STATED MEETING, HELD NOVEMBER 3, 1913.

Dr. John H. Gibbon, Vice-President, in the Chair.

ARTHROPLASTY FOR ANKYLOSIS OF ANKLE.

Dr. Astley P. C. Ashhurst presented a boy, aged eight years, who caught his right foot in the machinery of a grist mill, two years before coming under observation. Most of the soft parts on the inner side of the foot and ankle were torn away exposing the bones. Subsequently there was a great deal of sloughing, infection extended up the inner side of the leg nearly to the knee, and the boy was completely disabled for a long time. Part of the third toe was lost. On June 15, 1913 he was brought to the Orthopædic Hospital and admitted to Dr. Harte's service. The wounds had only recently healed: there were long scars densely adherent to the underlying bones all along the inner side of the foot and ankle, and up the inner surface of the leg almost to the knee. The foot was in a position of equinus, at 140 degrees with the leg, and there appeared to be bony ankylosis at the ankle (Fig. 1). This supposition was confirmed by a skiagraph, which showed ankylosis also of most of the tarsal bones, all bony outlines being obliterated (Fig. 4). The boy walked on the toes with the foot in a position of marked equinus and slight varus, and with the great toe in marked hallux valgus deformity (Fig. 5). There was nothing but scar tissue on the inner side of the foot and ankle, and this was densely adherent to the bone, absolutely no soft tissues being left. Careful and skilful massage was given for over seven weeks, but though some improvement occurred in the nutrition of the skin most of the cicatrices remained densely adherent to the bones. At length operation was decided on, and it was planned by Dr. Ashhurst to excise a wedge of bone of sufficient size to bring the foot up to a right angle with the leg, and then, if it had been found possible to preserve the lateral ligaments, so as to ensure stability of the foot on the leg, to transplant a piece of fascia lata between the
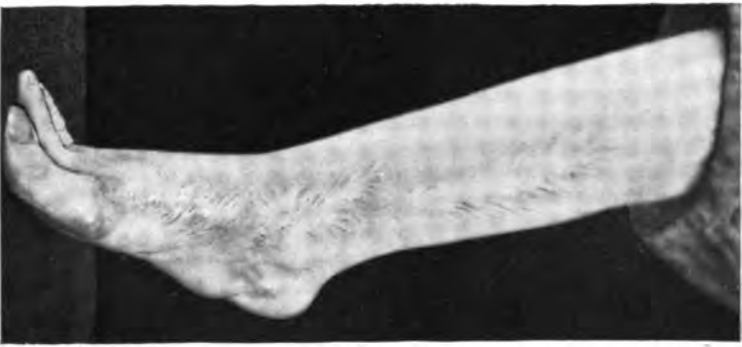
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Fig. 1.

Bony ankylosis of ankle-joint in position of equinus (140°).
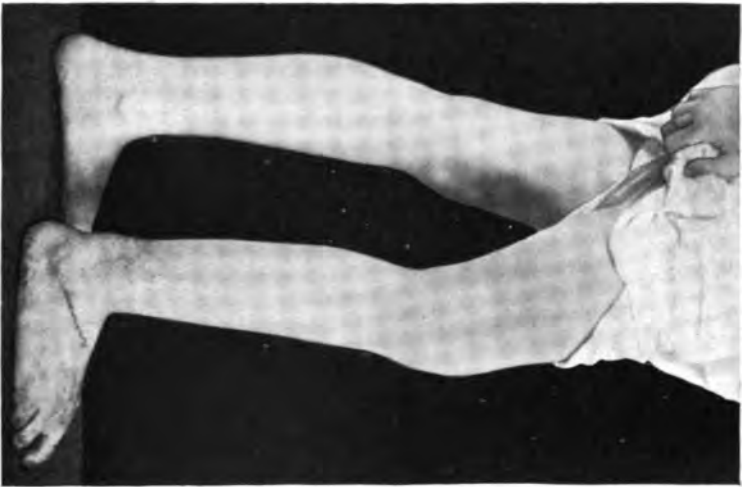
Fig. 2.

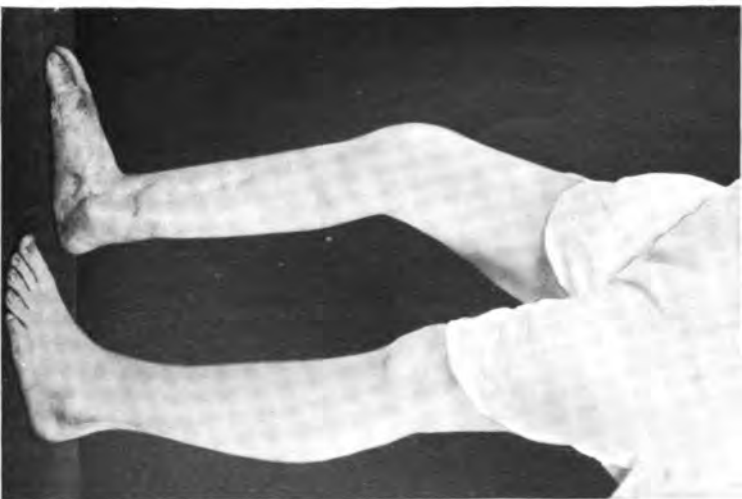Showing external incision for arthroplasty of ankle.

Fig. 3.

Result of arthroplasty of ankle.

FIG. 4.

X-ray of ankylosis of ankle-joint in position of equinus.

FIG. 5.

X-ray showing traumatic hallux valgus, etc.

FIG. 6.

X-ray showing result of operation for hallux valgus.

FIG. 7.

X-ray showing lateral view of foot after arthroplasty of ankle-joint. In lateral view the new joint can be seen a short distance below the epiphyseal line of the tibia. In the anteroposterior view it can scarcely be seen.

bones, thus providing for motion at the ankle-joint. The loss of the subastragalar joint is much less disabling than that of the ankle-joint, and even in performing an arthrodesis of the ankle-joint in cases of infantile paralysis it is better to secure firm fibrous rather than actual bony ankylosis, so as to promote locomotion.

