

The Journal of the American Medical Association

Published under the Auspices of the Board of Trustees.

VOL. XXXVI.

CHICAGO, ILLINOIS, MAY 18, 1901.

No. 20.

Original Articles.

AMPUTATION THROUGH THE HIP-JOINT WITH A SYNOPSIS OF 267 CASES IN WHICH THE AUTHOR'S METHOD WAS EMPLOYED.*

JOHN A. WYETH, M.D.
NEW YORK CITY.

From the dawn of surgery to within a very recent period, amputation at the hip-joint has been considered one of the gravest surgical operations.

In 1808 Earle¹ described it as "unjustifiable," and said: "I have seen it done and am now very sure that I will never do it unless it be on a dead body." In the third edition of his "Principles of Military Surgery," Hennen,² in 1829, said: "Obliged as we are, coolly to form our calculations in human blood, there is still something in the idea of removing the quarter of a man, at which the boldest mind naturally recoils. There is not one patient in a thousand that would not prefer instant death to the attempt." Even as late as 1881, Prof. John Ashhurst, Jr.,³ one of the highest authorities in modern surgery, wrote: "The removal of the lower limb at the coxo-femoral articulation may be properly regarded as the gravest operation that the surgeon is ever called upon to perform, and it is only within a comparatively recent period that it has been accepted as a justifiable procedure."

ORIGIN.

The origin of this amputation is involved in no little obscurity. Dr. Louis Coronat⁴ claims that at about the beginning of the eighteenth century a French surgeon, Morand, was the first to have the boldness to conceive the idea of severing the lower extremity from the body at the coxo-femoral articulation, and that the first operation of this nature was done by Lacroix, of Orleans, in 1748. It is now well known that this operation by Lacroix was in no sense an amputation at the hip. The ligamentum teres and the sciatic nerve were the only tissues which had not completely sloughed away at the line of demarcation in a case of gangrene which destroyed the entire lower extremity, and these Lacroix divided with scissors.

In the fourth volume of "Sabatier's Médecine Opérative," published in 1832, there is an account of another operation of this character, done by Perault in the case of Francois Gois, a man 21 years of age, whose thigh had been crushed by the pole of a wagon. Septic infection followed by extensive suppuration and gangrene ensued until all the soft parts were dead and were separated from the bone—*le femur était disséqué de toutes*

parts. Through these gangrenous and bloodless soft tissues the amputation was made.

Mr. Frederick Treves, in Volume I of his "Manual of Operative Surgery," claims that Mr. Henry Thomson, surgeon to the London Hospital, was the first to perform this operation, about 1777, but the first clearly authentic record of an amputation at the hip-joint, through living tissues, is of one performed by Mr. Kerr of Northampton, in 1778, on a girl of 11 years, who was suffering from destructive osteo-arthritis at the hip and who survived the operation eighteen days.⁵ The early history of this procedure should not be passed over without mentioning the name of the French surgeon, Ravaton, who in 1743 clearly and distinctly proposed a method of amputation with disarticulation at the hip-joint, although he did not live to carry into actual practice the operation he devised.

Professor Ashhurst, writing in 1881, voiced the accepted opinion of surgeons when he said: "The most pressing risk in amputation at the hip-joint is that of hemorrhage," and with this fact in mind it is not surprising that the ingenuity of surgeons has been earnestly employed in devising means for controlling the circulation.

CONTROL OF HEMORRHAGE.

Beginning with compression of the aorta by digital or mechanical means, as advised by Pancoast, Lister, Abernethy, Donald Maclean and others, and later the intrarectal lever of Davy for compressing the common iliac artery against the pelvis, the first really valuable suggestion for controlling hemorrhage was that of Richard Volkmann, the distinguished German surgeon.⁶ In 1874 he reported three cases of hip-joint amputation in which he had used the Esmarch elastic bandage for driving the blood out of the member to be amputated into the body, and then had placed an elastic loop in the femoro-scrotal commissure, drawing the ends upward and outward, the anterior passing parallel with Poupart's ligament, the posterior near the gluteal fold, in which position it was held by an assistant. To further secure it in position loops of roller bandage were thrown beneath the rubber tourniquet in front and behind, and upon these, during the operation, upward traction was also made by an assistant. In two of these cases there was no hemorrhage. In one, Volkmann says, "a severe hemorrhage occurred which I succeeded in stopping by compression."⁷ Of the three cases two died. It may be that the hemorrhage in one case and the fatal result in two of the three operated upon discouraged surgeons at large from repeating this innovation of Volkmann's. But scant mention was made of it in surgical literature, and it is well known the method was not adopted.

In *The Lancet* in 1883, Mr. Jordan Lloyd advised the use of the figure-of-eight elastic bandage which included

* Read before the New York State Medical Association, October, 1900.

the posterior aspect of the thigh in its grasp and then passed over the rim of the pelvis, and around the body, making compression of the external iliac by means of a roller bandage placed over this artery. But this method, as in the case of Volkmann, did not meet with the consideration it deserved and failed to be generally adopted.

The use of the needle or skewer for the control of hemorrhage in amputation at the hip was first employed on July 28, 1880, by Trendelenburg, at the suggestion of Newman.⁸ "A steel needle 38 cm. long, 6 mm. broad, biconvex on cross section, and in the thickest portion or center 2 mm. thick, was inserted just below the anterior iliac spine and carried in the direction of the perineum, passing between the neck of the femur and the vessels, and emerging on the inner aspect of the thigh, near the perineo-femoral crease. A figure-of-eight ligature was then thrown over the ends of the needle and in front of the thigh, thus constricting the femoral artery and vein. The limb having been previously emptied of blood by the application of Esmarch's bandage as high as the middle of the thigh, a long knife

nerve. A piece of cord was passed under the heel and point of the needle, forming a figure-of-eight ligature."

Myles, of England, advised a slight modification of the Newman-Trendelenburg procedure. A steel skewer was passed through the thigh, the point entering an inch below Poupart's ligament, going external to the femoral artery and internal to the neck of the femur and emerging a little above the gluteal fold. An India-rubber cord in figure-of-eight fashion was then to be thrown over the ends of the skewer and the inner aspect of the thigh. The amputation was by lateral flaps.

Author's Method.—In theory and practice it is clear that any method of constriction which does not with absolute safety control all of the blood-vessels at the level of the hip-joint must prove unsatisfactory. In 1888 I removed the outer half of the clavicle, the glenoid, acromion, and coracoid processes, and part of the body of the scapula, together with the upper extremity, of a patient suffering from a large sarcoma of the head of the humerus. Not wishing to perform a preliminary deligation of the subclavian in its third division, I transfixed, with a stout mattress needle, the major pectoral

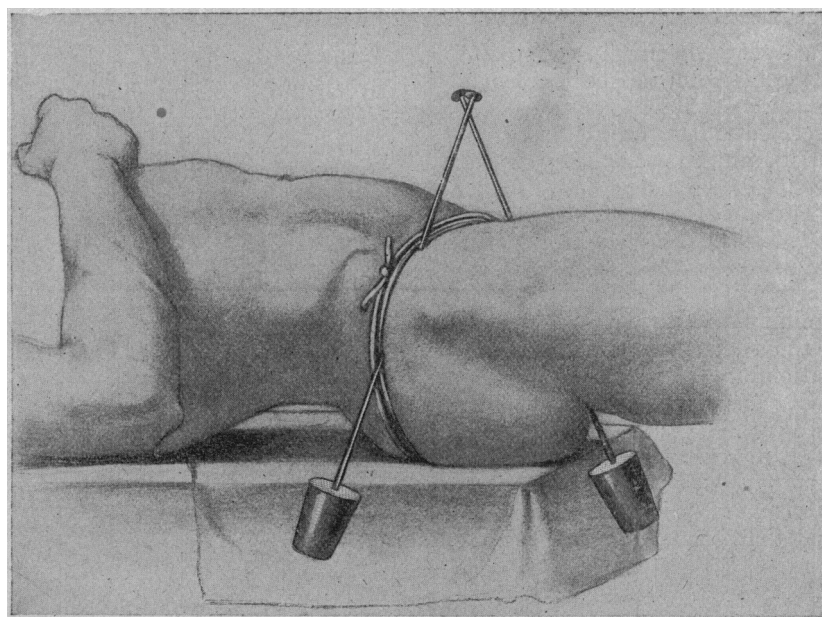


Fig. 277.—Hip-joint amputation. Pins and rubber-tube tourniquet in position. The Esmarch bandage has been removed.

From Text-Book on Surgery. Copyright, 1897, by D. Appleton & Co.

was carried through the front of the thigh 2 cm. beyond the needle and parallel with it (Lisfranc), and a flap formed by cutting by transfixion. The vessels were then tied, and the needle and figure-of-eight loop removed, and the head of the femur disarticulated. The needle was again introduced behind the bone, the figure-of-eight carried posteriorly, and the posterior flap then formed."

