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EXCISION OF THE ELBOW-JOINT, SHOWING RESULTS. FROM A SERIES OF TWENTY-ONE CASES OPERATED ON AT THE MASSACHUSETTS GENERAL HOSPITAL.

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Surgeon to Out-Patients.

THIS collection of cases, comprising all, fatal as well as successful, which have occurred in the hospital service of Dr. R. M. Hodges, during a period of ten years, is reported for the purpose of showing the ultimate and excellent results of excision of the elbow when recovery takes place, and the advantages of a single straight incision in its performance. This method, largely avoiding the cross-cutting of any tissues, allows "the connection of the triceps-extensor tendon, with the investing aponeurosis of the arm and fore-arm, to be preserved almost intact. An attachment for the muscle is thus retained which diminishes, to a certain extent, the loss of power following its unavoidable separation from the olecranon."¹ Transverse incision of the integuments, even though the above mentioned connection is maintained, is in itself prejudicial to the subsequent motions of the limb, if the wound does not unite by first intention, but cicatrizes by granulation, as it almost invariably does.

Another cardinal point in this operation is the preservation of the attachment of the brachialis anticus muscle. It is commonly stated that this muscle is inserted into the coronoid process. No method of demonstration better displays the absolute fact in regard to this anatomical point than excision of the elbow on the dead subject, which, without dissection, makes plain that the attachment is into the shaft of the ulna and *base* of the coronoid process, abundant room being left between the process and the tendon for the passage of the saw (which should always be started on this side of the bone), and the removal of this portion of the ulna. Experience shows that the extent of fracture permitting an attempt to save the limb by excision seldom reaches a degree which prevents the carrying out of these rules; and it rarely happens that so much of the radius requires removal as to cause any interference with the insertion of

¹ Report of a Committee of the Associate Medical Members of the Sanitary Commission on the Subject of Excision of Joints for Traumatic Cause, 1862, page 11.

the biceps. The great muscles of extension and flexion are thus left in a comparatively undisturbed condition. The amount of bone excised decides to some extent the subsequent mobility. Excision of the articulating surfaces alone would probably in most cases be followed by an ankylosis. Regret might sometimes be felt at not having excised enough, but seldom at having removed too much. The sacrifice should always be at the expense of the humerus, since the limit for the ulna and radius is fixed, as has been stated, by the necessity of preserving the brachialis anticus and biceps muscles. This method of operation, as Dr. Hodges informs me, was taught twenty-six years ago by Alphonse Guérin in his private courses of instruction at Clamart. The *Éléments de Chirurgie* is, however, singularly deficient in details as regards excision of the elbow. A straight incision was proposed and practiced by Parck, on the dead subject, in 1782, and is that followed in what is known as Langenbeck's operation. A claim of "originality" for the procedure by which "the aponeurotic structures passing from the arm to the fore-arm" are preserved has been made by Mr. Maunder, of London, so recently as 1873. The earliest operation of the accompanying series was in 1866. The details above alluded to were observed then and in all subsequent cases, except when modified by existing wounds. In all its steps, the method has been taught in the operative courses of the Harvard Medical School since 1855. If the operation thus performed still possesses novelty it will not detract from the usefulness of this report.¹ The cases which follow are arranged in three groups, namely, excisions for injury, for disease, and for deformity. All of them were "complete excisions."

EXCISIONS FOR INJURY.

CASE I. *Compound Fracture ; Wound torn open Eleven Weeks after Operation ; Recovery with a Useful Arm.* — A man aged twenty-nine. Compound comminuted fracture of humerus and radius into the elbow-joint. Wounds communicating with the fracture over internal and external condyles. Excision a few hours after the accident. Two inches of humerus removed. Discharged at end of five weeks. Eleven weeks after the operation he could take his hat off with the injured arm. At this period he wrenched it and tore open the cicatrix. Three days later he fell and struck the joint, and was readmitted to the hospital, with a transverse wound, disclosing the ends of the bone, covered with granulations. It required six weeks for his recovery, and at the end of

¹ Dr. H. J. Bigelow's plan for excising the elbow-joint has been suggested since these cases were operated on. The incision is similar to that described, but in removing the articular surfaces he preserves the internal and external condyles of the humerus. This secures additional chances of good pronation, supination, flexion, and extension, by saving the attachments of muscles having their origin at the condyles. *Proceedings of the Boston Society for Medical Improvement ; Boston Medical and Surgical Journal*, March 30, 1876.

twenty-two weeks from the occurrence of the injury he was again discharged.