Operation, August 7, 1913: Dr. Ashhurst. Ether. Esmarch band above the knee. An incision was made on the outer side of the tarsus from below the external malleolus forward above the peroneal tendons as far as the extensor tendons (Fig. 2). This incision was carried to the bone, and all the soft parts were raised from the bones across the dorsum of the foot and ankle. Another incision, about an inch in length, was then made on the inner side of the ankle-joint, just in front of the internal malleolus and parallel to the shaft of the tibia. This incision had to pass through the old cicatrix adherent to the bone. The inner and outer wounds were then joined by burrowing from one to the other between the bones on the dorsum of the ankle and the overlying soft parts, thus raising all extensor tendons and the anterior tibial vessels out of harm's way. Next a wedge of bone was cut out by means of osteotome and gouge; the wedge had its base on the dorsum of the tarsus, and its apex at the posterior surface of what used to be the ankle-joint. After this wedge was removed, and the foot rendered movable on the leg, the next task was to excavate the tibio-fibular mortise. Then the foot came up to a right angle with the leg. Having preserved the lateral ligaments it was now found that there was only slight lateral mobility and tendency to valgus deformity (there had been varus deformity previously); therefore, it was determined to insert a flap of fascia lata so as to preserve the motions of the ankle-joint. Owing to the dense cicatrices all around the ankle and foot there was no possibility of employing a pedunculated flap. Accordingly an incision was made over the left thigh, and a piece of fascia lata and muscle was cut free at the point where the tensor fasciæ femoris is inserted. This transplant was two inches square and about one-quarter of an inch thick. The transplant was then placed in the new ankle-joint, and stitched in place with chromic gut; there was no tendency for it to be displaced. The external incision at the ankle was closed in two layers, but the inner incision, through scar tissue previously adherent to the bone, per-

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mitted of closure only in a single layer of skin sutures. The operation took about one hour. The foot was dressed in plaster of Paris.

The plaster case was removed in two weeks, and the wounds were found healed. Some motion was possible in the ankle-joint. Three weeks after operation passive motion was begun; there was free voluntary motion of about 10 degrees, but the foot did not come up quite to a right angle with the leg. It might have been better to have lengthened the tendo Achillis at the first operation, but this was postponed because of the poor vitality of the tissues in which the arthroplasty was done.

Second operation, October 2, 1913 (eight weeks after the first operation): Dr. Ashhurst. The hallux valgus caused extreme deformity (Fig. 5), and it was planned to correct this as far as possible, and at the same time to lengthen the tendo Achillis so as to permit flexion of the ankle beyond 90 degrees. The old scar tissue was densely adherent to the projecting head of the metatarsal, but by turning up a flap with its convexity over the proximal phalanx good exposure of the metatarsal joint was secured. The head of the metatarsal was removed, and the toe brought around into proper position. The long extensor of the toe had sloughed away at the time of the original injury, and the only soft tissue which could be utilized to interpose between the sawn surface of the metatarsal and the base of the phalanx was the tendon of the abductor hallucis. This was accordingly turned into the new joint, and the soft parts closed. Then the remaining stump of the third toe was removed, the deforming cicatrix which covered it was excised, and an Agnew operation for webbed fingers was done to restore the contour of the toes as far as possible. The improvement in position is readily seen by comparing the X-rays made before and after operation (Figs. 5 and 6). Finally the tendo Achillis was lengthened by the usual Z operation. When the tendo Achillis had been divided it was found that free motion was possible in the ankle-joint: flexion to about 70 degrees, and extension to about 120 degrees. The foot was dressed in plaster of Paris at an angle of about 80 degrees with the leg.

The plaster case was removed October 23, three weeks after operation. There was a little sloughing of the margins of the flap over the metatarso-phalangeal joint of the great toe, but the

other incisions were firmly healed, and the deformity was almost entirely overcome (Fig. 7). Passive motion was instituted, and the boy encouraged to walk around. Examination November 1, 1913, showed that he had free voluntary motion in the ankle from 85° to 95°; and that passive motion was possible from 85° to 110°.

The patient was shown at this meeting, Dr. Ashhurst said, because he would leave for his home in Maryland before the next meeting. It is hoped that it will be possible to report improved motion at a future time.

RESULT OF EXCISION OF WRIST FOR TUBERCULOSIS.

DR. ASHHURST presented a man, twenty-eight years old, who came under his care in August, 1912. When four years of age he had suffered from tuberculosis of the right hip; a cold abscess formed and was opened, but healed soon. He was under treatment for the hip condition until the age of 8 years, being confined to bed 18 months, and on crutches for nearly 3 years. He eventually secured a very useful limb, with fair motion at the hip-joint, but with shortening and adduction, which caused a marked limp. The hip remains weak, and is subject to slight injuries. He walks on his toes.

In February, 1912 he fell and injured his left wrist, and was treated for five or six weeks on a splint for what was considered a fracture of the radius and two of the metacarpal bones. The wrist never became normal, but remained swollen and painful and perfectly useless. In June, 1912 he applied to the Surgical Dispensary of the Episcopal Hospital, and came under the care of Dr. Carmany, who recognized the true condition as tuberculous (Fig. 8), and dressed the wrist on a palmar splint. In August, when Dr. Ashhurst went on duty in the Dispensary, an attempt was made to secure more absolute immobilization by the use of a plaster-of-Paris splint, applied to the dorsum of the forearm and hand, with the wrist in slight hyperextension. Although temporary improvement took place for a few weeks, the disease then began to progress: the joint was hot, red, and painful; the entire carpus was puffed up, on the flexor and extensor surfaces; the fingers were stiff and useless, and though the skin was in good condition and no sinuses were present, it was not considered

safe to persist in conservative treatment, especially as the patient had another (healed) tuberculous lesion in the hip, and it was feared this might light up again. A skiagraph made at this time (early in September, 1912) showed involvement of the radius and ulna, all the carpal bones, and the bases of all the metacarpals, except that of the thumb. Unfortunately this plate was broken.

The patient was admitted to Dr. Frazier's service in the Episcopal Hospital.

