgery of paralysis. Many varied types of operation have been suggested and performed on these structures since then, such as shortening by tucking, by cutting out a section, by changing the point of insertion and by changing the angle of pull, by passing the tendon through a subperiosteal groove and fixing it there (Dr. W. E. Gallie, Toronto, Can., ANNALS OF SURG., March, 1913, and *Amer. Jour. Orth. Surg.*, July, 1913). In all of these methods, the immediate results are good but in all excepting where the tendon of a live muscle is transplanted and where it is fixed in a subperiosteal groove, the deformity is extremely likely to recur, because the structures which stretch, viz.: the degenerated and paralyzed muscles, are still subjected to strain. Where they are eliminated as in the procedure reported by Gallie, the results are sure and certain, as the tendons are converted into ligaments and do not stretch.

In the third group, Robert Jones has had good results from the resection of a portion of skin and fascia on the elongated side and bringing the edges together to maintain correction. This procedure when used in conjunction with tendon work affords reinforcement and lessens strain.

The fourth group has been extensively employed and is to be very strongly recommended. The results of the inserts of paraffined silk appear to be permanent, whether the parts reinforced be tendon or ligament. The only criticism to be offered against it is that silk is a foreign body, and if the same results can be secured by the use of living structures which are already in position and which are unyielding, I believe the local tissues should be utilized even though it is urged that the silk inserts rarely cause trouble by suppuration or otherwise.

In August, 1913, Dr. V. Putti, of the University of Bologna, Italy, performed for the writer another method of fixing these permanently paralyzed tendons which he has been using for some time with excellent results. The underlying principle is the same as that used by Sangiorgi (quoted by Gallie) and Gallie, viz.: to convert the tendons of the paralyzed muscles into ligaments, but Putti eliminates absolutely the degenerated muscle tissues which are the structures that stretch and permit the recurrence of the deformity and in this respect renders results more certain.

The operation for toe-drop with paralysis of the tibialis anticus, dorsal flexors of the toes and the peroneus tertius as done by Putti is as follows:

The tendo achillis is first made long enough (if not already so) to allow a right-angled position of the foot. An incision four or five inches long is then made from above the ankle-joint upward along the tibial crest and the anterior tendons exposed. These are separated and all are severed from their muscle attachments as high up as possible. The tibia is then freed about the middle of this incision and an oblong hole of sufficient size to receive all the tendon ends is mortised through it. The periosteum is next lifted from the front surface to the tibia. A tendon end is passed through the hole from one side and drawn taut, the foot being held at a right angle. Another tendon is next passed through from the other side and the remaining tendons alternately until all are threaded. The ends are

next drawn under the raised periosteum and firmly stitched in place to tendons, periosteum and tendon ends (Putti uses silk-worm gut sutures for this and leaves them buried) and the wound is closed. The parts are fixed for a couple of weeks by a splint; but Putti expresses himself as favorable to treatment without any support, believing that union will be much more firm if a little strain is permitted on the operated tendons and that we weaken the attachments by long continued fixation.

The mechanical features of the operation are entirely correct in the elimination of the weak and easily stretched muscle structures and conversion of the tendons (which stretch but little when continuous) into a large strong ligament having a sufficiently long hold on the foot and leg to give firm fixation and withstand quite a degree of strain. On November 21, 1913, I operated by this method upon a boy, S. M. (patient shown to the Academy), aged thirteen years, who had an attack of infantile paralysis over eleven years ago. There was complete loss of all the anterior muscles of the leg and foot with slight power in the plantar flexors of the toes and in the tendo achillis. There is also good power in the hamstrings, very slight power in the rectus femoris, and flexion of the knee to 15°.

After fixing the proximal ends of the severed tendons, as above described, the foot was maintained perfectly in the right-angled position and a plaster splint was applied to the entire leg, the knee being first forcibly straightened preparatory to a transplantation of the external hamstring into the patella.

In one feature, however, the operation impressed me as lacking and I shall correct this at the subsequent operation on this case. When the dorsal flexors are drawn taut, the toes stand out straight and would probably remain so if the plantar flexors were also paralyzed, but with these muscles alive and in action during function of the foot, it will be but a short while until the toes will become flexed through dropping downward of the metatarsophalangeal joints (from stretching of the fibres holding the dorsal flexor tendons to the top of the metatarsals and proximal phalanges), and the flexion of the distal phalanges of the toes and a condition of hammer-toe will be established with dorsal dislocation of the toes upon the metatarsal ends.