In 1886 (August 10), Dr. Muscroft,⁹ of Cincinnati, employed a somewhat similar method: "A needle one-eighth of an inch wide, slightly bent at the point, about the thickness of a dime and four inches long, was introduced perpendicularly into the front of the thigh about an inch and a half below Poupart's ligament. The exact point of entrance was one-fourth of an inch internal to the combined sheaths of the vein, artery and nerve. The point was pushed beyond the vessels, then turned outward until the needle had passed beyond them; the point was then pushed out through the integument. The needle was then behind the vessels and

muscle about three inches from the shoulder, and, at about the same distance from the joint on the dorsum scapulæ, I introduced a second needle in such a way that when I carried a strong rubber tube several times around the shoulder, above these needles, with strong traction, the compression was so great that hemorrhage was controlled during the amputation. It occurred to me at the time that the same plan was equally feasible at the hip. In February, 1890, I successfully applied this method in my first hip-joint amputation, and in the improvements which have been made on the original technique I believe I have demonstrated and established an operation in which hemorrhage in amputation at the hip-joint is as safely and as easily controlled as at any other portion of the thigh.

The patient should be placed with the sacrum resting upon the corner of the operating-table, the sound limb and arms being wrapped with cotton batting, and the body thoroughly protected from unnecessary loss of heat. The member to be removed should be emptied of blood

by elevation of the foot and by the application of the Esmarch bandage, commencing at the toes. When a tumor exists, or when septic infiltration is present, pressure should be exercised only to within about six inches of the diseased area for fear of driving the new elements or septic material into the circulation. After injuries with great destruction—crushing or pulpification—one must often trust to elevation alone, as the Esmarch bandage can not always be applied. In this last group of cases where hemorrhage more or less severe has occurred, the injection of a sufficient quantity of normal salt solution should precede any operation. Before the Esmarch bandage is removed the rubber tubing constrictor should be applied. The object of this constriction is the perfect occlusion of every vessel above the level of the hip-joint, permitting the flaps to be made, disarticulation to be completed and the vessels secured without hemorrhage and before the tourniquet is removed. To render the manipulation of the femur, in the process of disarticulation, free from the danger of the tourniquet slipping, I employ two strong steel needles or skewers, three-sixteenths of an inch in diam-

cepting the small quantity of blood between the limit of the Esmarch bandage below and the constricting tube above, the extremity is bloodless and will so remain.

In several instances surgeons have operated successfully and with satisfactory control of hemorrhage by using only one of the pins as above described—the outer—and by employing assistants to hold the rubber tubing in place. The operation has even been done successfully without the use of pins, but since these, if properly employed, are not at all in the operator's way, and since they render additional assistance unnecessary and assure safety by holding the tourniquet securely in place during the manipulations which are necessary to disarticulate the femur in the critical period of the operation, I hold they are essential in obtaining the best possible results.

In making the flaps no fixed rule can be laid down. The surgeon should always be guided by the conditions within the field of operation. The accepted principle that the danger from shock diminishes in proportion to the distance of the amputation from the trunk should not be overlooked. When done for osteomyelitis or for

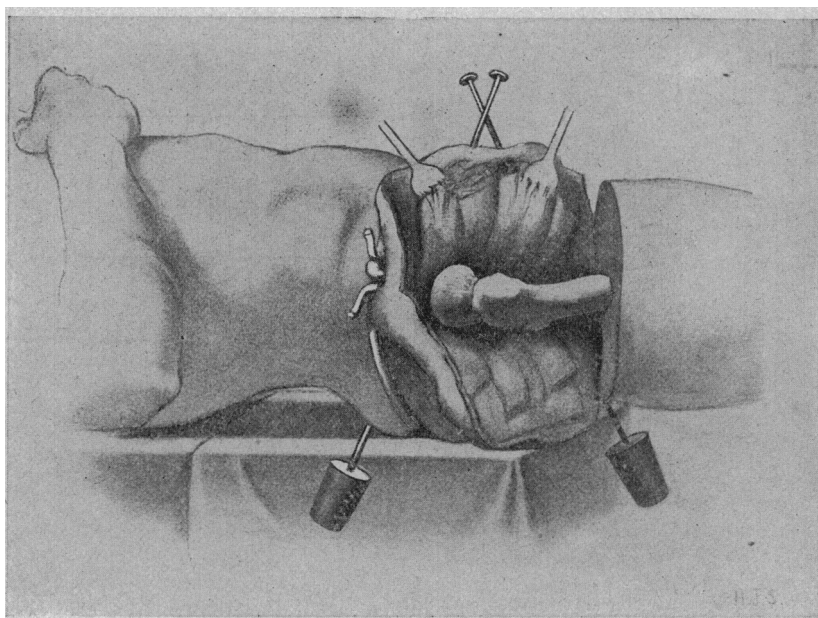


FIG. 278.—The same, showing the soft parts dissected from the bone and the capsule exposed.
From Text-Book on Surgery. Copyright, 1897, by D. Appleton & Co.

eter and ten inches long. One of these is introduced one-fourth of an inch below the anterior superior spine of the ilium and slightly to the inner side of this prominence, and is made to traverse superficially, for about three inches, the muscles and fascia on the outer side of the hip, emerging on a level with the point of entrance. The point of the second needle is thrust through the skin and tendon of origin of the adductor longus muscle one-half an inch below the femoro-perineal commissure or crotch, the point emerging just below the tuber ischii. The points should be shielded at once with cork to prevent any possible injury to the operator. No vessels are endangered by these pins. A mat or compress of sterile gauze, about two inches thick and four inches square, is laid over the femoral artery and vein as they cross the brim of the pelvis, and over this a piece of strong white rubber tubing one-half inch in diameter when unstretched, and long enough, when in position, to go five or six times around the thigh, is now wound very tightly around and above the fixation needles and tied. The Esmarch bandage is now removed and, ex-

cepting the small quantity of blood between the limit of the Esmarch bandage below and the constricting tube above, the extremity is bloodless and will so remain. In several instances surgeons have operated successfully and with satisfactory control of hemorrhage by using only one of the pins as above described—the outer—and by employing assistants to hold the rubber tubing in place. The operation has even been done successfully without the use of pins, but since these, if properly employed, are not at all in the operator's way, and since they render additional assistance unnecessary and assure safety by holding the tourniquet securely in place during the manipulations which are necessary to disarticulate the femur in the critical period of the operation, I hold they are essential in obtaining the best possible results. In making the flaps no fixed rule can be laid down. The surgeon should always be guided by the conditions within the field of operation. The accepted principle that the danger from shock diminishes in proportion to the distance of the amputation from the trunk should not be overlooked. When done for osteomyelitis or for

accident, where the conditions will permit, the soft structures should be divided at the junction of the middle with the upper third. A perpendicular incision commencing above the trochanter and carried down to the bone along the outer aspect of the hip and thigh should join the transverse incision. With the elevator, the muscles should be lifted from the bone or divided with a scissors or bistoury very close to the periosteum. When the capsule is reached this should be divided on its upper aspect, keeping the point of the bistoury always directed toward the center of the neck. The thigh should now be flexed on the abdomen, and after cutting across the capsule posteriorly, forcibly abducted and rotated until the ligamentum teres is ruptured, and the disarticulation completed. The leverage of the undivided femur is of invaluable aid in freeing the head of the bone from the socket. The vessels should now be tied with strong catgut.

In addition to the femoral arteries and veins, the following vessels must be secured: the saphenous vein, which on account of its proximity to the main trunk,

should be tied; the sciatic artery, which will be found near the stump of the sciatic nerve; the obturator, which is situated between the stump of the adductor brevis and magnus, usually about half way from the center of the shaft of the femur to the inner side of the thigh, the vessels being on a level with the anterior surface of the femur; the descending branches of the external circumflex two or three in number, usually found about an inch and a half outward and downward from the main femoral vessels beneath the rectus and in the substance of the crureus and vastus externus. The descending branches of the internal circumflex are insignificant and are usually in the substance of the adductor longus and between it and the adductor brevis and pectineus, only a little below the level of the femoral artery.

It is a wise precaution at this stage of the operation to loosen slowly the grasp of the tourniquet until the pulsation of the larger trunks is perceptible in order to be sure that none of the vessels have been overlooked. To prevent the oozing which is more or less extensive in operations through such large masses of muscular tissue, I introduce a wick of sterile gauze into the cavity

keeps farthest from the tumor and gives the healthiest flaps. When there is scant material to cover the stump, it is even safer to err on the side of an unclosed wound and trust to granulation or grafting for ultimate closing. I employ silkworm gut sutures for uniting the flaps, leaving no drainage excepting the ribbon of sterile gauze which is packed into the acetabulum and the space from which the bone was removed. It is usually withdrawn at the first dressing, about a week after the operation, and its place taken by a small-sized drainage-tube.