Operation, September 6, 1912: Dr. Ashhurst. Ether. Esmarch band below elbow. The dorsum of the hand was split between the index and middle fingers, the incision extending on to the radius above the wrist, and being continued through the web of the fingers on to the palmar surface of the hand for about an inch. The extensor tendons were turned aside, the wrist-joint was opened, and the ends of the metacarpals cut off with osteotome; the ends of the radius and ulna were removed in like fashion. Most of the carpus was removed in one mass, but the unciform, the scaphoid and trapezium had to be removed piece-meal. The end of the thumb metacarpal was not cut off, as it appeared to be healthy. The synovial membrane, and the tendon sheaths on the flexor and extensor surfaces were all invaded by the granulomatous tissue, and a rather tedious dissection was required to remove them. The Esmarch band was removed before any sutures were introduced, and there was very little bleeding except from one large branch of the radial which re-quired ligation. The radius was then drilled in two places, and one drill hole was made in each of the metacarpals of the index and middle finger and a suture of aluminum bronze wire was used to approximate the hand to the radius, in the hope of securing firm bony ankylosis and thus arresting the disease. The soft parts were closed with chromic gut sutures; and a small drainage tube was left in the wound. The hand was dressed in almost full pronation, in slight extension, and fixed by anterior and posterior splints of gypsum. The time of the operation was an hour and a half.

Two days later the drainage tube was removed, without dis-turbing the deep dressings. The first dressing was made ten days after the operation, when the wound was found healed except at the point where it had been drained.

FIG. 8.

Tuberculosis of left wrist, June 7, 1912; duration 4 months.

FIG. 9.

Excision of wrist, 7 months after operation (March 29, 1913).

FIG. 10.

FIG. 11.

FIGS. 10 and 11.—Result of excision of wrist for tuberculosis—limits of supination and pronation.

Subsequently a sinus formed on the anterior aspect of the wrist over the radius. This was dressed with mercurial ointment, and the hand was kept at rest in a gypsum splint. The sinus remained moist until the end of January, 1913, more than four months after operation; but during all this time the wrist was painless, and gave no evidence of active disease.

A light brace was now ordered, and when seen in March, 1913, the patient was regaining considerable use of his hand, and had fair strength in his fingers, and good thumb motion.

Examination, October 20, 1913, over a year since operation (Figs. 9, 10, 11): The patient keeps a cigar store, and has no discomfort in the wrist except on violent motion. He can lift and carry almost any weight with the arm extended, the force being applied in the long axis of the hand and forearm; but the hand is weak if force is applied at right angles to its long axis. He goes hunting, and uses his left hand to hold the gun, without difficulty. He can oppose his thumb to the index and middle fingers, but not to the ring and little fingers. His grip is strong. There is rotation in the forearm from a position of almost full pronation to beyond mid-supination (90°). There is slight hypæsthesia in the ulnar distribution to the fourth and fifth fingers. The hand inclines to the radial side, and the head of the ulna is prominent on the dorsum. There is scarcely any motion in the wrist-joint. The wire suture causes no symptoms, but appears to be palpable on the extensor surface of the wrist.

CONGENITAL DEFORMITY OF THE AURICLE AND EXTERNAL
AUDITORY MEATUS, WITH LOP EAR.

Dr. Ashhurst presented a boy, now eleven years old, with a congenital deformity of the left ear. Apart from the disfigurement produced by the lopping over of the pinna (Fig. 12) and the existence of supernumerary auricular cartilages on both sides of the head, the external auditory meatus was absent (Fig. 13). Dr. T. S. Stewart, skiagrapher to the Episcopal Hospital, who made an X-ray examination, thought the skiagraph showed no evidence of a middle ear. But Dr. C. C. Eves, aurist and laryngologist to the hospital, who very kindly examined the boy, reported as follows:

" Yesterday I examined your patient, Elmer W., and demonstrated that without a doubt there is present a patent Eustachian tube on the left side. The Eustachian catheter was easily introduced into the opening of the tube, and by placing one end of the diagnostic tube into the depression of the auricle on the left side the familiar oscillating sound of the air entering the middle ear could easily be heard when the air was blown through the catheter. The oscillating sounds were so distinctly heard that I feel sure that he must also have an external bony auditory meatus. In testing his hearing on the left side I found that he could hear the higher pitch tuning fork for a short duration. Bone conduction on that side is increased. He also lateralizes for that side when the tuning fork is placed on the vertex.

" These tests indicate that his deafness is of an obstructive type which may easily be due to closure of the external auditory meatus by skin and cartilage."

The patient's birth had been secured by instrumental delivery, and the ptosis of the left eyelid is attributed to injury at this time. The parents also blame this as the cause of the deformity of the pinna, but in view of the other congenital deformities of the ear it seems more rational to consider the lop ear also a congenital deformity.

The boy was admitted to Dr. Frazier's service at the Episcopal Hospital, and on August 26, 1913, Dr. Ashhurst did the usual operation for lop ear, removing an area of skin from the back of the pinna and from a corresponding surface of the adjoining scalp, and suturing the ear back against the head with interrupted chromic gut sutures. The supernumerary auricular cartilages were also excised from both sides of the head. The result is shown in Fig. 14, from a photograph made a month later.

No operation was done at this time on the external auditory meatus, because the parents did not desire it, and it was not urged because Dr. Eves had not yet made his examination which demonstrated the probable existence of a middle ear.

IMPERFORATE RECTUM.

Dr. Ashhurst presented a boy, nearly six years of age, who, on January 14, 1908, being then a baby fourteen days old, was brought to the Episcopal Hospital, and admitted to the service

FIG. 12.

Lop ear, before operation.

FIG. 13.

Congenital occlusion of external auditory meatus.

FIG. 14.

Lop ear, after operation.

of Dr. G. G. Davis. *There had been no bowel movement since birth;* it was said that the urine once was very dark. The baby's abdomen was immensely distended, very tense, shiny red, and covered with many enlarged veins. The family physician had postponed sending the child to the hospital earlier, because a proctodæum was present. This, however, was found to be only three-quarters of an inch deep, ending in a blind pouch. The condition of the child was critical; the abdomen was so dreadfully tense that it seemed almost unsafe to bend the thighs up upon it for fear it would burst. However, the baby was placed on the operating table (lying on a hot water bag) in the lithotomy position. No anæsthetic was given. A median perineal incision was made 4 cm. in length, and deepened through the proctodæum to a depth of about 4 cm. from the skin surface. Here the rectal pouch was found, and incised; at once semisolid fæces squirted out in the form of a goose-quill or slate-pencil. The opening was dilated with forceps, and a large quantity of fæces was evacuated. The bowel (the mucosa of which was inflamed and red) was stitched to the skin with interrupted sutures of chromic gut. No ligatures were needed. The time of the operation was fifteen minutes.