To obviate this, I propose to engraft the tendons of the dorsal flexors into the distal end of the metatarsals, either by severing them well forward and drawing the end through a hole drilled in that part of the metatarsal, or by lifting a flap of periosteum and cutting a groove on the dorsal surface of the bone, laying the tendon in this groove and securing it by suturing the periosteal flap over and to it (as described by Gallie and Sangiorgi).[1] A bone-flap could also be used if desired, but I believe one of the others will be sufficient to focus the ligamentous pull on the distal end of the metatarsals and obviate the threatening deformity of the toes.

This procedure is simply a combination of two mentioned operations but it will, I believe, provide the solution of the treatment of this most troublesome condition. Putti's method of fixing the tendons in the bones of the leg is safe and sure and of course can be applied to any type of paralytic deformity about the foot, such as calcaneus (using the tendo achillis and plantar flexors of the toes or the tibialis posticus or the peronei), valgus (using the tibialis anticus or posticus or both), or varus (using any or all of the peronei).

DR. A. B. GILL (by invitation) said that he had observed four cases in which silk ligaments have been implanted to correct paralytic foot-drop. The ligaments are put through a hole drilled through the tarsus and then passed up the leg within the sheaths of the peroneus tertius and the tibialis anticus, and then passed through a hole drilled through the crest of the tibia and fastened there. Of the four cases, one is now of two years' standing, in which the silk is still holding the foot in good position with marked improvement in the gait. One silk ligament of the four broke, owing to weakening of the silk by too prolonged boiling in the bichloride of mercury. It was an easy matter to replace the silk. The other cases are in good condition. There has been no condition of flexion of the toes resulting from the operation. It will

[1] This operation was completed as above outlined on December 12, 1913, with very satisfactory immediate results and there is every reason to feel that the ultimate results will be as desired as this additional work has been thoroughly tried out by many operators and has received the stamp of approval.

be interesting to observe in the Putti operation when the tendon is severed above and below whether there will occur degeneration and stretching of the tendon.

DR. GEORGE ERETY SHOEMAKER expressed surprise at the use of buried silkworm gut sutures. This is a substance which was tried out very thoroughly years ago in this country and abandoned as a buried suture material, because it was absolutely unattacked by the cells of the body and always remained as a foreign body during the lifetime of the patient. A permanent suture does no more good than a temporary one, as under the slightest tension it cuts until it does no more holding. He had had occasion to take out a considerable number of silkworm gut sutures put in under perfectly sterile conditions, the sterility persisting for say two years, when the sutures would begin slowly to work their way out. He had buried many hundred worm gut sutures in aponeurotic tissue, and had seen probably one per cent. give trouble after long intervals.

DR. J. TORRANCE RUGH (in closing) said that he had mentioned the fact that Professor Putti used the silkworm gut, though he himself did not. He called his attention to its abandonment in America and he said he never had any trouble whatsoever from it. He had used it for a number of years and he claimed most excellent results. Dr. Rugh used chromicized catgut in this case as he does in all.

In regard to the silk ligaments, he was a firm believer in their use, but anything of that kind is a foreign substance, and if you have structures which are capable of preserving the position of the foot, why introduce a foreign substance? He had done quite a number of these cases of silk ligaments for this condition of toe-drop, for valgus and for varus and had had no trouble since using the paraffin silk, but he did have trouble with bichloride silk, as it came out by sterile suppuration. The paraffin silk remains in and is very good. But here are structures which are inelastic, and already in place and if you fix them you make ligaments out of the tendons. If any change takes place, even if they lose their identity as tendons, they are still ligaments.

This operation has been done for a couple of years by Putti, who claims that they were holding splendidly, and unless the tendons should stretch, it is the ideal operation for this condition.

RADICAL CURE OF AN INCARCERATED INGUINAL HERNIA IN AN INFANT TWENTY DAYS OLD.

DR. WALTER E. LEE reported the history of an infant who was admitted, January 20, 1912, to the service of Dr. James P. Hutchinson at the Children's Hospital.

It was by the courtesy of Dr. Hutchinson that the reporter operated upon the child and had the privilege of reporting the case.

Upon admission the right half of the scrotum was found enlarged and tense and the tumor emerged from the external inguinal ring. The scrotum became normal in size after taxis when a gauze pad over the external ring with adhesive plaster and spica bandage reinforcements were applied to secure the reduction. Following this the child had three normal bowel movements and seemed perfectly comfortable for twenty-four hours when the tumor reappeared and operation was decided upon.