In order to preclude the oozing which is likely to occur in such an extensive wound as an amputation at the hip necessitates, before tightening the silkworm gut sutures, I thoroughly dry out the flaps with sterile absorbent gauze, and while the constricting tourniquet is still in place, tighten the sutures and apply a light dressing of loose gauze which envelops the stump. Over this a gauze bandage is applied, making sufficient compression to prevent the transudation of serum or the oozing of blood. Additional loose gauze is now laid over the stump and is held there by firm compression with the hands of an assistant while the tourniquet is

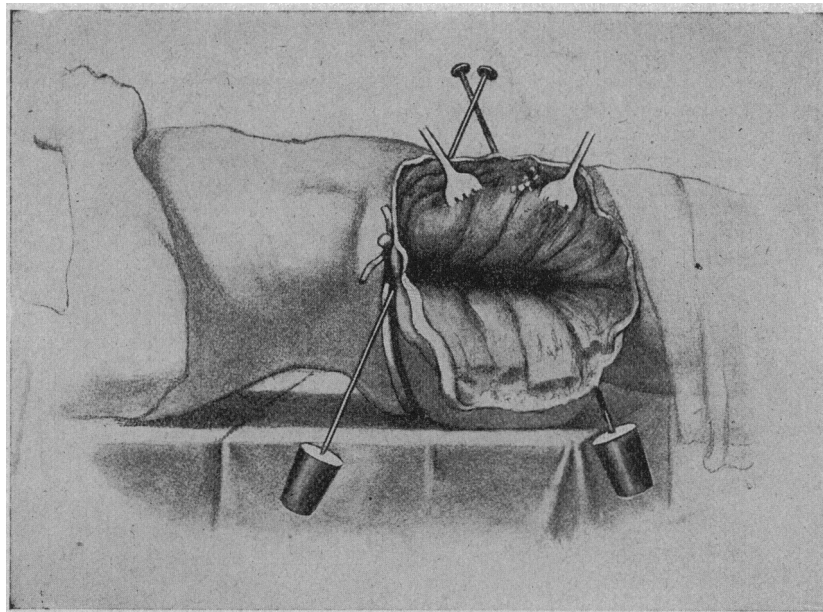


FIG. 279.—The same, with the disarticulation complete. Constrictor still in position.

From Text-Book on Surgery. Copyright, 1897, by D. Appleton & Co.

of the acetabulum, packing this thoroughly in the space between the muscles from which the bone has been dissected, leaving one end of the wick to pass out between the flaps for the purpose of its removal. In addition to this, with a long half-curved Hagedorn needle, armed with good-sized catgut, deep sutures are then passed through the stumps of the divided muscles, taking three or four inches in the grasp of each suture. In this way large masses of muscle are brought snugly together when these sutures are tied.

This method of forming the flaps and of disarticulating the femur was practically the operation devised by Ravaton in 1743, and was the method employed at Bardstown, Ky., in August, 1806, by Dr. Walter Brashear, the first hip-joint amputation made in the United States.¹⁰

When, from destruction of the parts by accident or disease, or from the proximity of a neoplasm, this ideal method is not practicable, any modification may be employed, preference being given to the incision which

loosened, and it, with the pins, removed. A figure-of-eight spica is then thrown over the stump and around the waist, the final turns of which give support to the stump and hold it snugly against the pelvis.

With these precautions I have not been troubled with the oozing which has been complained of by some experienced operators. It is a wise precaution to lower the upper extremity of the patient before removing the tourniquet, as this partial Trendelenburg posture takes off some of the pressure in the arteries at the seat of operation. In fact, in the case of injury where extensive hemorrhage has already occurred, it is better to operate with the patient in this position, even when the intravenous injection of salt solution has been employed.

Method of Digital Compression.—Within recent years two other methods having for their object the control of hemorrhage in amputation at or near the hip-joint have been successfully tried and are recognized by surgeons of reputation and experience. In a paper read at the meeting of the Surgeons of the Pennsylvania

Company, at Pittsburg, in 1888, Dr. J. J. Buchanan suggested the propriety of making an abdominal section under strict antiseptic precautions, and of having an assistant introduce the hand to control, by digital compression, the descending aorta, while the amputation was being made. This suggestion was received with favor by the surgeons then present, and afterward published in "Stemen's Railway Surgery" (1890). As with many other pioneers in surgery, Dr. Buchanan did not have the opportunity of carrying his operation into execution, but Dr. Neal Hardy, of Sandusky, Ohio, who was present at the meeting in Pittsburg, where Dr. Buchanan's paper was read, in November, 1890, applied it with success upon a male patient, 34 years of age. Applying this idea of digital compression within the peritoneal cavity, to the common iliac artery, Dr. Charles McBurney, of New York, has within recent years performed several amputations at the hip-joint, and has commended the procedure.

Method of Gradual Dissection.—Another method worthy of consideration by reason of the distinguished surgeon who commends it, Dr. W. L. Estes, of Beth-

will hold good when applied to the method advised by Dr. McBurney. Notwithstanding the too common assertion that opening the abdominal wall and invading the peritoneal cavity under aseptic precautions is not dangerous, and that the gridiron incision carries no risk of hernia with it, I insist and believe the vast majority of surgeons will endorse this position—that we should never enter the abdominal cavity when it can be avoided. Every minute of time unnecessarily lost and every unnecessary traumatism are factors in increasing the danger of shock, and this is the greatest danger in hip-joint amputation. Moreover, compression applied to the common iliac artery for anatomical reasons can not control the circulation in the field of operation as well as the constricting tourniquet when employed with the pins, for the reason that the free anastomosis with branches of the opposite iliac within the pelvis and upon the abdomen must, under the increased arterial pressure, cause the loss of a considerable quantity of blood, especially from the posterior flap.

Results of Author's Method.—The accompanying tables contain 267 cases of amputation at the hip-joint,

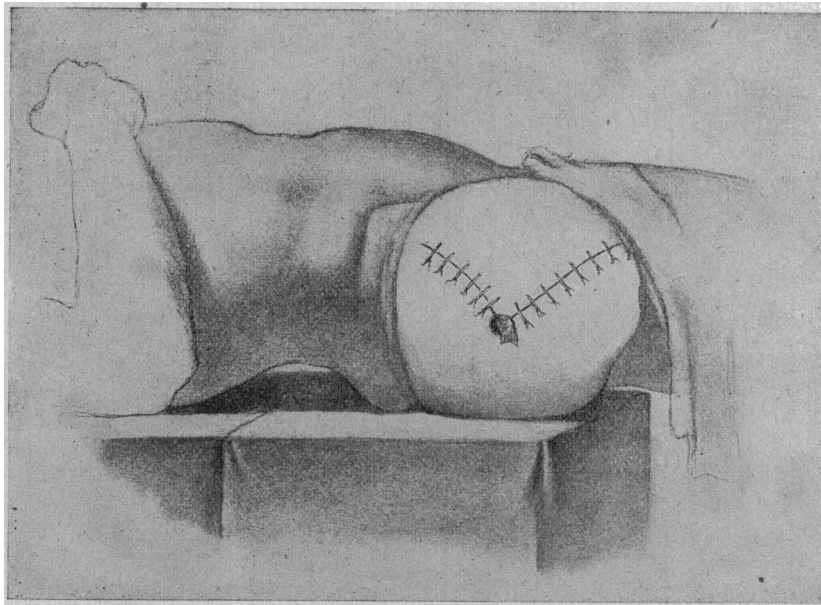


FIG. 280.—The operation completed

From Text-Book on Surgery. Copyright, 1897, by D. Appleton & Co.

lehem, Pa., is that of gradual dissection in which the femoral vessels are first exposed, tied and divided between two sets of ligatures. The flaps are then formed as may be indicated, and the soft parts divided as for any operation of the body where a tourniquet can not be employed, all known vessels being secured before they are divided and all others caught with the forceps as soon as severed.

Objections.—There are several serious objections to these methods which I insist do not hold good as compared to the method which I have advised. Compression of the abdominal aorta, as recommended by Dr. Buchanan, of Pittsburg, and practiced by Dr. Neal Hardy, of Sandusky, Ohio, is objectionable in the first place because it interferes very seriously with the general circulation and throws a dangerous volume of blood upon the heart and lungs. In Dr. Hardy's case, he says: "The patient during the operation became cyanotic, but was soon relieved on pressure being removed from the aorta." Again, it necessitates an unnecessary invasion of the peritoneal cavity. This latter criticism

in which the writer's method of hemostasis was employed. For convenience of study they are classified into three groups: 1, neoplasms, including sarcoma, carcinoma, epithelioma and one case of elephantiasis and probably one osteoma; 2, septic infections, including pyogenic ostitis or osteomyelitis, tuberculous ostitis or osteoarthritis, gangrene, cellulitis and ulcer; 3, injuries, with or without pyogenic infection.

In the group of amputations at the hip for neoplasms, all of which were malignant in character—with the exception of one case of elephantiasis and one of osteoma—there were 131 cases of sarcoma, 5 of epithelioma of the soft parts, and one reported as osteocarcinoma. None died in this group, excepting 14 fatal cases of the subdivision of sarcoma, giving the rate of mortality in disarticulation at the hip for sarcoma as 10.6 per cent., while for the whole group of 137 cases, the death-rate was 10.2 per cent. Of the fatal cases 1 was complicated with gangrene for two weeks before the operation, and had a rectal temperature of 104° at the time of amputation, and died of shock twenty-four hours

MALIGNANT NEOPLASMS; SARCOMA, CARCINOMA, EPITHELIOMA.