The baby's bowels moved almost continuously for 12 hours after operation. No vomiting occurred after operation, the baby nursed well, and next day the abdomen was soft, not distended, and the redness and shininess had disappeared. Four days after operation the baby and its mother were sent home. Three weeks after operation, when the baby was five weeks old, the mother brought it to see Dr. Ashhurst at the Dispensary; the bowels acted normally, and the general health was excellent.

Nothing further was heard of the baby until he was brought to see Dr. Ashhurst again in September, 1912. He was now four years and a half old, and the complaint was that he had no control of his bowels.

Examination showed the anus and proctodæum as at birth, about half an inch deep, and ending in a blind pouch. Between this and the coccyx was a larger opening, about an inch in length, through which the fæces were passed. The mucocutaneous juncture of this opening appeared normal, but evidently there was no sphincter (Figs. 15 and 16).

Operation, September 30, 1912: Dr. Ashhurst (service of Dr. Frazier, at the Episcopal Hospital). Ether. Patient in Sims's position.

A grooved director was passed into the anal pouch, and was jabbed through into the rectum above (Fig. 15). The septum between the anal pouch and the rectal opening was then slit open,
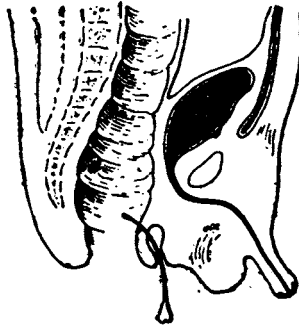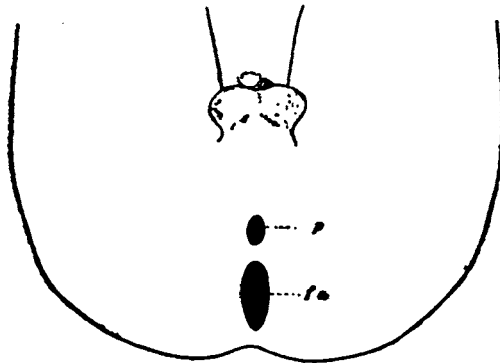
FIG. 15.

FIG. 16.

Figs. 15 and 16.—Proctoplasty for imperforate rectum, with secondary operation 4 years later to close a false anus in the perineum. *p*, proctodæum; *fa*, false anus.

on the grooved director as a guide. The fold of mucosa which remained on the anterior rectal wall (Fig. 17) corresponding to the septum between anus and rectum, was then divided in the long axis of the bowel, and was sutured transversely (Fig. 17, 2 and 3), thus restoring the anterior wall of the rectum. Then the rectal wall was dissected free from the skin of the perineum

all around the false anus and as far back as the coccyx, and was inverted toward the median line of the body in two flaps. These flaps were then united in the median line by numerous interrupted quilt sutures of No. o chromic catgut, all the knots being placed on the mucous surface of the rectum. This inverted the mucosa well (Fig. 17, 3). Then the ends of the sphincter ani (divided when the septum was slit open at first) were re-united. Next two buried sutures were employed to approximate the levator ani muscles between anus and coccyx; and finally, the skin between anus and coccyx was closed (Fig. 17, 4). A small tube was

FIG. 17.
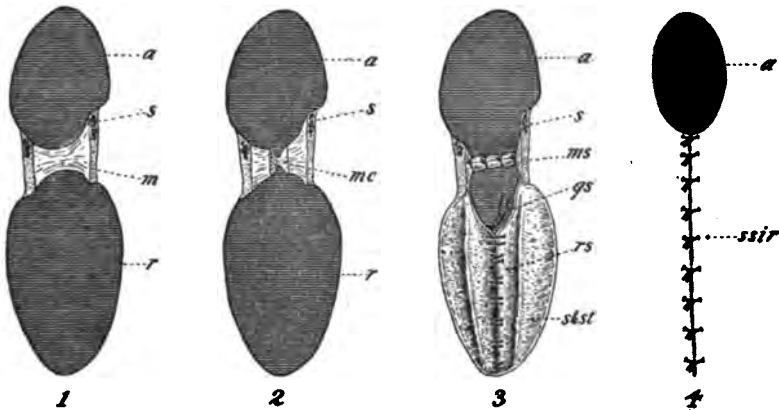
1, *a*, anus; *s*, sphincter ani; *m*, mucous valve separating proctodæum from rectum; *r*, rectum. 2, *a*, anus; *s*, sphincter ani; *mc*, mucous valve cut; *r*, rectum. 3, *a*, anus; *s*, sphincter ani; *ms*, mucous valve sutured; *qs*, quilt sutures; *rs*, rectum sutured; *s* and *st*, skin and subcutaneous tissues. 4, *a*, anus; *ssir*, skin sutured over inverted rectal wall.

left in the anal opening, to provide for passage of flatus, and if possible to relieve tension on the rectal flaps.

A few of the sutures sloughed out, but good control of the bowel movements was retained, and a finger in the anus detected a strong sphincter. When examined September 20, 1913, one year after operation, the anus was found normal, and perfect control of the bowels had been present ever since leaving the hospital.

EXCISION OF THE ENTIRE TONGUE FOR CARCINOMA.

DR. ASHHURST presented a man, aged fifty-nine years, who was an inveterate smoker. Apart from some trouble with his teeth in November, 1912, he had enjoyed excellent health of

late. One morning in April, 1913, on putting his pipe in his mouth (he always held it on the left side) he felt a burning and smarting sensation in his tongue. On his return to the house he looked in the mirror, and saw what appeared to be a slit on the left margin of the tongue, opposite the molar teeth. After one month he consulted his physician, Dr. H. M. Freas, who put him on mixed treatment, internally, and used iodine solution locally, over the alveolar border and the floor of the mouth, thinking the trouble arose in the teeth. Nevertheless an ulcer formed and increased in size; it was raised above the level of the surrounding tongue, and its margins and base were hard. Finally, about August, it was noticed that the ulcer was spreading up the anterior pillar of the fauces on the left side. Toward the middle of September, Dr. Freas thought some enlargement of the sub-maxillary lymph-nodes was occurring.

Dr. Freas brought his patient to see Dr. Ashhurst on September 20. The growth had then been noticed for about five months. The patient was a large healthy man weighing about 200 pounds. His blood-pressure was 80–160 mm. There were some albumen and casts in his urine, but the quantity of urine was sufficient, and the heart was normal. A " bronchial " cough had been present for the last forty years.