The skin and subcutaneous tissues were anæsthetized by infiltration with thirty minims of a four per cent. solution of eucaine. On opening the sack about one drachm of bloody fluid escaped. One large loop of small intestine, ten inches in length, with its mesentery were found in the sack and the mesentery was twisted upon itself one complete turn. The bowel was very dark in color but the peritoneal coat lustrous, and after irrigating with hot normal salt solution, the color of the bowel improved and the circulation returned in the mesenteric vessels. The constriction was found at the internal ring and after dividing it the bowel was returned to the abdominal cavity. The aponeurosis of the external oblique and the internal oblique muscle were then sutured to Poupart's ligament with chromicized catgut, thus depressing the cord. The skin wound was closed with three silkworm gut sutures. At the close of the operation the infant vomited fecal matter and this was the first vomiting of which we had any knowledge.

The child nursed the following morning and this day there was a normal bowel movement. The convalescence was uneventful and the child was discharged with a firm wound on the twenty-first day.

Dr. Lee called attention to the satisfactory anæsthesia obtained by the local infiltration of a solution of eucaine. The anæsthesia seemed perfect during the entire operation, the infant busily sucking the thumb of the nurse.

RADICAL OPERATION FOR A HERNIA OF THE UMBILICAL CORD IN A NEW BORN INFANT.

DR. WALTER E. LEE reported the history of an infant who was brought to the dispensary of the Children's Hospital one hour after its birth. Dr. Edward B. Hodge saw the child and advised immediate operation. It was by his courtesy that the reporter operated and had the privilege of reporting the case.

The infant seemed perfectly formed except for a large cystic tumor which protruded from the anterior abdominal wall. The tumor was nearly as large as the infant's body. The circular opening in the abdominal wall, an enlarged umbilical ring, extended from the xiphoid cartilage to within one inch of the pubic bone. The skin of the abdomen was continued upon the pedicle of the sack for one-quarter of an inch, where it ended as a sharp border beyond which a transparent membrane as thin as paper covered the remaining portion of the tumor as far as its distal extremity, where the covering was drawn out like a funnel and became continuous with the ligated umbilical cord. The umbilical vessels could be felt as a cord on the lower surface of the tumor. The liver, the spleen and the large and small bowel could be clearly seen through the hernial covering floating in a clear transparent fluid. These organs were all outside of the margin of the umbilical ring.

The child was anæsthetized with ether and an attempt made to reduce the organs. This was unsuccessful and upon opening the sack, the bowel, liver and spleen were found adherent to the sack wall in many places. After ligating the umbilical vessels and breaking the adhesions the bowel and spleen were reduced, but it was necessary to enlarge the opening in the abdominal wall by an incision toward the pubes before it could be replaced. The hernial sack was excised and the abdominal wall united with ten chromicized catgut sutures which passed through the entire thickness of the wall. The tension upon these sutures was relieved with strips of Z. O. adhesive encircling the abdomen. The increased intra-abdominal pressure resulted in a large amount of meconium being expelled at the end of the operation. The child lived for five days. During this time the bowel moved three to four times daily and it regurgitated small amounts of mucus flecked with black particles which looked like meconium. It was fed with a weak mixture of condensed milk and an attempt was

made to bring some of the mother's milk to the hospital on the fourth day but the plans miscarried.

No autopsy was obtained and the cause of death remains uncertain.

Dr. Lee added that congenital herniæ of the umbilical cord should be classified as malformations since the peritoneum and viscera are not abnormally protruded but lie in front of the anterior abdominal wall as in the early stage of intra-uterine life, the normal closure failing to take place. It is really an ectopia.

The outer covering of the sack is formed by the distended tissues of the umbilical cord, a thin layer of the jelly of Wharton, and behind this is the hernial sack, corresponding in its position to the peritoneum and continuous with the abdominal peritoneum.

As the circulation in the umbilical cord ceases immediately after birth the stump of the cord becomes necrotic, shrinks up and is cast off after several days; the covering of the hernia of an umbilical cord naturally undergoes the same fate, exposing the abdominal viscera, the consequent suppurative peritonitis usually causing death.

Radical operation was first advocated by Lindfors in 1881. Hansson published a collection of 73 cases treated in the antiseptic method, 1900. Mortality of 32.8 per cent.