Condition Nine Years after the Excision. — “Can knock a man down with a blow from the arm operated on. Can carry three full lager-beer glasses at once in the hand. Do a certain amount of teaming for a living. Can load and unload carts of furniture, coal, and wood.”¹

CASE II. Compound Fracture ; Excision through Existing Wound ; Recovery with a Useful Arm. — A man aged twenty-four. Compound fracture of humerus and radius into the elbow-joint by being violently thrown against a revolving machine. Ragged wound on the outer and posterior aspect of the joint, through which lacerated muscles protrude. Excision, one hour after the accident, through the existing wound. A month after the operation an attack of hospital gangrene (prevalent at that period). Discharged two months from the time of injury.

Condition Ten Years after the Excision. — Can easily touch the forehead and shoulder of the same side with the hand of the injured arm. Can put on his collar, button it behind, write, and lift as much and as well as with the arm of the other side. Can easily earn fifteen hundred dollars a year by mechanical work which requires the use of both arms. Has for several years run a stationary engine and made his own repairs. Has good sensation throughout the limb, and perfect motion of wrist and finger joints. (See heliotypes.)

CASE III. Joint opened by a Saw ; Excision through the Wound ; Recovery with a Useful Arm. — A man aged twenty-three. Arm caught by a “band saw,” which entered behind the elbow, cutting off the ulna at the base of the olecranon, the outer condyle of the humerus, and cutting into the head of the radius. The muscles were cleanly incised, and a large wound was inflicted. Neither the brachial artery nor the ulnar nerve were injured. One hour after the accident the ends of the bone were squared and removed, without the necessity of any additional incision. Discharged four weeks from the time of injury.

Condition Six Years after the Excision. — “Can carry a pailful of water over half a mile with the hand of that side. Can raise my hand above my head with ease, and take down clothes or anything else that is hanging. Can use the ax to chop wood, and the fork to pitch hay. Have worked hard with it for about two years.”

In connection with this case mention should be made of a similar accident reported in this journal, August 14, 1862, by Dr. Edward Barton, of Orange. A “tub-saw,” of twenty-two inches diameter, came in contact with the flexed elbow of a man aged sixty-one, passing through “the soft tissues and diagonally through the humerus, at the

¹ These quotation marks here, and where they occur subsequently in describing a patient's condition, indicate that the statement is his own, communicated in writing. Other statements in relation to condition are from personal examination.

point where the bone spreads out to form the condyles, and in a similar manner through the neck of the radius and ulna, just below the coronoid process, the entire joint dropping upon the floor." The final recovery of this patient was such that he resumed his occupation of a chair-maker, "working from morning till night," and it is stated that "at some branches of his business he can accomplish as much as ever he could."

CASE IV. *Compound Fracture ; Excision Five Weeks after ; Recovery with a Useful Arm.* — A man aged twenty-three. Compound fracture of humerus and radius into the elbow-joint, the arm having been caught between the bunters of two rail-road cars, six days before admission to the hospital. The limb was much swollen from the wrist to the shoulder. Profuse suppuration followed, and sloughing of the skin. Excision by a single straight incision five weeks after the accident. Discharged at the end of thirteen weeks.

Condition Five Years after the Excision. — Is now employed as freight brakeman on a railroad, and works from seven A. M. until six P. M., using the arm constantly. He has perfect sensation in the limb, and the movements of flexion and extension, pronation and supination are complete and satisfactory. He can put his hand over his head unaided ; also around behind him so as to touch the middle of his back with either the palmar or dorsal surface.

CASE V. *Compound Comminuted Fracture ; Excision One Week afterwards, through an Existing Wound ; Recovery with a Useful Arm.* — A man aged twenty-three. Compound comminuted fracture of the humerus, radius, and ulna, opening the joint, from being pushed off a rapidly moving horse-car. A week after the injury excision was performed through the existing wound. Discharged at the end of three months.

Condition Five Years after the Excision. — Has good flexion, pronation, and supination, but not complete extension, though sufficient to permit his carrying a pail of water comfortably for quite a distance. Uses garden tools readily, and dresses himself without difficulty. There is shortening of the arm to the extent of three and a half inches.