Examination of the mouth showed that the left border of the tongue from one inch back of the tip to the anterior pillar of the fauces was occupied by a raised, hard, ulcerated tumor, with sharply defined borders, and covered by an ashen gray slough. The mucosa covering the floor of the mouth was invaded, but the ulceration did not extend up on to the alveolus. The anterior pillar was just beginning to be invaded. The ulcer did not extend to the midline of the dorsum of the tongue. The tongue was not fixed. The floor of the mouth (mylohyoid) was not involved. Enlarged lymph-nodes were palpable on the left side at the level of the hyoid bone in the submaxillary region; no other lymph-nodes were palpable anywhere, on either side of the neck. A skiagraph showed no invasion of the mandible.

This was evidently a comparatively early case, as such cases go.

The patient was admitted to the Episcopal Hospital on September 23, and operation was done by Dr. Ashhurst on September 25, 1913, under anæsthesia by intratracheal insufflation of ether,

FIG. 18.

Tongue excised for carcinoma; submaxillary salivary gland and cervical
lymph-nodes.

administered by Dr. W. E. Lee and Dr. Billings. Dr. Ashhurst said he would not go into the technic of the operation, as he hoped to bring this subject before the Academy on a future occasion. It sufficed to say that the plan of operation was modelled on Crespi and Bastianelli's modification of Langenbeck's method. The fat and lymphatics and the submaxillary salivary gland on the left side were removed in one mass, from the bifurcation of the carotid artery to the tongue and mastoid (Fig. 18); then the tongue was removed by turning aside the cheek. The neck wound was drained by a tube. The entire operation took two hours.

The patient left the table with a pulse less than 100, and subsequently it never exceeded this rate. There was no post-operative vomiting, and at no time any evidence of pulmonary irritation. The temperature averaged about 99° F., for the first few days, and then reached normal. The patient slept well the night after the operation, with a little paraldehyde, which he *said* tasted pleasant to him. Next morning he was able to make himself understood in talking. He was encouraged to swallow at once, and was able to take liquid nourishment from the first attempt. On the third, fourth and fifth days after operation a little liquid food discharged through the neck wound in swallowing, but this did not recur. He left his bed on the sixth day, and walked out of the hospital on the twelfth day after operation.

Swallowing of solid food was difficult for the first two weeks, but he found that if his mouth was filled absolutely full he could by effort force the mouthful back into the pharynx and so into the œsophagus. Before the end of three weeks he had dined with comfort off pork and beans, and took sauer kraut with relish. He talks with remarkable distinctness, considering the absence of his tongue, and is fairly well understood by the casual interlocutor, while his family never fail to understand what is said.

Pathological Report.—The specimens were examined by Dr. C. Y. White, pathologist to the Episcopal Hospital. He reports:

"The specimen shows a typical epithelioma of the tongue. The epitheliomatous tissue extends from the surface one-half to three-quarters of an inch into the meshes of the tongue. This degree of infiltration would indicate metastasis at least to the draining lymphatic glands. The lymphatic gland in the region of the sublingual salivary gland is free from metastasis. Numerous other microscopical sections,

from the root of the tongue and anterior pillar of the fauces, from the under surface of the tongue, and from the mass of tissue removed from the neck (submaxillary salivary gland, with submaxillary, submental, sub-parotid, and upper deep cervical lymph-nodes), fail to show any evidence of metastases. Microscopical sections made from the bone removed from the alveolus also are negative for metastasis."

Dr. John H. Jopson said that in his experience the after history of cases of imperforate anus is marked not so much by incontinence as by obstruction from the contraction of the opening which is made to replace the imperforate anus. In one case under observation for between five and six years the condition was such that after three or four years operation was contemplated for the relief of the stenotic condition. In this case the anus was absent and the rectum was found high up; there was no proctodæum and the whole dissection had to be carried out through the perineum. Persistent dilatation was maintained up until a short time ago by means of English catheters and later by conical steel bougies. At one time the boy had distention of the colon as a result of stenosis and a plastic operation for its relief was contemplated, but always just as they would decide on this procedure he would improve and get all right; from last accounts he was in splendid health.

A short time ago he saw a child on whom he had operated eighteen months previously, the patient having been lost track of in the interim. At this visit the child was suffering from constipation, and he found here that there was a tendency to contraction of the septum which he had divided above the proctodæum, and he had to order dilatation in this case as well.

Dr. Edward B. Hodge mentioned a case seen a few weeks ago, at three and a half years of age, on whom a colostomy had been done two days after birth by Dr. Warren Walker. In the paper he referred to Dr. Ashhurst brought out the fact that few colostomy patients lived to grow up and have the second operation, but this was a patient who did live and who was fairly well nourished. The child came into the Children's Hospital for the establishment of a rectum. Here also was a proctodæum.

The rectal pouch was easily reached at a depth of 1½ inches, brought down and fastened to the skin with the addition of plastic work to secure a sphincter. So far the result has not been tested, as the colostomy opening has not yet been closed.

DR. JOHN H. GIBBON said that in his opinion the operation is easier when done from below in cases of imperforate rectum because a dilated rectum is more easily found than after a colostomy has pulled it up and contracted it. He thought, however, it would be a mistake in these cases to try to do a plastic operation in the beginning; what Dr. Ashhurst did first, although only producing temporary relief, is the proper procedure.

One case of his own, operated on at the Pennsylvania Hospital later, came into the Jefferson Hospital with a very tight opening through which very little could pass and he found the rectum filled with densely hard enteroliths which bounced on the floor like marbles when removed with a scoop. He did a plastic but had to dilate the opening from time to time; the child now has perfect control.

INTUSSUSCEPTION.

REVIEW OF TWENTY-SEVEN CASES.

BY FRANCIS OLCOTT ALLEN, Jr., M.D.,

OF PHILADELPHIA, PA.

THE patients with whom this brief review is concerned were under the care of various members of the medical and surgical staff of the Children's Hospital of Philadelphia and comprise all those recognized as intussusception in that institution. The first case was admitted in September, 1897, and the last one in February, 1913, the total number in these 17 years being 27.

In the histories of these patients there is no hint of any racial or hereditary predisposition. There are representatives of the Negro, Italian, Hebrew, Russian, Irish, and other unnamed nationalities. No family histories of interest were given.

A large majority of the patients were under one year of age. All except one were under 17 months, the oldest being 3 years old, and the youngest 3 months. Seventeen were boys and 10 were girls.