OBSTRUCTIVE PELVIC LESIONS ASSOCIATED WITH CHRONIC DIVERTICULITIS.

BY GEO. ERETY SHOEMAKER, M.D.,
OF PHILADELPHIA.
Gynecologist to the Presbyterian Hospital.

THE attention of surgeons has been directed of recent years to diverticula of the intestine as a cause in certain previously very obscure chronic indurated conditions. Suspicions of tuberculosis or syphilis, but especially of carcinoma, have led to exploratory operation, the pathology being finally determined as that of chronic diverticulitis. Often after most difficult dissection drainage of a small abscess in the centre of a rigid induration has been the only treatment possible. Curative treatment has required excision or resection of the bowel, a matter of much technical difficulty at times. Among the last 800 intra-abdominal operations by the writer five cases of various forms of diverticulum have been encountered, some of minor consequence, others of much gravity. They were as follows:

CASE I.—*Meckel's Diverticulum.* Incidentally observed while operating for extra-uterine pregnancy. It was a cone-shaped offshoot of the lower ileum. As its opening was large and there was no danger of subsequent strangulation it was treated by inversion and suture. Probably it had not caused symptoms. Patient was delivered normally a year later.

CASE II.—*Meckel's Diverticulum.* Acute obstruction of ileum. Boy of twelve years. Subsequent to recovery from typhoid fever two attacks of partial obstruction in previous months had been spontaneously relieved. The existing attack had gradually developed into complete obstruction and paresis which caused death thirty-six hours after operation, which was done too late and under unfavorable conditions. A strong broad adhesion band had strapped down an inch or more of small intestine to the root of the mesentery at a point immediately below the origin of a Meckel's diverticulum. The latter was enormously swollen as was the

nearby gut above. The diverticulum had apparently participated in the production of the obstruction due to kinking above the broad adhesion.

CASE III.—*Multiple Diverticula of Sigmoid Bowel.* Mrs. X., aged sixty, presented symptoms suggestive of pelvic carcinoma. In addition to benign uterine hyperplasia the lower sigmoid bowel was rigid and leathery. After resection the gut was shown to be pierced by numerous diverticula. Inflammation had extended from these to surrounding tissues (see ANNALS OF SURGERY, vol. lvi, p. 661).

CASE IV.—*Diverticulitis of Rectum.* Mrs. B., aged sixty-three, had suffered from pelvic inflammatory attacks, for years, and at times had been treated by various specialists, receiving the rest cure, etc. Operation showed broad ligaments, very small ovaries and tubes buried in very firmly organized old adhesions which also surrounded the rectum. While the entire rectum had not the rigidity and leather-like feel at times noted, there was a diverticulum readily accessible resembling a thick short epiploic appendage with a firm club-shaped head as large as a cherry. This contained a movable mass, continued pressure on which caused it to be extruded into the lumen of the rectum. The offshoot from the bowel then collapsed, showing it to be diverticulum. Deeply situated in the cellular tissue surrounding the rectum were several firm bean-sized indurations which probably represented other diverticula, though only the one was clearly demonstrable. Diverticulitis was doubtless the cause of old obscure pelvic symptoms.

CASE. V.—At intervals of several months during the past year I have operated for recurring intestinal obstruction under conditions which interested me greatly. The patient presented a most baffling and formidable combination of pelvic conditions, at first supposed to be carcinomatous but which were finally shown to be associated with one or more diverticula lying in an inextricable mass of indurated tissues and organs against the sacrum.

The extensive destruction and disarrangement of pelvic anatomy was remarkable. The patient, aged forty-three, short, muscular, fat, weighing 190 pounds, was admitted for an attack of intestinal obstruction which proved to be incomplete. Owing to distention little could be learned by examination above the pubis; below the pelvis was found blocked by a large rounded fixed mass. apparently incorporating both uterus and rectum high up. There

was a history of menorrhagia, and at long intervals slight discharge of mucus, so-called, but no blood from the rectum. There had been occasionally wire drawn stools for five years.