CASE VI. *Compound Fracture and Separation of Epiphysis ; Excision through the Existing Wound ; Recovery with a Useful Arm.* — A boy aged eight was run over by a horse-car, receiving a compound fracture of the right elbow-joint, separating the epiphysis of the humerus, which together with the heads of the radius and ulna were broken into several fragments. The integuments were stripped from the arm high up into the axilla. There was also a serious scalp wound, and the right ear was nearly torn off. Excision through the existing wound three hours after the injury.

Condition Two Years after the Excision. — Can use the limb for all

purposes, and joins in all games and athletic sports of boys of his age. The arm equals the other in strength, no movement being impaired except supination. It is three inches shorter than the left, growth in length not having kept pace with that of its fellow. Does not appear conscious of any difference in the two arms.

CASE VII. *Compound Fracture ; Excision Twenty-four Hours after ; Recovery with a Useful Arm.* — A man aged forty-eight. Compound fracture of the olecranon and external condyle, opening the left elbow-joint, from the kick of a horse, the corks of his shoe cutting the integument over the olecranon. Excision by a single straight incision twenty-four hours after the accident. Discharged at the end of four weeks.

Condition Three Years after the Excision. — Can carry a pail of water any distance, or lift a hundred pounds. Does all regular farm work. Hoes, shovels, mows, rakes, and “can use the fingers and hand as well as ever he could.” Feels that the arm is still gaining strength.

CASE VIII. *Compound Comminuted Fracture ; Excision Twenty-Four Hours after ; Recovery with Ankylosis.* — A man aged fifty-eight. A heavy stone fell upon his right arm, producing compound comminuted fracture of the humerus and radius into the elbow-joint, with a contused and lacerated wound over the external condyle and the upper third of the fore-arm, involving the muscles beneath. On the following day the joint was excised through a single straight incision, three inches of the radius being removed in a much comminuted condition. Discharged at the expiration of eleven weeks.

Condition Two Years after the Excision. — Ankylosis at an angle of one hundred and thirty-five degrees, with no pronation or supination. Has good use of his wrist and fingers, and is able to earn his living as a teamster ; “would not take five hundred dollars for the limb,” nor would he risk another operation through fear that it might not leave him so useful an arm as he already has. By his own confession he neglected to exercise the arm after leaving the hospital.

This patient is the oldest of those whose cases are reported. Statistics show that ankylosis has no connection with advanced years, but depends on other causes. In the present instance it was undoubtedly due to the injury inflicted on the muscles at the time of the accident, which was followed by long-continued suppuration, and to the fact that so much of the radius was removed.

CASE IX. *Compound Fracture ; Excision the Same Day ; Recovery with a Useful Arm.* — A man aged thirty-eight, while intoxicated, was thrown out, backwards, over the tail-board of a wagon, falling on frozen ground, causing a compound fracture of the internal condyle of the humerus into the elbow-joint. Excision was performed the same day through a single straight incision. A lacerated wound on the anterior

aspect of the joint, not communicating with the fracture, was closed by sutures. Discharged three months and a half after the accident.

Condition Nine Months after the Excision. — Is at work at his trade of a house-painter. This compels him to stand on ladders twenty and twenty-five feet from the ground. He holds on to the ladder with the injured arm, and reaching to one side does the required painting. Motions of the fingers and wrist are perfect. Has excellent flexion, extension, pronation, and supination. Says the arm is nearly as useful as ever it was, and that it is gaining strength every day.

Five cases are briefly narrated which resulted fatally; they are appended to complete the record of excisions for injury.

CASE X. Compound Fracture and Dislocation; Fracture of the Thigh; Excision One Hour afterwards; Death from Shock at End of Eighteen Hours. — A man aged forty. Compound fracture of ulna and radius, and dislocation of the elbow-joint from a fall of forty feet. Also simple fracture of the femur. Severe shock. Excision by a single straight incision one hour after the injury.

During the following night great distress in the abdomen. Gradually sank, and died towards morning. No autopsy could be obtained.

CASE XI. Compound Comminuted Fracture; Excision; Death from Tetanus in Thirteen Days. — A man aged twenty. Compound comminuted fracture of humerus and ulna into the elbow-joint, received in shackling cars. Soft parts extensively lacerated, and ulnar nerve exposed in the wound. Joint excised through a single straight incision a few hours after the accident. Eight days after operation, trismus followed by tetanus. Death thirteen days from time of injury.