No.	Operator.	Date, Sex, Age.	Cause of Operation.	Result.	Remarks.
1	J. A. Wyeth	1890 M. 39	Osteosarcoma, middle lower third of femur.	Recover'd	Femur first divided at level of lesser trochanter. Sixteen days later head and neck of bone enucleated.
2	"	1890 " 34	Neurosarcoma	"	Tumor of internal popliteal nerve was extirpated but recurred. Amputation at lower third of thigh; recurred and amputation at hip.
3	"	1892 F. 17	Osteosarcoma.	"	Amputation through lower third of femur had been done by Dr. Allen of Cleveland, Ohio. Recurred in stump. Died six months after operation from recurrence in abdominal viscera. No pulmonary symptoms.
4	"	1894 M. 19	Osteosarcoma.	Died	Rallied well from operation; twenty-six hours later pulse suddenly rapid and weak. Injection of two pints warm saline solution. Death forty hours after operation. Ether was the anesthetic. No renal or other lesions. Wound not septic.
5	"	1895 " 20	Osteosarcoma.	Recover'd	Died one year after operation from "rapid pneumonia." Probably recurrence of sarcoma in lungs.
6	"	1898 " 34	Sarcoma	"	Large sarcoma attached to trochanteric region of femur and infiltrating the soft tissues as high as the obturator foramen. This cavity was curetted in order to remove all suspicious tissues. The anterior incision was close to the tourniquet to get above the neoplasm. No recurrence two and one-half years after operation.
7	J. A. Wyeth and J. A. Bodine.	1895 " 18	Osteosarcoma.	"	No subsequent history.
8	A. M. Phelps	1891 " 55	"	"	No recurrence in 1898.
9	"	1895 " 16	"	"	No recurrence in 1898 when patient was last heard from.
10	Emory Lanphear.	1892 F. 28	Osteoma of femur	"	"
11	"	1898 M. 19	Osteosarcoma.	"	"
12	H. O. Walker.	1892 " 19	"	"	"
13	C. B. Nancrede.	1892 " 32	"	"	"
14	"	1894 " 35	Sarcoma.	"	"
15	"	1894 F. 16	"	"	"
16	"	1895 M. 30	"	"	"
17	"	1897 F. 16	"	"	"
18	William F. Fluhrer.	1890 " 18	Osteosarcoma of femur.	"	Spontaneous fracture at middle of thigh, April 26, 1890. "As little blood was lost as in an ordinary amputation at the middle of the thigh." Recurrence in stump in about six months and death.
19	Charles McBurney.	1890 M. 34	"	"	"No other appliance that has been suggested for the purpose could in any way compare in utility with that of Dr. Wyeth." No recurrence three months later. No subsequent history.
20	Frank Hartley	1892 F. 26	"	"	No recurrence two years later. No subsequent history.
21	Merrill Ricketts	1893 " 23	"	"	"The operation was entirely bloodless." Died eighteen months; recurrence at sacro-iliac synchondrosis.
22	"	1894 M. 27	" lower end of femur.	Died	Death in ten hours in shock. Very little blood lost.
23	C. A. White	1891 " 23	Osteosarcoma.	Recover'd	Patient was up and about after the operation, but on the twenty-seventh day was seized with pneumonia and died five days later.
24	W. W. Keen.	1892 F. 30	"	"	Patient was five months pregnant at time of operation. "It was reserved for an American surgeon to devise what is undoubtedly the best method, and, in fact, what I think we can now call the only method of hemostasis in amputation at the hip-joint." Died in three or four years from recurrence in viscera. No mention of involvement of lungs,
25	M. J. Ahern.	1892 M. 22	"	"	"
26	J. B. Murdock.	1892 " 17	"	Died	Death from shock twenty-two hours after operation. "I believe this method to be the best and the one destined to supersede all other methods for temporary arrest of hemorrhage."
27	J. McFadden Gaston.	1890 " "	"	Recover'd	Death on the twenty-sixth day from septicemia. "There was absolutely no trouble from hemorrhage, and I feel satisfied that with this process all bleeding may be prevented in amputation at the hip-joint."
28	A. J. McCosh.	1892 " 27	"	"	"
29	F. W. Parham	1893 " 3	"	"	Not having the surgical pins in this child large glass-headed lady's hat pins were successfully substituted. Died from recurrence in lungs six months after operation.
30	"	1899 F. 5m	Myxosarcoma of left knee.	"	"The tumor seems to have existed at birth and had grown rapidly during the preceding weeks. Fourteen months later child well.
31	J. M. Holloway.	1892 M. 27	Osteosarcoma.	"	Patient was discharged from hospital on the tenth and went to his home, a distance of seventy miles, on the twelfth day.
32	R. T. Morris.	1894 " 19	"Tumor" of thigh.	Died	Died eleven days after operation from tubercular peritonitis. Cause of death proved by autopsy. "While making the skin incisions, it was noticed that the limb was not completely exsanguinated, and the tourniquet was retightened, after which no bleeding resulted."
33	H. H. Vinke.	1894 F. 16	Sarcoma of thigh.	Recover'd	Used crutches in seven weeks. "Absolutely no loss of blood. There is probably no method which commends itself for simplicity and effectiveness so much as Wyeth's." Recurrence in two years in stump and mesenteric glands. Death.
34	J. S. Horsley	1894 M. 36	Recurring sarcoma of fascia of thigh	"	"No more blood was lost than in an amputation through the thigh. It remained for Dr. Wyeth to so perfect this method as to make this amputation practically a bloodless operation." Died in fourteen months from recurrence in lungs.
35	George W. Miel	1894 " 41	Osteosarcoma of thigh.	"	"A very satisfactory means of controlling hemorrhage." Died in eight months from recurrence in lung. No recurrence in stump. Lancinating pains in chest at time of operation.
36	F. Tilden Brown	1894 " 22	Round-cell osteosarcoma involving triceps femoris.	"	"Hemostatic effect all that could be desired." Died within a year from recurrence in lungs.
37	Robert Weir	1895 " "	Sarcoma of femur.	"	No recurrence up to February, 1898.
38	F. W. Murray	1894 " 18	"	"	Pins were by mistake made too small; they bent; caused hemorrhage. Died from recurrence in lungs about four years after operation.
39	W. T. Bull	1895 F. 5	Osteosarcoma of femur	"	Primary union; time of operation, 40 minutes. Died in seven months from recurrence in abdominal viscera.
40	Thomas R. Wright.	1895 M. "	Sarcoma of knee.	"	Died in eighteen months from recurrence in right lung.
41	"	1896 " 50	"	"	Lost comparatively no blood. Temp. 103 F. and pulse 120 before operation. Died in six months from apoplexy. Negro.
42	H. H. Grant	" F. 33	Chondroma with sarcomatous degeneration.	"	Enormous chondroma with sarcomatous degeneration; tumor weighed 65 pounds; operation lasted thirty-five minutes; bloodless except for oozing. "Method leaves nothing to be desired." No subsequent history.
43	"	1899 M. 43	Sarcoma of knee.	"	Died fourteen months after operation from recurrence in lymphatics of parts above Poupart's ligament.
44	W. R. Stewart.	1895 " 35	Sarcoma.	"	Was well November 19, 1896.
45	Eugene Boise.	1895 F. 21	"	"	No loss of blood. Vessels nearly all tied before tubing was removed. "Method of amputation is all that could be desired." Disease recurred very early in lungs.
46	L. L. Shropshire	1895 M. 20	Sarcoma, lower middle of left thigh.	"	Operation done in 30 minutes. Not over one ounce blood lost. Patient left hospital in two weeks; living and well February, 1901.
47	Howard Lienthal.	1896 " 16	Chondrosarcoma, from trochanter down.	"	"Method was employed to my great satisfaction."
48	J. D. Rushmore.	1896 F. 14	Sarcoma of femur	"	"
49	R. Matas	1896 M. 49	Sarcoma	"	No recognizable recurrence when last heard from, eighteen months after operation, but he was reported as developing "consumption," and very probably this was a metastatic process in the lung.
50	W. D. Hamilton.	1895 F. 48	"	Died	Neoplasm involved knee and lower end of femur. Died from shock in 5 hr.
51	"	1899 M. 56	"	Recover'd	Tumor of thigh. No recurrence February, 1901.
52	"	1900 F. 16	"	"	"

MALIGNANT NEOPLASMS; SARCOMA, CARCINOMA, EPITHELIOMA.—(Continued.)