Operation was most unsatisfactory; an irregular, very hard pelvic mass inextricably incorporated the rectum and uterus with adherent coils of small bowel. After patient dissection nothing was accomplished except the release of a few adhesions, and in the apparent presence of malignancy the colon was attached to the left parietes, to be opened later when necessary. Strange to say, obstructive symptoms entirely disappeared following this operation, and large, well-formed stools were passed. All appearance of wire drawing disappeared, doubtless due to rectal drainage of a fluid sac and release of external pressure on the rectum. This relief continued for four months, the patient becoming apparently well. Wassermann test was negative and full doses of iodide of potassium used experimentally had no effect on the tumor. Then obstruction occurred gradually, became complete, and the colostomy was completed with immediate relief. Again she resumed the use of the rectum intermittently. The colon opening might be unnecessary for weeks, when it would again come into play. There was no valve action and no slack in the attachment of the colon. Six months later and nine months after the first operation, as the general condition seemed absolutely to negative the presence of carcinoma, I yielded to the solicitation of the patient to again try to remove the obstructive mass and make possible the closing of the colostomy. The attempt was again very disappointing and unsatisfactory. After the most difficult dissection a rounded pus sac with walls half an inch thick and very firm was traced behind the rectum, but it could not possibly be dissected out and had to be abandoned to drainage. Before opening it pressure did not cause it to drain into the rectum, though doubtless this occurred at times. The rectum where it emerged above the extremely hard mass was stiffened and the local vessels were deeply engorged. The microscope afterward showed no mucous membrane lining this pus sac, but it might have been destroyed by suppurative processes during years. I consider this sac to have been a diverticulum holding about three ounces of mucopus, and so surrounded except on the rectal side by absolutely rigid tissue that when full it produced obstruction by compression, relieved spontaneously or otherwise at intervals. A second focus

was isolated from very hard tissue and finally detached, almost by fracture. It was found to be lined with mucous membrane. Its site was closed in by celluloid thread. No determination could be made of the kind of intestine from which it sprang but from its situation it was supposed to be also a diverticulum from the large bowel. The laboratory examination by Dr. Pfeiffer showed it, however, to contain glands unquestionably from the small intestine. It was, therefore, a Meckel's diverticulum, lying deep in the pelvis and caught in the general mass. With the greatest difficulty could the uterus be found, well in front. Large cigarette drains were placed in the diverticular pus cavity and another at the suture site of the Meckel's diverticulum. There was a troublesome oozing of indefinite origin which set in after reaction and which contributed more or less to the death by exhaustion after three days. Gas was passed by the colostomy.

The occurrence of five diverticula in such a small group of abdominal operations as 800, while probably only a coincidence, would seem to indicate that the abnormality may be more frequent than is supposed. Detection of short diverticula is difficult and when buried in dense, inflammatory tissue may only be possible after resection of the intestine. Certain it is that the lesion has been often overlooked in the past, especially in the sigmoid and rectum.

Device for Temporary Gas-Tight Plugging of Colostomy During Operation on the Abdomen Elsewhere.—Owing to the recurrent attacks of obstruction and the uncertainty of being able to remove the cause, it was necessary to operate without permanently closing the colon in the last case cited. The opening was therefore plugged by a finger cot of heavy type, passed part way in, then loosely packed with gauze both within and without the fistula so as to make a retention button. The cot was then tied to a catheter and inflated with air. This made a perfectly gas-tight valve, not affected by fluids or gentle manipulation. I reported the use of the same device to the Academy of Surgery in 1909 (see ANNALS OF SURGERY, vol. li, p. 425), when it was applied to a vesicovaginal fistula. Before removing a bleeding kidney tumor it was necessary to prove the function of the other kidney, which was impossible with a bladder collapsed by the presence of the fistula.

The distended rubber cot, however, made a watertight joint and made the cystoscopy perfectly easy. Unless a little gauze is put inside the cot before inflation, the air may all go into one end of the device, which would then slip out.

THROMBO-ANGIITIS OBLITERANS (BUERGER'S DISEASE).

Dr. Penn G. Skillern, Jr., said that thrombo-angiitis obliterans of the lower extremity is the designation proposed by Buerger (*Am. J. M. Sci.*, 1908, N. S. cxxxvi, 567) for the condition formerly known as "endarteritis obliterans," "arteriosclerotic gangrene" and "Spontan-gangræn" of the Germans, and is based upon conclusions drawn from pathological studies of the vessels obtained from nineteen amputated limbs. In brief, we are dealing with a thrombotic process in the arteries and the veins, followed by organization, and not with an obliterating endarteritis. Most of the larger arteries and veins of the amputated limbs were found obliterated over a large extent of their course. The veins share equally with the arteries in the lesion of occlusion, and may even be more extensively involved. The distal parts of the vessels, rather than the proximal, are closed. At times, 2 to 4 inches of a vessel's length is closed, while the portions above and below are apparently normal. There is often an involvement of some of the smaller branches, such as the tarsal and the metatarsal, but the smallest arteries are free. The process involves the intima, the media, the adventitia, and the perivascular tissues. The periarteritis is a fibrous agglutinative process that binds together the artery and its collateral veins, and sometimes also the accompanying nerve, so that the liberation of the individual vessels by dissection is difficult. The cause is probably partly static and partly toxic.