It is impossible to find any definite exciting cause for the production of the intussusception. It occurred only once in July and once in August, the season when summer diarrhœa is most common, and when the largest number of cases might be expected, if diarrhœa were an important factor in the etiology. There were 5 cases in June, 5 in October, 4 in February, and at least one case in each month throughout the year. There was only one in which the history indicates that indiscretion in diet might be held responsible: a child, sixteen months old, had been weaned two weeks before the acute symptoms began, and was being fed on milk, oatmeal, barley, and rice. In 15 cases mention is made of the kind of food the baby was taking, and of these 13 were breast fed. So commonly is the patient a nursling, though the history does not always record the fact,

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that it is accepted at the hospital as axiomatic that patients with intussusception are breast fed infants. The seasonal distribution and the preponderance of infants at the breast are rather striking in view of the common assumption that diarrhœa and irregularities and disturbances of peristalsis are largely concerned in the production of the condition. Usually the histories make no mention of symptoms preceding the acute attack; in one case it is definitely stated that there were none, one baby was subject to frequent coughs, five had diarrhœa for a few days to a few weeks, and two had more or less vomiting and diarrhœa for a month. These intestinal symptoms seem just as likely to have been due to the onset of the intussusception itself as to any preceding affection.

The acute symptoms which brought the patient to the hospital were vomiting and bloody stools. Although in two histories these symptoms are not recorded and in two others only one is mentioned, the combination is so constant as to be characteristic of the condition. The shortest period during which these symptoms were present was 12 hours, the longest 8 days. As is to be expected the duration of these typical acute symptoms has a distinct relation to the mortality rate, under both operative and non-operative treatment. With one questionable exception, death occurred in every case with a duration of four days or more—8 deaths in 9 patients—while of the patients in whom the symptoms existed one day or less, with one exception, all recovered—1 death in 7 patients—although a second one in this group succumbed later to a recurrence. In the intermediate group of 11 patients, where symptoms lasted 36 hours to 3 days, there were 6 deaths and 5 recoveries.

The examination for abdominal and rectal tumor is recorded in 24 histories. In 3, no mass could be felt in either situation; in a few it was found in one, but not the other. It is evident that the tumor might easily escape detection by abdominal examination if the abdominal wall were distended and rigid, as it sometimes was, and, of course, the rectal mass can only be found when the intussusception has progressed far enough to come within reach of the examining finger. There

does not seem to be any definite relationship between the extent of the invagination and the severity of the disease. It so happened that all the patients in whom no rectal tumor was found died, and only one where the abdominal mass was confined to the right side recovered. It is probable that the extent of the invaginated bowel depends entirely upon the underlying anatomical conditions, and has little to do with the amount of strangulation and destruction of tissue. Indeed, it seems probable that the extensive intussusceptions are those which form easily on account of the great mobility of the bowel and the large size of the colon, and for the same reasons are those most easily reduced.

Of these 27 children, 20 were operated upon and 7 were not, and it is rather surprising, at first sight, to find that operation gave a mortality of about 66 per cent., while non-operative treatment gave a mortality of less than 50 per cent. Only seven of the 20 operative cases recovered, while 4 recovered without operation and 3 died. In spite of this distinctly better statistical result for non-operative treatment, a more careful consideration will show, I think, that immediate operation is always the treatment of choice. As so often happens in acute abdominal disease, other means are exhausted before operation is undertaken and, in statistical reports, the failures of non-operative measures are glossed over by the ultimate result of operation. Among these 20 operative cases, 5 are definitely stated to have been treated by enemata unsuccessfully before operation was done, and all 5 died after operation. These should be considered as non-operative failures, and it is probable that there were several more, but the records are too incomplete to identify them. In one of these 5 cases, an anal protrusion was first noted 8 days before; the patient, a boy of 8 months, was then etherized and given an enema in an attempt to reduce the invagination. This treatment failing, the child was turned over to the surgeon for a second anæsthesia and laparotomy. Death occurred 5 hours after operation. In another one, it is said that the condition had existed 5 days and several enemata had been given before admission to the hospital. At operation the

small intestine was found to be necrotic at the entrance to the intussusception and was excised. The patient died 22 minutes after leaving the table. In a third case an enema had been given each day for four days with no result but blood. At operation a volvulus was found in addition to the intussusception, and the ileum was gangrenous and perforated. The child died 2 hours later. Such instances as these form no basis for a plea for even a preliminary trial of enemata or other non-operative measures, but urge strongly that laparotomy be performed at the earliest possible moment. It is practically certain that all the patients who died after operation would have died without it, and it is possible that some of those who died without it might have been saved by it. As the proper execution of the injection treatment requires a fairly long anæsthesia to allow the fluid to slowly distend the colon and force back the invaginated bowel and as the danger of recurrence after reduction is a very real one, it seems hardly necessary to argue in favor of opening the abdomen during the anæsthesia and of anchoring the ileocæcal region after reduction.

The histories do not give many details of the operations. In general the abdomen was opened in or near the median line, the tumor found, and reduction attempted by making pressure on its distal end, gently forcing the invaginated portion out of the proximal end, as paste is squeezed out of a tube.

The type of intussusception found is not clearly described in many of the histories. Usually the ileocæcal region was invaginated into the colon; in one case, at least, the ileum was invaginated into the cæcum through the ileocæcal valve. In several cases serious complications were present: once a double intussusception, once a volvulus, sometimes gangrene and perforation, requiring resection and anastomosis or the leaving of the damaged gut in the wound. All of these complicated cases died. When such complications were not present and the invagination could be completely reduced, the cæcum or ileum was sometimes anchored to prevent recurrence, and, at other times, the abdomen was closed without that precaution. One case illustrates the importance of such a procedure. The intus-

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susception was easily reduced and no complications were present; the abdomen was closed without anchoring the bowel. The child did well for 4 days and had normal bowel movements. Then bloody mucus appeared in the stools and the tumor recurred. The abdomen was reopened and the invagination again reduced, this time with some difficulty on account of adhesions about the cæcum. The intestine was sutured to the abdominal wall and the wound closed. The patient again did well, but pneumonia developed and death occurred on the third day. The method of fastening the bowel to prevent recurrence varied; once the mesentery of the ileum was shortened, once an injected appendix was removed and its stump sutured to the abdominal wall, and in two other cases the peritoneum of the cæcum was sutured to the parietal peritoneum. These four patients recovered. The only fatality following an operation in which the history records this step was the case just quoted when the patient died after a second operation. This is good evidence that the procedure is not, in itself, detrimental.