No.	Operator.	Date, Sex, Age.	Cause of Operation.	Result.	Remarks.
53	Charles S. Hamilton.	1899 F. 32	Sarcoma	Recover'd	No recurrence in March, 1901—two years. Patient has borne a healthy child since operation.
54	Wm. H. Noble	1896 M. 21	Osteosarcoma of head of tibia.	Died. . . .	"Operation completed—patient in bed in forty-eight minutes. Died in collapse four hours later. Operation was absolutely bloodless, but the oozing afterward from the capillary vessels was very great, certainly half a pint, if not more, being lost."
55	W. B. Van Lennep . .	1894 F. . . .	Sarcoma	Recover'd	
56	" "	1895 " 24	" "	"	Died two years later with what was reported to Dr. L. as "acute lung trouble," or metastasis in lung. "Thorough occlusion of every vessel below the hip."
57	" "	1896 M. 56	Epithelioma.	"	
58	M. Banby, Toulouse, France.	1897 " 37	Sarcoma	"	"No hemorrhage, no shock, no fever." (Association Francaise de Chirurgie, 1897.) Recurred in stump one month after leaving hospital.
59	L. L. Hill	1893 " 35	Osteosarcoma.	"	Tumor measured forty-four inches in circumference.
60	Thos. F. Chavasse. . .	1896 F. 39	Endosteal sarcoma	Died. . . .	Neoplasm involved lower third of femur, where fracture had occurred six months previously. Death from shock in ten hours.
61	" "	1896 " 29	" "	Recover'd	Intravenous injection of fifteen ounces of saline fluid. Patient was six months pregnant. Dead fetus aborted one month after operation. Died thirteen months later from recurrence in left lung. Stump not affected.
62	" "	1899 M. 56	Periosteal Sarcoma	"	Neoplasm of lower third of femur, where fracture occurred three days before amputation. Soft parts infiltrated high up, necessitating division of muscles at level of acetabulum. One pint saline fluid. Died in eleven months from recurrence in both lungs. The stump was unaffected.
63	" "	1899 F. 23	Endosteal sarcoma.	"	Neoplasm infiltrated head of tibia, right knee-joint and belly of semi-membranous muscle. Eight months pregnant. Premature labor ten days before operation. Died in twelve months from recurrence in both lungs. Stump was not affected.
64	L. M. Tiffany.	1900 " 16	Osteosarcoma.	"	
65	W. H. Gilbert.	1899 M. 42	Carcinoma of shaft of femur.	"	
66	John B. Deaver. . . .	1899 F. 24	Sarcoma of femur.	"	
67	Robert G. Le Conte. .	1900 M. 18	Osteosarcoma, left femur . .	"	Time of operation thirty minutes. Recurrence in stump and death about six months after operation.
68	Jas. G. Garrard. . . .	1897 " 37	Epithelioma of lower half of left thigh.	"	Extensive burn of this extremity. About twenty years later epithelioma developed in cicatrix. Negro.
69	George Heaton, Birmingham, England.*	1896 F. 29	Periosteal sarcoma.	"	Living two years later. Very little shock in either of Mr. Heaton's cases.
70	George Heaton.	1898 M. 17	Round-celled sarcoma of muscles.	"	Left semi-membranous muscle. Died in fourteen months from recurrence of growth in stump.
71	J. F. Binnie.	1898 " 32	Sarcoma of femur.	"	Died several months after operation from recurrence.
72	W. E. Parker	1895 " 23	Osteosarcoma of femur	"	Living at last report, six months after operation.
73	E. D. Martin, New Orleans.	1895 F. 35	Sarcoma of knee	"	Six months later died with recurrence in stump.
74	E. D. Martin	1896 " 40	Sarcoma of femur	"	Both operations practically bloodless. No shock. No further history.
75	J. M. Maury.	" M. 54	Sarcoma	"	Neoplasm followed ten years after gunshot wound of femur and was situated near the knee. Suspicious signs in stump when patient left hospital. No subsequent history.
76	Wm. B. Coley.	1897 F. 11	Periosteal sarcoma of femur	"	Hemorrhage completely controlled. Rubber tubing left on until vessels had been tied, then slowly released, thus reducing the loss of blood to a mere trifle. No further history.
77	" "	1898 M. 6	" " " "	"	Died in six months from recurrence in lungs and abdomen.
78	" "	1898 F. 13	Chondrosarcoma of femur. . .	"	Died from recurrence in two years. Location of metastasis not given.
79	" "	1898 M. 49	Sarcoma of thigh (soft parts)	"	Died from recurrence in stump and iliac fossa eighteen months later.
80	" "	1899 F. 24	Sarcoma of thigh, fascia and muscles.	"	No recurrence January, 1901, about eighteen months.
81	" "	1900 M. 45	Osteosarcoma of femur following fracture.	"	Disarticulation completed in six minutes. No recurrence January, 1901, six months after operation.
82	R. W. Stewart	1895 " 35	Sarcoma, lower end of femur	"	No recurrence after two years.
83	" "	1900 " 47	" " " "	"	Less than an ounce of blood lost in either of these cases.
84	G. K. Dickinson . . .	1894 F. 50	Sarcoma of thigh.	Died. . . .	Gangrene commenced two weeks before operation. Rectal temperature was 104. Died in twenty-four hours.
85	W. C. Dugan	1894 M. 40	Osteosarcoma of condyle of femur.	Recover'd	Operation lasted thirty-five minutes. No recurrence in seven years.
86	" "	1898 " 17	Osteosarcoma of shaft.	"	To facilitate disarticulation "the thigh was flexed on abdomen and adducted while the capsular ligament was cut on the posterior inferior portion." Died from recurrence in abdominal viscera (glands and liver) in eighteen months.
87	B. F. Curtis.	1898 " 50	Recurrent sarcoma.	"	Neoplasm recurred after local extirpation. Disease not in stump. Death in few months.
88	Leonard Freeman . .	1896 " 49	Central osteosarcoma of lower third of left femur.	"	Spontaneous fracture while turning over in bed a few days before operation, Sept. 20, 1896. Rectal injection hot salt solution before operation. No recurrence in July, 1900.
89	D. C. Hawley.	1896 " 21	Osteosarcoma, femur.	"	No recurrence in 1900. Spontaneous fracture before operation.
90	J. H. Oliver.	1900 " 45	Epithelioma of anterior and outer surface of thigh, involving shaft of bone.	"	Died two months later from recurrence.
91	J. J. Clausen.	1894 " 22	Periosteal sarcoma, l. femur	"	No subsequent history obtainable. Negro.
92	Carl Beck.	1896 " 54	Osteosarcoma, right femur. .	"	Died two years later. Recurrence in pleura or lung.
93	H. A. Sifton.	1895 F. 39	Sarcoma	"	Died one year later with recurrence; location of recurrence not stated.
94	M. B. Herman.	" M. 24	" " " "	"	No recurrence in eight months; no later history obtainable.
95	C. B. Schoolfield. . .	1895 F. 65	Sarcoma, lower end of femur.	"	Tumor measured twenty-six inches in circumference.
96	Hunter P. Cooper. . .	1897 M. 30	Osteosarcoma of femur. . . .	"	Living and well two years later.
97	" "	1899 " 40	Large epithelioma of skin of thigh.	"	Inguinal glands removed.
98	W. S. Elkin.	1894 " 14	Osteosarcoma of femur. . . .	"	"The simplest and safest method at our command." Recurred in liver eighteen months after operation.
99	George R. Fowler. . .	1893 " 15	Sarcoma of lower end of femur.	"	Sail-maker's needles were used in absence of the steel pins. A Jordan Lloyd figure-of-8 was added for security. During the operation one of the needles gave way under pressure of the constricting rubber-tube, necessitating the tightening of the figure-of-8 bandage. Died in eighteen months from recurrence in lungs.
100	" "	1899 F. 20	Sarcoma of femur	"	Died eighteen months later from recurrence in viscera.
101	R. H. Whitehead. . .	1895 M. 16	Sarcoma of femur	Died. . . .	No bleeding. Died on night following operation. Cause not known.
102	Wm. D. Hilliard . . .	1898 F. 44	Osteosarcoma of left thigh. .	"	Unfortunately patient had severe hemorrhage just before she was brought into the operating room and was considered almost hopeless from any standpoint. Amputation perfectly bloodless. Died in short time; shock.
103	Ernest Laplace. . . .	1900 M. 26	Sarcoma of knee	Recover'd	Patient extremely weak at time of operation. About 2 oz. of blood lost.
104	J. J. Buchanan. . . .	1899 " 13	Sarcoma of femur	"	No blood lost. Death from recurrence in lungs six months later.
105	" "	1899 " 35	Epithelioma.	"	Epithelioma developed in discharging sinuses of old osteomyelitis. Thigh amputated at middle. Malignant disease returned and disarticulation of hip performed.
106	Floyd W. McRae . . .	1899 " 13	Osteosarcoma of right femur	"	Method bloodless, tube drainage, catgut sutures in stump of divided muscles, silkworm-gut sutures for flaps. Recovery uneventful. Recurred fatally in eleven months in the liver.
107	" "	1899 " 17	" " left femur	"	Recurred in left pleura near the pericardium within a year of operation.
108	W. B. Rogers.	1899 F. 37	" " " "	Died. . . .	There was no loss of blood, no shock or sepsis. Died from asphyxia on twelfth day. No postmortem. The symptoms pointed to rapid infiltration of the air-cells with metastatic products.

* See a third by Mr. Heaton at end of tables.

SEPTIC INFECTIONS, OSTEITIS, ARTHRITIS, OSTEO-ARTHRITIS, TUBERCULOSIS, GANGRENE, CELLULITIS, ULCER.—Continued.