The disease usually attacks Polish and Russian Jews between the ages of twenty and thirty-five or forty years, so that the names juvenile and presenile gangrene have been employed. After longer or shorter periods, characterized by pain, coldness of the feet, ischæmia, intermittent claudication, and erythromelalgic symptoms, evidences of trophic disturbances appear which finally pass over into a condition of dry gangrene. The left leg is usually the first to become affected, and when simultaneously bilateral the diagnosis of Raynaud's disease is often made. In the pendent position a bright red blush comes on the toes and foot. Soon a blister, hemorrhagic bleb, or ulcer develops near the tip of one of the toes, usually the big toe, and frequently under the nail, and when this condition ensues the local pain becomes intense. Even before the gangrene, at the ulcerative stage, amputation may become imperative because of the intensity of the pain.

The following case illustrates with great fidelity most of the features described by Buerger.

M. L., male, Hebrew, aged forty-two, sheet-metal worker, presented at the Surgical Out-patient Department of the University Hospital, service of Dr. B. A. Thomas, July 17, 1913, complaining of intense pains in both legs of a year's duration. The pain in the left leg is greater, and is constant, night and day. It is chiefly burning in character.

Examination revealed both feet involved in ischæmia, obliteration of pulse or dorsalis pedis on both sides, and a dusky blush involving both great toes. A trophic ulcer beneath the nail of the left great toe exposes the end of the ungual phalanx.

Nerve-stretching had been performed in another city without relief, and everywhere the patient went amputation was advised as the only method of relief from the wearing pain. Examination of the distribution of the pain showed that it was confined chiefly to the area presided over by the cutaneous filaments of the musculocutaneous nerve. It was figured out that if this nerve were resected, amputation could be postponed indefinitely, and the patient allowed to retain the otherwise useful limb—at least until extensive development of gangrene indicated amputation. Accordingly, using a solution of novocaine two per cent., with adrenalin 1 to 3000, intradermic infiltration along a transverse line 2 inches broad with centre over antero-external border of fibula, was made 4 inches above the base of the fibular malleolus. The cutaneous division of the musculocutaneous nerve was exposed at its emergence from the deep fascia, and a section one inch long was excised. The relief from the burning pain was *immediate*. The wound was drained by a folded strand of silkworm gut. It was closed by 4 silkworm gut sutures, and a dilute alcohol dressing applied.

The day after operation there was no pain in the foot. Reports upon the blood and the urine, which had been previously collected, showed that the Wassermann reaction was negative and that there was no sugar. The patient was given 5 drops of a saturated solution of the iodide of soda and one one-hundredth of a grain of nitroglycerin three times a day after meals.

Owing to the impoverished circulation of the limb, the operative wound remained indolent for several weeks, but was eventually stimulated to heal by the application of Bier's powder of nitrate of silver and powdered clay.

A month after operation the patient complained of pain in the distribution of the anterior tibial nerve to the adjacent sides of the great and of the second toes. This nerve was reached in the first interosseous space by a hypodermic needle, and was blocked with alcohol. This sufficed to relieve the pain.

Dr. Morris Booth Miller said that he had had some experience with Buerger's disease and had been very much interested in Dr. Skillern's account of the relief of pain by the severance of the musculocutaneous nerve. These cases are most distressing, the patients suffering at all times, especially during cold weather. He was surprised at so much benefit having resulted from cutting a single nerve; his observations would have made him believe that the severance of the whole nerve trunk would be necessary. Within the last ten days he had seen another complication which may occur, a man upon whom he had operated at different periods for Buerger's disease was stricken with a cerebral embolus. The diseased condition is one of vascular change involving all parts of the blood-vessels, both arteries and veins, and of the structures outside of the vessels, thereby affecting the nerves. This process is not a continuous one; it seems to show periods of rest, when the patient will be nearly free from pain though showing distinct objective symptoms, and then there will be an increase of all symptoms corresponding to new and further vascular change. In the case mentioned of cerebral embolus the man had just suffered an augmentation of this phenomenon.