CASE XII. Compound Fracture; Excision Seventeen Days after; Death at End of Twenty-Four Days from Thrombus and Gangrene of the Lungs. — A man aged forty-eight. Walking on a railroad track was struck by a locomotive, receiving a compound fracture of the olecranon, opening the elbow-joint. Seventeen days afterward excision, performed through a single straight incision. A series of chills supervened, and he died twenty-four days after the accident, and seven days after the operation.

At the autopsy a thrombus was found in the pulmonary artery, and the right lung was in a gangrenous condition.

CASE XIII. Compound Comminuted Fracture; Fracture of the Ilium; Excision Five Hours afterwards; Death at End of Six Days. — A man aged fifty-five. Five hours before admission fell through the hatch-way of a coal-vessel. Compound comminuted fracture of the ulna into the elbow-joint, with laceration of the soft parts. Also, fracture of the crest of the ilium. Elbow-joint excised through a single straight incision. The patient did well at first, though he complained greatly of

pain. On the third day diarrhœa set in, and the arm became very much swollen. There was great ecchymosis about the ilium. His pulse grew weak, and he gradually sank, and died six days after the injury. No autopsy was permitted.

CASE XIV. *Compound Fracture ; Other Serious Injuries ; Excision two Hours after ; Death from Shock at End of Eighteen Hours.* — A lad aged nineteen. Caught in the machinery of a flour-mill, he received a compound fracture of the right humerus, radius, and ulna into the elbow-joint ; also a compound fracture of the os calcis. From a lacerated wound of the left axilla the belly of the biceps muscle protruded. The skin of the abdomen was torn up from the pelvis to the ribs, and hung loose. There was also fracture of the pelvis and a wound of the left thigh. Excision was performed two hours after the accident. The shock of the injury was not recovered from, and the patient died in eighteen hours.

Of these fourteen cases of excision for injury it will be seen that five terminated fatally ; in two (Cases X. and XIV.) hardly any other result could have been anticipated. In Case XIV. the propriety of operation was discussed, and, but for the youth of the subject, would not have been decided upon affirmatively.¹

Tetanus (Case XI.) and septicæmia (Cases XII. and XIII.), which together occasioned three deaths, at the end of twenty-four, six, and eight days respectively, were as much, and even more, results of injury than of operation. In Case XII. excision was deferred, possibly to a too remote period from the time of accident. In none of the cases ending fatally, however, was there any reason to think that amputation, or expectant treatment, would have been followed by more favorable results. If traumatic excisions, in civil practice, were comparable with those performed for gun-shot injuries, the opinion of Dr. Otis, expressed in the Surgical History of the War of the Rebellion, would perhaps not support this consoling conclusion. He says, "although the point is open to argument, I fear the substitution of this resection for amputation effected no saving of life."

EXCISIONS FOR DISEASE.

CASE XV. *Articular Caries ; Excision ; Recovery with a Useful Arm.* — A man aged forty-two. For a year, pain in the elbow, obliging him to give up work. Joint enlarged and inflamed, with a number of fistulous openings, discharging pus copiously. No history of injury or

¹ That excessive injury does not absolutely forbid operation is shown by a case now under my care, in which I excised the elbow of a man aged twenty-seven, and two weeks afterwards laid open the knee-joint by extensive incisions, almost detaching the leg, on account of suppuration set up within the articular capsule, from a wound over the head of the tibia received at the same time as that of the elbow. At the end of sixty-one days he is doing perfectly well.

other assignable cause. Excision by a single straight incision. Articular surfaces of humerus, radius, and ulna found in a carious condition. Discharged at the end of six weeks.

Condition Six Years after the Excision. — Since leaving the hospital has worked in a cemetery, digging graves, wheeling a barrow, etc., and now uses the arm for every purpose as well as the other. On examination it is found that though he cannot completely extend it there is excellent flexion, pronation, and supination. Two years ago had trouble in his knee, with suppuration, ending in a complete ankylosis.

CASE XVI. *Disorganized Joint; Excision; Recovery with a Useful Arm.* — A colored man aged twenty-three, struck his elbow violently against a cart-wheel. Six weeks afterwards the joint was hopelessly diseased with fistulous openings. Excised through a single straight incision. Discharged at the end of six weeks.