No.	Operator.	Date, Sex, Age.	Cause of Operation	Result.	Remarks.
36	Thos. F. Chavasse* (England.)	1897 F. 14	Osteo-arthritis.	Died.	Death from exhaustion on fourth day. Intravenous injection of half a pint of saline fluid.
37	" " "	1897 F. 24	" " "	Recover'd	Syme's amputation for osteitis in 1895; one year later amputation at knee; six months later at hip.
38	" " "	1899 F. 26	Tuberculous osteo-arthritis of left knee-joint; septic infiltration of thigh.	"	Same patient. Pint of saline fluid injected.
39	" " "	1899 F. 8	Tuberculous osteo-arthritis.	"	Excision of head of femur two years before. Half a pint of saline fluid injected. Amyloid degeneration of liver and kidneys.
40	" " "	1900 M. 23	" " "	"	Head of left femur excised Feb. 13, 1899.
41	G. F. Shears.	1896 M. 26	Osteo-arthritis with general septic infiltration.	"	"The very great mortality could be materially reduced by the general adoption of this method."
42	Horace Packard.	1897 M. 30	Osteomyelitis.	"	
43	G. K. Dickinson.	1899 M. 33	Gangrene of right thigh.	"	Four months later gangrene occurred in left leg. Gangrene caused by thrombosis and phlebitis. Condition desperate.
44	" " "	1900 F. 65	Gangrene.	Died.	Preliminary amputation above knee, but as the muscles here were necrotic, disarticulation at hip was done. Died from exhaustion and shock in five hours.
45	H. H. Grant.	1900 F. 28	Osteitis, right femur.	Recover'd	Amputation in lower third two years before. Hip was ankylosed.
46	R. H. M. Dawbarn.	1895 F. 30	Osteomyelitis.	"	
47	" " "	1898 F. 10	Tuberculous osteo-arthritis.	"	Died one year later with pulmonary tuberculosis.
48	L. S. Pilcher.	1900 M. 30	" " "	"	Perfect control of circulation.
49	George P. Jessup.	1898 M. 30	Osteo-myelitis of femur.	"	
50	J. William White.	1896 M. 14	Total necrosis of femur.	"	
51	" " "	1896 M. 14	Total necrosis of femur, with pathological fract. of thigh	Died.	There was extensive necrosis of right humerus and shoulder joint. Patient greatly exhausted by prolonged suppuration and sepsis. Died 7th day.
52	" " "	F. 6	Destructive osteitis of femur	Recover'd	Upper third of bone almost entirely destroyed; neck fractured during disarticulation. No difficulty in removing head of bone.
53	Lewis C. Boshier.	1897 M. 7	Osteomyelitis, right femur.	"	Spontaneous fracture before operation.
54	" " "	1899 F. 9	" " " left femur.	"	
55	Manning Simons.	M. 30	Gangrene.	Died.	Patient at time of operation was exhausted by prolonged general septicemia. The gangrene was caused by occlusion of the femoral vessels.
56	" " "	M. 18	" " "	"	Aneurysm five inches in diameter involving external iliac and femoral arteries. Extensive hemorrhage occurred from the diseased vessels after the tourniquet was removed. Died from hemorrhage and shock.
57	" " "	1899 F. 35	Osteomyelitis.	"	Died three days after operation from exhaustion and chronic septicemia.
58	George E. Brewer.	1898 M. 56	General septic cellulitis, with destruction of soft parts.	"	Patient extremely septic at operation, which was followed by temporary improvement. Secondary infection of flaps ensued, necessitating revision, which ended fatally.
59	" " "	1898 M. 50	Diabetic gangrene.	"	Wound healed quickly. Patient died suddenly at end of second week. Supposed apoplexy.
60	" " "	1899 M. 45	" " "	Recover'd	
61	" " "	1899 M. 40	Osteomyelitis.	"	
62	E. F. Robinson, U.S.A., Philippine Islands.	1900 M. 29	Gangrene.	"	Gangrene caused by deligation of external iliac artery on account of aneurysm. Collateral circulation was so complete that tourniquet had to be employed.
63	Wm. Perrin Nicolson.	1896 M. 35	Large ulcer in cicatrix of burn.	"	Extensive ulcer of right thigh, caused by burn in youth, undergoing seeming malignant change.
64	M. B. Herman.	M. 20	Gangrene.	"	
65	" " "	M. 30	" " "	Died.	Recovered from operation. Died from pneumonia one week later.
66	" " "	M. 35	Tuberculous osteitis.	Recover'd	
67	" " "	M. 40	Extensive septic infection of thigh (cellulitis).	"	
68	Hunter P. Cooper.	1894 M. 16	Osteomyelitis of femur.	"	Whole shaft of femur destroyed. Highest temp. after operation 99.5° F.
69	" " "	1897 F. 13	" " "	"	"Operation at college clinic. Patient removed in ambulance immediately to her home. This method marks an epoch in modern surgery."
70	Wm. D. Hilliard.	1898 M. 60	" " "	"	Osteo-myelitis of thirty-five years' duration from gunshot wound at Gettysburg, 1863. Perfectly bloodless.
71	W. B. Rogers.	1895 F. 16	Osteo-arthritis of hip-joint.	"	
72	" " "	1895 M. 38	Rapidly developing gangrene	Died.	Died 40 hr. after operation from general septic infect'n prior to amputat'n.
73	Harry M. Sherman†.	1895 M. 7	Tuberculous osteo-arthritis.	Recover'd	
74	" " "	1897 M. 14	" " "	"	
75	" " "	1897 F. 8	" " "	"	
76	" " "	1898 M. 10	" " "	"	
77	" " "	1898 F. 13	" " "	Died.	
78	" " "	1898 F. 19	" " "	"	
79	S. T. Hunkin.	1898 M. 6	" " "	Recover'd	No bleeding from upper tissues.
80	Charles K. Briddon.	1897 M. 33	" " "	"	
81	Tilman Ramsey.	1900 M. 34	Osteomyelitis of femur.	"	Epiphysis and joints also involved (not tubercular).
82	George F. Wilson.	1898 M. 11	" " "	"	
83	" " "	1898 M. 15	" " "	"	
84	" " "	1899 F. 21	Gangrene of extremity.	"	
85	Wm. Jones.	1894 M. 65	Tuberculous osteo-arthritis of hip.	"	
86	Charles H. Frazier.	1900 M. 21	Tuberculous osteomyelitis (with arthritis?).	"	
87	Andrew C. Smith.	1895 M. 68	Osteitis of femur.	"	
88	J. D. S. Davis.	1897 F. 13	Tuberculous osteomyelitis of femur.	"	The entire upper half of femur and the acetabulum were involved. The diseased surfaces of the cotyloid cavity were removed. Cured.
89	" " "	1898 M. 11	Tuberculous osteitis of head of femur.	"	
90	A. C. Bernays.	1894 M. 39	Tuberculosis of femur, hip and knee joints.	"	
91	Edwin Walker.	1900 M. 15	Chronic osteomyelitis of femur.	"	Patient much exhausted by sepsis of two years' duration. Not exceeding two ounces of blood were lost.
92	Thomas F. Chavasse.	1898 F. 23	Extensive ulcer of thigh with infantile paralysis.	"	Amputation at knee three years. One pint salt solution in vein at time of operation.
93	" " "	1901 M. 29	Gangrene from traum. aneurysm of right femoral artery.	"	One pint salt solution before operation.
94	Harry M. Sherman.	1900 M.	Tuberculous osteo-arthritis of hip.	"	

* See two additional cases by Mr. Chavasse at end of tables.

† See additional case by Dr. Sherman at end of tables.

later. The second had a severe hemorrhage immediately before the operation, from breaking down of the neoplasm, and was practically hopeless when it was undertaken. A third recovered from the operation and died from tubercular peritonitis, on the eleventh day, while in a fourth case, after a good recovery from the operation, the stump became infected and the patient died from septicemia, on the twenty-sixth day. In a fifth

the neoplasm involved the acetabulum and the pelvis, which necessitated curettage of an extensive region, death following from shock, within four hours. In a sixth case there was no shock nor hemorrhage; the patient died suddenly, from asphyxia, twelve days after the operation; no post-mortem was made, and the cause of death was unknown. The other 8 died in shock from four to twenty-six hours after the operation.

INJURIES WITH OR WITHOUT PYOGENIC INFECTION.