Dr. Duncan L. Despard said that he had had an opportunity of operating on a number of these cases and then following them by microscopic examination of the vessels. In regard to the cause of the condition he had been struck by the proliferation in the intima and the elastic tissue which takes place in these vessels and frequently without obliteration of the lumen of the artery. He did not think that the obliteration by a thrombus is entirely to be accepted as the cause. He had a case last summer, of a man who suffered greatly. Since June applications of X-rays, two or three times a week, had been made. As a result he has obtained a great deal of relief from his pain. It has passed entirely from his toes and legs and he now complains of pain in the region of the knees, which have not been subjected to the X-rays. Strange to say, the temperature of the legs has increased. They were cold

during the summer and the other day there was a perceptible increase in the local temperature to the hand. Whether he will have continued relief or that this is simply a temporary improvement, remains to be seen.

Dr. George P. Müller said that he had seen a great many of these cases, mostly in Dr. Frazier's Clinic in the University Hospital. A number of years ago the affection seemed to be limited to the great toe, and was commonly known as Mitchell's disease, but in recent years they have observed more cases in which the entire foot or even the leg was involved. He did not know that they had obtained any permanent relief by any method of treatment short of amputation. They have stretched, injected, and cut the internal saphenous or external cutaneous nerves, and have had X-ray treatment used, and high frequency current, etc. In two cases he performed arteriovenous anastomosis and in another he tried to do so but found the femoral artery a solid cord. He was not an advocate of this method of treatment and cannot agree with the enthusiastic claims of Wieting, Bernheim, and others. They have resorted in at least two cases to amputation. These amputated limbs were examined in Dr. Speese's Laboratory and there was distinct evidence of thickening of the femoral vessels and more or less thrombosis in the veins.

Dr. Nathaniel Ginsburg (by invitation) said that for some time he had been interested in this subject, because of the almost sole limitation of this affection to a single race—the Jews.

Continued observation of young Russians, who have recently come to this country, with the idea of determining whether it is a purely peripheral condition, has convinced him that this disease possesses a symptom complex of which the peripheral state is only a part. As an example, he has been observing now for the past five years a young man of about twenty-four years of age, who presents marked disturbance of the circulation in his hands and feet. Examination of his surface blood-vessels reveals very feeble pulsation in his brachials, axillary and femoral arteries, indicating a general vasomotor constriction of all these blood-vessels. The maximum effect is first felt in the digits of both upper and lower extremities, which become the seat of trophic changes, very often necessitating amputation of the part. While Buerger has established the pathology of this condition as far as the peripheral ves-

sels are concerned, possibly Dr. Mitchell was correct, when many years ago he suggested the spinal cord as primarily the seat of the trouble, since theoretically stimulation of the sympathetic motor neurons of the cord will produce marked peripheral vasomotor constriction of the blood-vessels.

The relationship of this condition largely confined to a single class of people may be explained upon the basis which Dr. Crile has enunciated in his theories underlying the production of shock. This disease is found in a highly emotional class, subject to tachycardia, and neuroses of every description, and who suffer postoperative shock to a greater degree than any other class of patients. They are more subject to sensory stimulus, and therefore react to a greater corresponding degree; hence the great variations in blood-pressures observed in the same patients at different times. It would seem that an important predisposing factor in the production of this condition is something in the physiological make-up of these patients, not any previous article of diet, but perhaps an unusual sensitiveness of their cerebral or spinal motor neurons acting upon the blood-vessel wall.

DR. PENN G. SKILLERN (in closing) said that in regard to the entire relief from pain in this case it might be explained by the pain being confined to the distribution of the cutaneous division of the musculocutaneous nerve. The process described by Buerger involves the intima, the media, and the adventitia together with the perivascular tissues, one huge cicatricial mass from the lumen out to the muscles. The veins are equally involved and that is why any attempt at arteriovenous anastomosis fails. This condition is not to be confused with Raynaud's disease, which is a *functional* disturbance. The kinetic theory of Crile, suggested by Dr. Ginsburg, does not explain in any way this cicatricial mass of blood vessels. The cause is most likely a toxæmia somewhere in the body, and the predilection of the disease for the vessels of the lower extremity is determined by the static strain to which they are constantly subjected.

EPIPHYSEAL-METAPHYSEAL FRACTURES.