Condition Five Years after the Excision. — Can use the arm for everything that he could before the operation, except carrying a "hod;" can use a pickaxe or shovel as well as he ever did. Pitches hay and shovels coal. "Mowed all summer, eighteen hours a day." "Is not left-handed, but can lift more with the injured arm (the left one) than he can with the right." At present "works ten hours a day as a gardener."

CASE XVII. *Chronic Disease of Joint; Excision; Recovery with a Useful Arm.* — A colored woman aged sixty-one years. For three years, disease of the elbow-joint. Several fistulous and suppurating openings; motions limited. Excision through a single straight incision. Discharged three months after operation.

Condition One Year after Excision. — Has excellent flexion, extension, pronation, and supination. Can knit, sew, darn stockings, or lift a chair with perfect ease. Has good use of the wrist and fingers, as implied by the above statement. Is still gaining strength in the limb.

CASE XVIII. *Chronic Inflammation of Joint; Excision; Recovery.* — A man aged twenty-four. Nine weeks ago his elbow, which had previously troubled him, became painful and swollen. The arm is now extended and nearly motionless, with three fistulous openings into the joint. Excision was performed through a single straight incision. Repeated attacks of mild erysipelas delayed his discharge until three months after the operation.

Condition Eight Months after the Excision. — He writes that "the arm is gaining strength every day," but does not specify in his letter how much or what he is able to do with it.

EXCISIONS FOR DEFORMITY.

CASE XIX. *Ankylosis; Excision; Recovery with a Useful Arm.* — A man aged twenty-nine. Complete bony ankylosis between the ulna and humerus from an injury, three years before admission. Radius

rotates freely, but there is a large mass of ossific deposit about the lower end of the humerus and the olecranon. Excision performed through a single straight incision six inches long, removing with difficulty a shapeless mass of bone, very thick, and two inches in length. The operation was a bloody one, and a large number of ligatures were required. At the expiration of three months a renewed deposit of bone formed, and, in spite of passive motion under ether, ankylosis again occurred. A second excision was performed, three inches of bone being removed. The radius was found firmly united to the humerus by strong ligamentous bands. The ulna was lengthened upwards and beyond the junction of the radius and humerus. Discharged five weeks after the second operation.

The difficulties attending excision for ankylosis are remarked upon by Dr. Hodges in his *Excision of Joints*, and it is stated that, "if the bones are not removed so freely as to leave a considerable interval between them, the tendency to reunion will be with difficulty overcome." The operator considers that inattention to this maxim occasioned the necessity of a second excision.

Condition Five Years after the Excision. — No better statement of the ultimate result of this case can be given than the following letter from the patient himself.

March 12, 1876.

SIR, — Yours of the 11th inst. received by me to-day, and in reply to the first inquiry, Is it my right or left hand? It was the right. And if it was the right, if I could write? Yes, as well as ever. Second, How much can I lift. Never tested as to lifting, but in wheeling a barrow, say five or six hundred pounds, can do it without any injury; or in shoveling, don't hurt me in any way; also in carrying parcels, one is just as useful as the other. What I can take in one hand, shift it to the other, and it is just the same. Next inquiry is, If I could put the injured hand to the top of my head. Yes, readily. Also, if I can straighten the arm. Yes, completely. Next inquiry is, can I touch the shoulder of the injured side. Yes, as readily as I could before being injured. Next is, can I rotate the hand. Yes, can whirl it or twist it as fast as the other. Then you say, please state what assistance the arm is to me in any ordinary occupation. It is as useful to me as ever it was previous to my being hurt, and if I could afford it I would go in person and let you see that what I have written above is correct. I can shave myself with the right hand just the same as before being injured; in fact, can do everything under hand just the same. I remain, most respectfully,

W. R.

CASE XX. *Cicatrix from a Burn; Ankylosis; Death from Hæmorrhage.* — A female aged fourteen. Some years before admission, her arm, axilla, and side were severely burned. An ulcerated and granulating surface persists in the vicinity of the elbow-joint. Muscles of the arm and fore-arm atrophied, and motions of the elbow arrested by cicatricial tissue which extends around the joint and for some distance above and below it. Fore-arm flexed upon the arm at an acute angle. Hand partially flexed and supinated. Excision by a single straight incision. Ten ligatures applied, the wound, as might be expected, being very vascular. Two days afterwards severe secondary

hæmorrhage occurred, which required five bleeding points to be tied. She gradually failed, and died four days from the time of operation.