Within the last month I have attempted to trace the 11 survivors of the 27 patients admitted to the hospital. Unfortunately I have not been able to find the 4 earliest ones. The other 7 have been uniformly free from symptoms of intussusception. The first was operated upon 5 years ago and has had excellent health ever since. The second was operated upon 2 years ago, developed an incisional hernia, which was repaired in another hospital a year and a half later, but has otherwise been perfectly well. The third was operated upon 17 months ago and has remained well since. The fourth had an operation 14 months ago and is still in good health. The fifth has remained well since the operation 13 months ago. The sixth passed through an attack of measles while in the hospital convalescing from operation and was well until whooping cough developed, of which the patient died 9 months after operation. The seventh was prepared for operation 8 months ago, but the symptoms having abated and the tumor disappeared, operation was held in abeyance. There has never been a recurrence and the patient is now in good health.

From a study of these histories and a few of the patients themselves, it seems to me that, when the diagnosis is made, there is only one treatment which is proper to pursue. That cases are cured by rectal injections is evident from this report and many others. But to secure a permanent cure by this means the reduction must be made neither too early nor too late. If made before the serous coat of the bowel is sufficiently inflamed to produce adhesions, recurrence is to be feared. On the other hand, if attempted too late, after the layers of the intestine are adherent to each other, or gangrene or perforation has occurred, the injection must necessarily fail, as illustrated by several cases in this series, and may do great damage. Immediate operation is always indicated. The only step in the operation which these cases suggest is in need of emphasis is the anchoring by suture of the ileo-cæcal region. The delayed cases with serious complications are almost hopeless from the start.

The mechanism of the production of infantile intussusception is not satisfactorily explained. The underlying factors which make the invagination possible are, of course, anatomical, and consist of unduly long mesenteries of ileum and cæcum and, perhaps, unusual disparity in the calibres of the small and large bowel, allowing the parts involved to move freely within wide limits and encouraging the entrance of the smaller into the larger segment. It is not hard to imagine that, having once entered the cæcum, the folded mass forming the apex of the invagination may be forced onward by colonic peristalsis. The difficulty is to understand how the invagination starts. The theories usually ascribe its beginning to some irritation which induces irregular or excessive peristaltic action. But there is little evidence in these 27 patients that such is the case. The increase in diarrhœal diseases during summer does not in the least increase the incidence of intussusception and, with a few exceptions, the histories of these patients do not conform to the theory. My own impression is that the occasional preceding diarrhœa is a result, rather than the exciting cause of the trouble, and that the condition depends chiefly, if not entirely,

on the defective anatomical arrangement. And I have wondered whether the invagination does not start in the physiological pouting of the ileocæcal valve, which may become exaggerated, on account of the laxity of the attachments of the intestine, until it is caught in the grip of the colonic peristalsis and forced onward, dragging the cæcum with it. There is only a small proportion of cases in which the ileum is found invaginated through the valve, but it may easily retract after the bulkier head of the cæcum becomes the apex of the intussusception.

Whatever the precise mechanism be, it seems probable that the formation and spontaneous reduction of intussusception is much more frequent than our records show, and that the condition occurs many times in infants who die or recover without a correct diagnosis being made. Take, for example, a history like this: seven weeks before admission, vomiting and blood in the stools; then cessation of vomiting and bloody stools; 3 weeks later treated in the dispensary for gastro-enteritis, the child doing well; later a return of vomiting and bloody stools; then a protrusion from the anus. This was almost certainly an intussusception with spontaneous reduction and a later recurrence. Another patient had vomiting and blood in the stools a month before admission, these symptoms lasting 10 days and then abating; 3 days before admission vomiting and bloody stools recurred. How many infants have had vomiting and bloody stools due to a temporary intussusception which was spontaneously cured it is impossible to imagine. Here are two who temporarily recovered, but in whom a complete cure was not effected spontaneously. These instances are sufficient to show that the condition is not one which, having started, progresses until the patient dies or is cured by treatment, but rather suggest that the anatomical defect allows of frequent invagination and reduction until the inflammatory changes hold the gut in one or the other position. The condition is diagnosed and treated only when swelling and other inflammatory reactions prevent spontaneous reduction and cause more or less

obstruction of the fecal current and hemorrhage from the congested mucous membrane.

If it be so that cases of intussusception recover without intervention on our part, the cure must take place as a result of inflammatory adhesions which hold the parts approximately in their normal relations. The descriptions of the findings at operation and autopsy are too incomplete for definite conclusions, but there seem to be certain points at which the bowel remains folded upon itself longer than elsewhere—stations in the progress of the invagination—and at those points inflammation is most marked and adhesions are most likely to occur. The ileocæcal region is practically always involved. In the right-sided tumors the apex of the intussusceptum seems to be blocked by the hepatic flexure, and the inflammation is confined to the ileum, cæcum, and ascending colon. In those where the tumor runs transversely across the abdomen, the angulation at the entrance to the intussusception is in the neighborhood of the hepatic flexure, so that adhesions may form there. In the cases of left-sided tumor the angulation occurs at the splenic flexure, and adhesions may be expected there.

Assuming that some of these various forms undergo spontaneous reduction and permanent cure, it is interesting to speculate upon the conditions which may be present in after life. The mobile cæcum of the adult seems like a direct continuation of the conditions underlying infantile intussusception. If the lower portion of the ileum slips in and out of the ileocæcal valve under certain anatomical conditions in infancy, and is finally prevented from doing so by the formation of adhesions which its own pernicious activity have produced, we should expect to find in later life, within a few inches of the ileocæcal junction, bands of adhesions shortening the mesentery, and on either side of this area an unusually long mesentery permitting ptosis of the proximal ileum and the cæcum, with the production of a typical Lane's kink. I think intussusception offers also a plausible explanation for the obstructing inflammatory bands at the hepatic and splenic flexures. Mr. Lane explains the formation of these bands and kinks which bear his

name by an elaborate theory based on the reactions of the parts involved to the application of lines of force, and considers them the result of the ptosed condition of the intestines. It seems to me that it is more reasonable to assume that they are the result of some such process as I have indicated. I am not aware that Dr. Jackson, either, has included intussusception among the possible causes of the pericolic membrane he has described, but, if intussusception does recover, it seems almost inevitable that such a pericolitis should be one of its sequels. And, finally, a spontaneously cured cæcal invagination will account for some of the curious and almost impossible situations in which an appendix may be bound by old adhesions