DR. PENN G. SKILLERN, JR., called attention under the above heading to partial fracture of an epiphysis or of the adjacent portion of the shaft, latterly designated the metaphysis. This injury is not to be confused with the well-known epiphyseal injuries that

have been classified by Ollier as paraepiphyseal strains, paraepiphyseal sprains, and disjunction of epiphyses.

Illustrative of partial epiphyseal fracture is the following case:

M. E., male, aged four and a half years, while riding a bicycle was run into the curb by a coal wagon and fell off, injuring the right knee. Skiagram (Fig. 1) shows the separation of a small unciform fragment from the tibial side of the lower epiphysis of the femur. Gypsum case was applied. This fragment shows equally well in lateral view (Fig. 2). It will be noted that it was caused by *direct* violence, and therefore is not a true tear-fracture.

Illustrative of partial metaphyseal fracture is this case:

W. G., male, aged five, fell off the porch, injuring the right elbow. Examination 4 days later revealed swelling, tenderness and lemon-yellow ecchymosis about the external condyle. Skiagram (Fig. 3) showed partial fracture of the external corner of the lower metaphysis of the humerus, with but trifling displacement. The arm was dressed on an internal right-angle splint. This injury was also produced by direct violence.

In addition to these epiphyseal and metaphyseal fractures by direct violence, it is conceivable that tear-fractures of the metaphysis might arise from overstretching of a part of the articular capsule, or of one of its specially thickened bands, or ligaments. Tear-fractures of certain epiphyses, to which ligaments are attached, could also occur, in which event the epiphyseal bond of union is stronger than the ligamentous.

EXTENSIVE COMMINUTED FRACTURE OF THE LOWER THIRD OF A HUMERUS STUMP.

DR. PENN G. SKILLERN, JR., presented the following case more as a surgical curiosity than for any other reason.

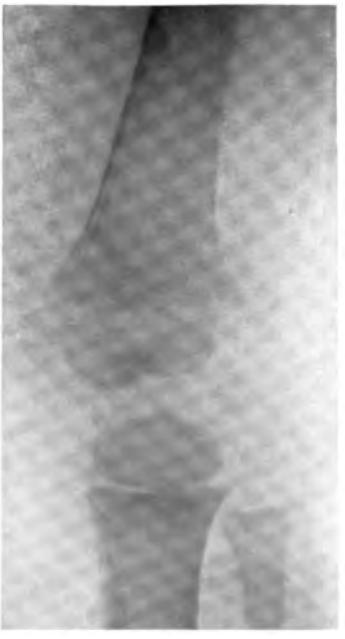
C. W., male, aged thirty-three, clerk, fell backward, landing on the lower end of the stump of the left humerus. Clinical examination revealed swelling, preternatural mobility, crepitus and tenderness in the lower third of the humerus. Skiagram (Fig. 4) revealed comminution of the shaft of the left humerus, just above the lower end, into a dozen small fragments, with vertical splitting of the shaft. This was dressed upon an anterior and a posterior splint.

Sixteen years previously disarticulation at the left elbow-joint was performed for a gunshot injury to the forearm. Two years ago he fell, and had a clean transverse fracture of the same stump.

FIG. 1.

Partial fracture of lower epiphysis of femur. Anteroposterior view.

FIG. 2.

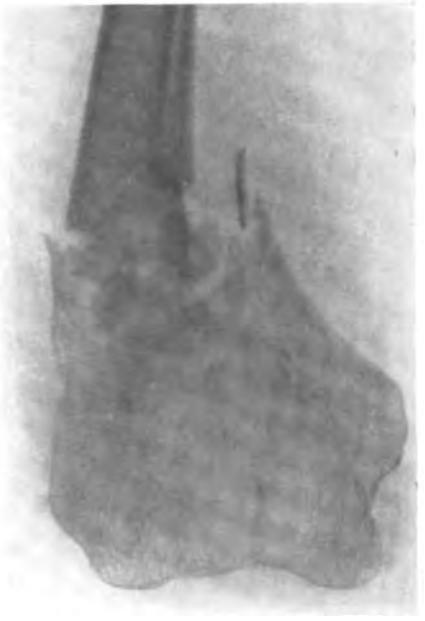


Partial fracture of lower epiphysis of femur. Lateral view.

FIG. 3.

Partial fracture of lower metaphysis of humerus.

FIG. 4.



Extensive comminuted fracture of lower third of humerus stump.

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