In explanation of this result, it should be said that this patient was an exceedingly feeble girl, and, as an autopsy showed, the subject of tuberculous lungs. The hæmorrhage took place in the night, unknown to herself, and was overlooked by her attendants, until no other termination than that which followed could be expected.

CASE XXI. Anchylosis from Unreduced Dislocation; Excision; Recovery with a Useful Arm. — A man aged twenty-seven. One year ago dislocated both bones of the forearm backwards. An unsuccessful attempt at reduction, twenty days after the accident, resulted in making the injury compound, the wound being on the anterior surface of the joint. Several openings communicating with the joint continue to discharge, and bits of bone have exfoliated. The arm is extended and anchylosed, with the hand pronated. The integuments are tightly stretched over the back of the elbow joint. Excision was performed through a single straight incision, and the removal of the articulation, anchylosed by ligamentous union, was effected with difficulty. Two inches of bone were excised. Sharp secondary hæmorrhage occurred five hours after the operation, and again on the following morning. These hæmorrhages were repeated at intervals, during the succeeding month, and after the wound had filled with granulations. They were apparently due to the impaired health of the patient. They never required ligature of any vessel, but always stopped by compression. They debilitated and demoralized the man to such an extent, that he eloped from the hospital seven weeks after the operation.

Condition Eight Months after the Excision. — From neglect to use the arm considerable stiffness has resulted. Two months ago he was etherized, and the false joint easily carried through the full motions of extension and flexion, but not of pronation and supination. At present carries the arm at a right angle, and can slowly flex and extend it through a quarter of a circle, neither complete flexion or extension being attained. The muscles of the upper arm are recovering from their extremely atrophied condition, and the motions of the wrist and fingers are perfect.

The treatment pursued in these excisions can be briefly stated. The wound was invariably closed with sutures. The arm, after the operation, was laid upon a pillow, flexed at an angle of 135°, that being the position most comfortable for the patient. Local inflammation, abscesses, pain, etc., were met by active measures based on general surgical principles. A generous diet was always allowed and encouraged. When the arm was in a state to permit of bandaging, an internal angular splint of tin, broader than usually adopted for fractures,

and fitted as regards length to each individual case, was applied, and the patient allowed to get up and walk about, the wound being dressed without the removal of the splint. The time spent in the hospital was not great; one patient remained seventeen weeks, the others an average of about nine weeks. When discharged the splint was usually dispensed with, and a sling substituted. Passive motion was rarely practiced beyond that which came from such use of the limb as patients could be persuaded to make, and a useful arm was seldom obtained before the end of a year from the time of excision.

In twenty-one cases where amputation must otherwise have been performed, this report exhibits fifteen arms preserved, several of them being useful to a remarkable degree, and all of them, except one, retaining motion of the elbow, fore-arm, hand, and fingers. These excellent results suggest the inquiry whether this operation is not deserving of a broader application. A successful excision always leaves an arm more serviceable than one in which ankylosis has taken place after a bad fracture unaccompanied by a wound. Professor Busch, of Bonn, has twice excised with success the entire joint, for irreducible dislocation of the head of the radius, both pronation and supination being regained. A measure which of itself, in civil practice, so seldom occasions a fatal result, would seem more than merely justifiable in this seemingly trivial but thoroughly disabling accident, in which reduction is often impossible, or, if possible, so rare to maintain.

Excision of the elbow was first performed in the United States, in 1834, at the Massachusetts General Hospital, by the late Dr. John C. Warren, and although now very generally practiced in certain classes of injury and disease, it may still be doubted whether, in this brief period of forty years, the full range of usefulness has been reached which belongs to this invaluable operation.

RECENT PROGRESS IN MEDICAL CHEMISTRY.

BY E. S. WOOD, M. D.

Fermentation of Urine. — The method of preparing delicate test paper for the detection of urea in the urine or other fluid has been previously referred to in these reports.¹ M. Musculus has continued his researches upon this subject, and now recommends² the ropy alkaline urine of a patient with cystitis as the best material from which to obtain the ferment which causes the decomposition of urea to ammonia and carbonic acid. Such a specimen of urine should be precipitated with strong alcohol and filtered. The alcohol precipitates the mucus, etc., and renders the separation of the solid from the fluid by filtration very easy. The precip-

¹ The JOURNAL, July 2, 1874.

² Archiv der Physiologie, xii. 214.