No.	Operator.	Date, Sex, Age.	Cause of Operation.	Result.	Remarks.
1	Samuel H. Pinkerton.	1892 M. 6	Compound, comminuted, gunshot fracture of femur.	Died. . . .	Two hours after operation, death from shock.
2	G. A. Baxter	1891 " 17	Railroad pulpefaction of r. foot, leg; l. lower extremity as high as middle of thigh.	"	Patient rallied well; four hours later raised himself to reach a glass of water, and instantly expired; no bleeding after operation.
3	" "	1896 F. 4½	Crush of leg and thigh by car wheel.	Recovered.	Operation immediate. Car wheels passed twice over this extremity, crushing bone, with extensive laceration of soft tissues.
4	W. Johnston	1892 M. 39	Railroad pulpefaction of lower extremity as high as middle of thigh.	Died. . . .	Death ninety hours after operation from shock and exhaustion. "There was not one drop of arterial blood and only a slight venous oozing from the muscular tissue."
5	J. D. Thomas	1891 " 18	Femoral vessels divided in Scarpa's triangle by red-hot iron bar, impend. gangrene.	"	Great hemorrhage from the accident. On seventh day after injury, amputation; death thirty-six hours later; no bleeding after operation.
6	A. Schachner.	" 55	Fracture of femur; gangrene.	Recovered.	First dressing six days after operation.
7	Daniel Strock.	1894 " 35	Limb pulpefied.	Died. . . .	Railway crush; including upper third of thigh. Hemorrhage entirely controlled. Patient died of shock. Patient bled profusely before admission to hospital.
8	R. Matas	1894 " 27	Traumatic gangrene.	"	Entire lower extremity gangrenous with great edema. General septicemia. "Saline infusion alone prevented death on the table."
9	" "	1898 " 58	Crush by machinery	"	Extensive comminution of bone and pulpefaction of soft parts. Kidney lacerated. Died from shock.
10	George W. Crile	1898 " 26	Injury of hip and thigh. . . .	Recovered.	Crushed under railway train. Considerable hemorrhage at time of accid't.
11	Wm. B. Van Lennep	1897 " 46	Compound comminuted fracture of right thigh.	Died. . . .	Died from shock within a few hours.
12	L. L. Hill.	1894 F. 14	Gunshot wound.	"	Died in eighteen hours from shock.
13	Chas. G. Levison.	1899 M. 50	Crush by elevator.	"	Operation twenty-four hours after accident. Gangrene in one lower extremity extending almost to the hip; the opposite leg was gangrenous to the knee. Pulse before operation 160. Hemostasis complete. Duration from beginning to end, twelve minutes. Died six hours later.
14	W. S. Bickham.	1895 " 48	Comminuted gunshot fracture of femur; upper third.	Recovered.	Saline infusion.
15	" "	1897 " 50	Crush and pulpefaction of thigh; gangrene.	Died. . . .	Gangrene of entire extremity as high as seat of wound.
16	W. E. Parker.	1895 F. 8	Railroad crush.	"	Hemorrhage well controlled. Died in 12 hr. from shock. "Good quantity of salt solution injected, but the good effect was only temporary."
17	George L. McCoy.	M. 35	Severe crush by machinery.	Recovered.	Severe hemorrhage at time of accident. Two pints saline fluid injected in vein at elbow before operation. He rallied from profound shock.
18	G. K. Dickinson.	1892 " 25	Compound comminuted fracture.	Died. . . .	Died in shock. Hemostasis complete. Subcutaneous injection of saline fluid by rectum. No intravenous injection.
19	W. C. Dugan.	1896 " 30	Railroad injury	"	Thigh was amputated for injury at upper and middle third. Secondary hemorrhage occurred and stump was cut through higher up, and the fragment of bone disarticulated. Died eight hours after last operation.
20	B. Hatchett.	1891 " 31	Legs crushed under car wheels.	"	Died 48 hours after operation. Internal injuries. One extremity amputated at hip, the other just below knee. Absolutely no loss of blood.
21	H. A. Sifton	1897 " 45	Railroad crush of thigh	"	Intravenous saline injection, 2000 c.c. before amputation. "I have often used saline injections before operating in severe railroad injuries with most gratifying immediate results. I have, however, observed symptoms in some of the fatal cases after its use which I have thought might be due to the direct effect of the fluid upon the blood."
22	" "	1898 " 22	Railroad crush of thigh with compound dislocat'n of hip.	Recovered.	
23	E. F. Robinson, U. S. A., Philippine Islands.	1900 " 62	Gunshot wound of femur; explosive effect.	Died. . . .	Died in twelve hours from shock. While under ether and before operation one pint normal salt solution was given by hypodermoclysis. During operation the pulse became very weak and one quart of salt solution injected into veins, followed by marked improvement in heart action. Symptoms of shock supervened about seven hours later, and a pint more was thrown beneath the skin.
24	E. A. Neely.	1900 " 41	Gunshot wound of femur. . . .	Recovered.	Operation four months after injury. Although patient was in bed from prolonged septic absorption, he stood the amputation so well saline injection was not required.
25	Wm. Perrin Nicolson. . . .	1896 " 22	Railroad crush.	Died. . . .	Operation performed when condition of patient was bad on account of other injuries. Hypodermatic injection of salt solution. Died in shock five hours later.
26	P. B. M. Miller	1898 " 21	Gunshot wound of thigh. . . .	Recovered.	Charge of large bird-shot entered the thigh over trochanter major, carrying away all the bone here except a fragment the size of an English walnut which was lodged beneath Poupert's ligament. Patient greatly exhausted from hemorrhage and three days' journey to reach assistance. No intravenous injection of saline solution.
27	George R. Fowler.	1900 " 29	Compound fracture of femur with destructive osteitis.	"	
28	Wm. D. Hilliard	1896 " 35	Railroad crush.	Died. . . .	Compound comminuted fracture of thigh with great laceration of soft parts and much hemorrhage. Amputation eight hours after injury. Perfectly bloodless. Died of shock in a few hours.
29	Frank D. Smythe.	1898 " 32	Railroad crush.	"	Left thigh crushed and soft parts pulpefied. Salt solution injected before operation. Died from shock day of operation.
30	P. J. Kirschner.	1899 " 33	" "	"	Died twelve hours after operation.
31	H. C. Deaver	1900 " 22	" "	Recovered.	
32	George R. Dean.	1894 " 35	" "	Died. . . .	Car wheel crush and pulpefaction of thigh, involving the ilium and outer rim of the pelvis. Severe hemorrhage, with profound shock. No infusion. Died in three hours from shock.
33	" "	1896 " 24	" "	Recovered.	Comminution of femur from knee to middle third of thigh, with pulpefaction of soft structures to near hip.
34	R. Harvey Reed	1895 " 28	Crush of leg and thigh.	"	
35	" "	1896 " 30	" "	Died. . . .	
36	" "	1898 F. 10	" "	Recovered.	

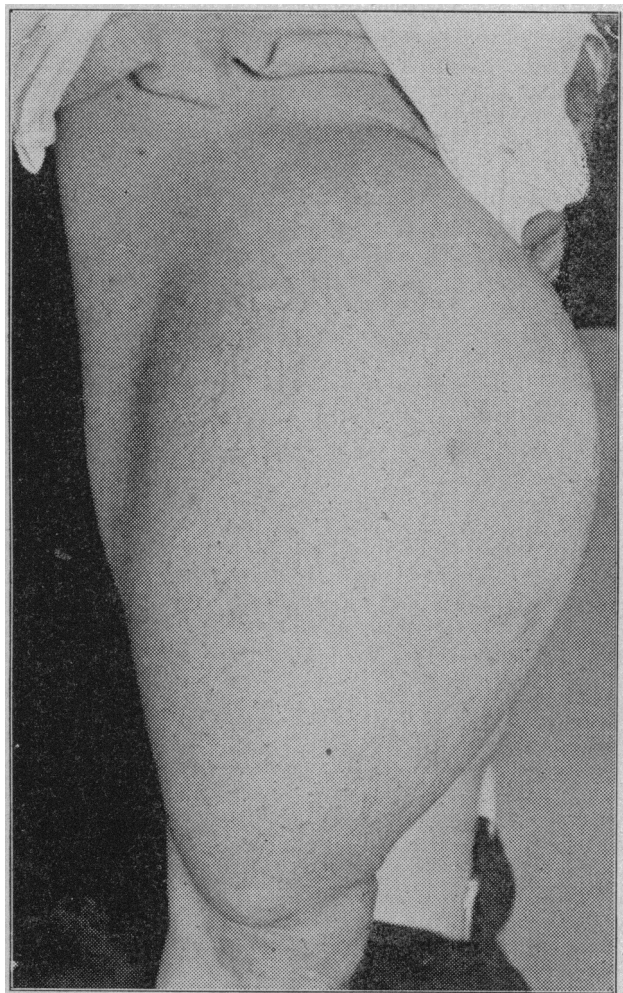
Under the heading of septic infection, 94 hip-joint amputations were made. As recorded, they are classified as follows: Pyogenic osteitis or osteomyelitis—not tuberculous—36, with 5 deaths, a mortality ratio of 14 per cent.; tuberculous osteitis or osteoarthritis 41, with 4 deaths, or 9.7 per cent.; gangrene—moist and diabetic—12, with 6 deaths, or 50 per cent.; general cellulitis 3, with 1 death, or 33 1/3 per cent.; ulcer from breaking down of an extensive cutaneous surface 2, with recovery; total for septic infections, 94 cases, of which 16 died, or 17 per cent. Practically all the fatal cases were in a condition of great exhaustion due to prolonged sepsis, or they died from causes not directly

referable to the operation. Of the five fatal cases in the first group, 1 was in such a seemingly hopeless condition that the operation was not advised. It was only done at the urgent insistence of the child's parents. The second case was almost equally emaciated and anemic from prolonged septic absorption. A third fatal case was complicated with a fracture which had existed for several months before the operation, while a fourth died of cerebral apoplexy on the tenth day, the cause of death not being referable to the operation.

For tuberculous osteitis and osteoarthritis—or hip-joint disease—4 out of 41 died, or 9.7 per cent. There were no serious complications in these 4 fatal cases,

although they were weakened by the prolonged sepsis and waxy degenerations which are characteristic of tuberculosis in the bones. The operation was undoubtedly the immediate cause of death in each of these.