DR. GEORGE G. Ross said that he had seen three cases of intussusception. Two of these were in adults, the other in a young child about 22 months of age. The first adult case was one in which an intussusception occurred during convalescence from typhoid fever, giving rise to symptoms simulating those of perforation. On opening the abdomen an intussusception was found high up in the jejunum. It had occurred only a few hours previously, it was easily reduced, and the abdomen closed; the patient recovered. The second case was a man who had eaten deviled crab which was bad, he was taken violently ill that night; the following morning he had a violent pain in his abdomen and the doctor concluded he had obstruction of the bowel and hurried him to the hospital. He had an enterocolic intussusception which was tightly fixed, the ring about the intussusception was gangrenous, and the condition required an ileocolostomy. In addition to the distention from the obstruction there was a distention from the food poisoning, but the patient died. In the baby the condition came on without apparent exciting cause. He was crawling over the floor when he suddenly grabbed his abdomen and howled with pain. The diagnosis of intussusception had been made by the family doctor in the country. The child's abdomen was opened, an ileocolic intussusception was found, easily reduced and stayed reduced, but during the trip to the hospital the child developed a cold and died 18 days after operation from pneumonia.

He was interested in the theory of intussusception causing the Jackson membranes or Lane's kink adhesions. He had felt

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.
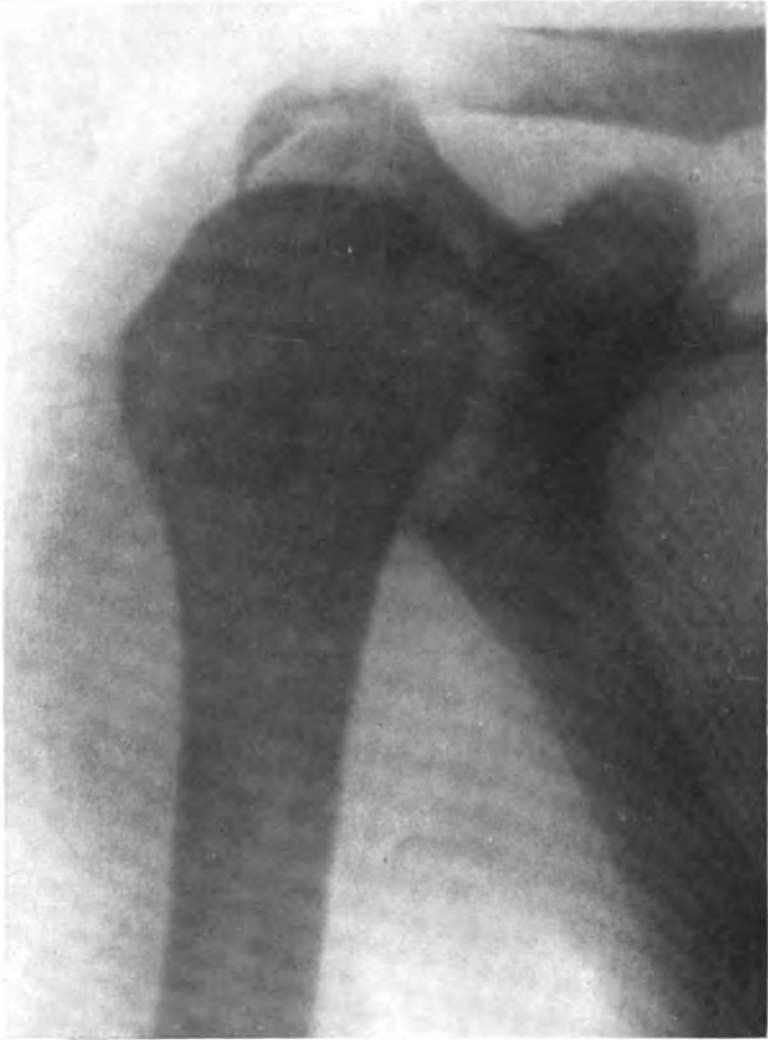
Those cases of injury to the acromion in which we have, as in the old or unreduced luxations of the head of the humerus or the fractures of the humerus, evidence of great force ex-
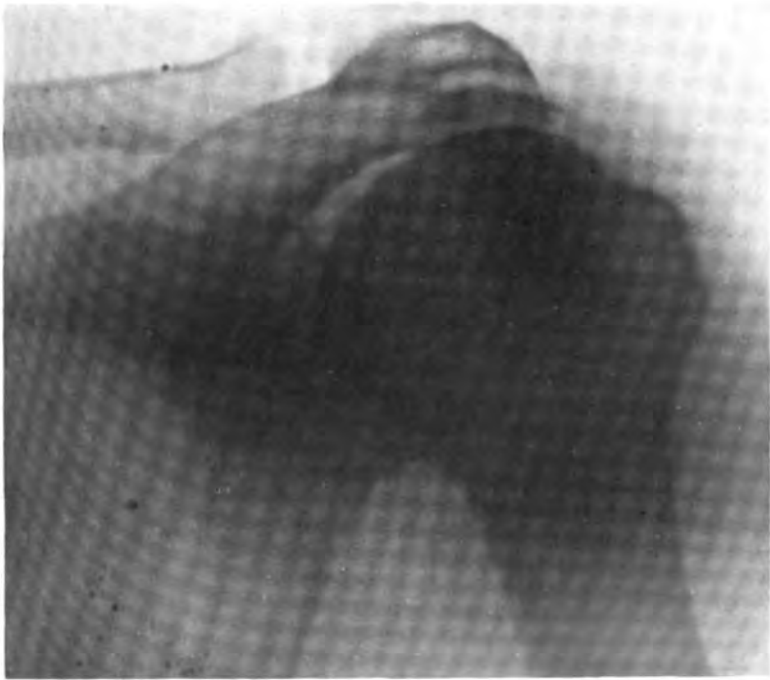
FIG. 1.

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.,

OF PHILADELPHIA, PA.

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-

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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 epi-thelia 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 kid-ney and the ureter. The former (pelvic epithelia) are char-acterized 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 de-picted 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.