In the case of gangrene, as one would naturally suppose, the death-rate was exceedingly high, 6 of the 12 ending fatally. In 1 of these a preliminary amputation was made above the knee and, as the muscles were gangrenous at this level, a second operation of disarticulation at the hip-joint was done, followed by shock and immediate death. In the second case, in which an aneurysm five inches in diameter involved the external iliac and femoral arteries, while the hemostasis was complete during the operation, exhaustive hemorrhage followed the removal of the



Osteosarcoma of femur.

tourniquet, the bleeding coming from broken-down vessels at the seat of the aneurysm. The patient was septic and greatly exhausted by reason of the gangrenous condition of the entire lower extremity. In the third, the patient died from pneumonia, a week after the operation. Two other fatal cases had prolonged septicemia, to which, with the added shock of the operation, they quickly succumbed. A sixth case of diabetic gangrene had practically recovered from the operation, but died from cerebral embolism at the end of the second week. One case of cellulitis died out of 3, the fatal one being extremely septic and anemic at the time of operation. Improvement followed, but secondary infection of the flaps took place, necessitating a revision which was followed by death. One case of extensive ulcer result-

ing from the breaking down of scar tissue following a burn in youth was of doubtful diagnosis, but was classed as an ulcer because no demonstration of epithelioma was made.

In the third group, injuries with or without septic infection, there are 36 cases with 23 deaths, a mortality ratio of 63.9 per cent. Twenty-four disarticulations at the hip were performed on account of extensive injuries to one or both lower extremities by railway trucks or heavy machinery. Of these, 16 died, a mortality ratio of 66.6 per cent. When we consider the character of these injuries and the unfavorable conditions to which the patients were subjected, this high rate of mortality is not surprising. Hemorrhage more or less severe occurred in all cases, and it was difficult, and at times impossible, to overcome the shock which supervened. It is more than probable that had the intravenous injection of a saline solution been made before all of these were subjected to operation, the ratio of mortality would have been decreased, since the majority of the fatal cases died in shock and before septic infection was observed.

CASE 2.—Here the right leg and foot and left lower extremity were crushed as high as the middle of the thigh. Amputation was performed at the hip on one side, and at the knee on the other. The patient died in shock four hours afterward.

CASE 3.—This patient presented a crush of the leg and thigh by a car wheel, with extensive laceration of the soft tissues. Operation was immediate, and he recovered.

CASE 4.—Pulpification of the lower extremity, as high as the middle of the thigh was present here and the patient died in ninety hours, from shock.

CASE 7.—Here there was crush and pulpification as high as the upper third of the thigh. Profuse hemorrhage occurred before admission. The patient died of shock within a few hours.

CASE 10.—A crush of the hip and thigh with considerable bleeding at the time of admission was followed by recovery.

CASE 16.—Death in twelve hours, from shock. Salt solution was injected into the veins.

CASE 19.—This patient recovered from the first operation, but secondary hemorrhage ensued. Amputation at the hip-joint was followed by death in eight hours, from shock.

CASE 20.—Death in forty-eight hours, here followed one extremity amputated at the hip, the other just below the knee. There were also internal injuries.

CASE 21.—This patient died within a few hours, from shock. Salt solution was injected into the veins.

CASE 22.—This case was a crush of the thigh, and compound dislocation of the hip. The patient recovered.

CASE 25.—This patient died of shock, in five hours. Salt solution was tried hypodermically. The patient's condition was practically hopeless on account of other injuries.

CASE 28.—Here a railroad crush presented great laceration and much hemorrhage. Amputation eight hours after injury resulted in death in shock within a few hours.

CASE 29.—This was also a railroad crush, of the left thigh. The soft parts pulpified. Salt solution was injected into the veins. Death followed in twenty hours, from shock.

CASE 30.—This patient died in twelve hours, from shock.

CASE 31.—Recovery resulted.

CASE 32.—Crush and pulpification here involved the thigh and the ilium and outer rim of the pelvis, with severe hemorrhage. The patient died in three hours, from shock.

CASE 33.—Here the femur was crushed from the knee to the middle third of the thigh, with pulpification of the soft structures to near hip. Recovery followed.

CASE 34.—A crush of the leg and thigh was here followed by recovery.

CASE 35.—Death followed a crush of the leg and thigh in this case.

CASE 36.—Recovery was the result after a crush of the leg and thigh in this instance.

MACHINERY CRUSHES.

CASE 9.—This patient presented extensive comminution of bones, pulpification of the soft parts, and the kidney lacerated. Death in shock followed.

CASE 13.—A crush in an elevator was followed by operation twenty-four hours after the accident. Gangrene had supervened in one extremity, almost to the hip, and in the opposite leg to the knee. The patient died in six hours, from shock.

CASE 15.—Crush and pulpification of the thigh, with gangrene of the entire extremity as high as the seat of the wound, resulted fatally.

CASE 17.—A severe crush by machinery, with extensive hemorrhage at the time of the accident, resulted in recovery. Two pints of saline fluid were injected into the veins.

COMPOUND COMMINUTED FRACTURES.

CASE 6.—Comminuted fracture with gangrene was followed by recovery.

CASE 8.—Traumatic gangrene of the entire lower extremity existed, with great edema and general septicemia. The patient died. Saline infusion alone prevented death on the table.

CASE 11.—This patient died in shock after a few hours, in a case of compound comminuted fracture of the right thigh.

CASE 18.—This patient presented a compound comminuted fracture, received subcutaneous salt solution, and by rectum, but died in shock.

CASE 27.—This compound fracture with destructive osteitis was followed by recovery.

GUNSHOT WOUNDS.

CASE 1.—A gunshot wound, compound comminuted fracture, with immediate operation, resulted fatally in two hours, from shock.

CASE 12.—This gunshot wound, with extensive lacerations and hemorrhage, caused death in eighteen hours, from shock.

CASE 14.—The same, with compound fracture of the upper third, with saline infusion, resulted in recovery.

CASE 23.—This patient received a gunshot wound with an explosive missile. While under ether and before operation, a pint of normal salt solution was given under the skin. During the operation a quart was injected into the veins, followed by marked improvement of the heart's action. Symptoms of shock supervened about seven hours later, and a pint more was thrown beneath the skin, but he died within twelve hours, from shock.

CASE 24.—In a gunshot wound of the femur, operation was not done until four months after injury. The patient was in bad condition, from prolonged sepsis. No saline injection was used. Recovery followed.

CASE 26.—A gunshot wound caused by a charge of bird-shot entering over the trochanter shattered the bone. The patient was greatly exhausted from hemorrhage and a three days' journey to reach assistance. No intravenous injection was made. He recovered.

CASE 5.—This patient had gangrene resulting from division of the femoral vessels by a red-hot bar of iron. Gangrene ensued on the seventh day, before amputation was done. Death resulted in thirty-six hours, from shock.

In addition to the foregoing I have two cases of railway crush of the thigh and hip in which the same method of hemostasis was employed, in which the femur was divided in one instance at the lesser trochanter, and in the other one and one-half inches below this point. There were extensive lacerations of the gluteal region beyond the level of the hip in one of these cases, while in the other the right leg and thigh bones were crushed to pulpification to within eight inches of the hip-joint. This patient was not discovered until several hours after he was run over by a train of cars, remaining on the cold ground throughout a greater portion of the night. He was then brought fourteen miles to the hospital, when the amputation was made. These two cases of recovery would reduce the death-rate to 60.5 per cent., but since they are not disarticulations, I have not included them in the statistics. The oper-

ators were Dr. P. B. Barringer, Charlottesville, Va., and Dr. A. W. Knox, Raleigh, N. C.

I have an additional and very instructive case occurring in the practice of Dr. George E. Brewer, in which the method of hemostasis was employed for gunshot wound of the middle and upper third of the thigh, but as the bone was divided near the lesser trochanter and disarticulation not performed, I have not included it in the statistics. This injury was inflicted with a soft-nose missile of high velocity, striking the femur about the middle, comminuting this bone from near the knee to the trochanter, with extensive destruction of the muscles by reason of the explosive effect of this form of bullet. The pins were extemporized from fence wire and the hemostasis was reported as complete.†

Of the 267 cases of disarticulation at the hip-joint for all causes herewith reported, 53, or 19.8 per cent., died. Every fatal case is recorded, and this list includes a number that died from intercurrent disease, such as pneumonia and apoplexy, although the cause of death was not justly referable to the operation. Several died from sepsis, one on the twenty-sixth day, which, as Mr. Chavasse of the Birmingham General Hospital remarks, "was an avoidable cause of death."

In many of the accident cases, while it was none the less the duty of the operator to give the patient this last chance for life, the extensive mutilations, such as the crushing of one or both lower extremities under car wheels or in machinery, and the exhausting hemorrhage which occurs in most of these, together with grave injuries of the viscera, made a fatal termination almost inevitable. Moreover, in the fatal cases in which the amputation was done for the relief of moist and diabetic gangrene, the prognosis was almost as unfavorable as after the most extensive injuries. In Ashhurst's "International Encyclopedia of Surgery," issued in 1881, Dr. F. C. Shepperd gives to that date a total of 633 cases of amputation through the hip for all causes, with a mortality ratio of 64 per cent. In *The Lancet* for March 5, 1892, Mr. Frederick Page gives 16 cases in which the amputation was done by other methods for disease in the Royal Infirmary, Newcastle-on-Tyne, with a ratio of mortality of 37.5 per cent. The death-rate for disease in the statistics herewith given is 17 per cent. Dr. John Erdmann, of New York, collecting the figures of eight hospitals of this city, gives 18 cases done by all methods with 8 deaths, mortality ratio of 44.4 per cent. Of these 18 cases, in 7 the method of hemostasis here advised was employed, and all of these recovered, leaving in this list 8 fatal cases in 11 amputations done by other methods. Asepsis must share with the improved hemostasis the credit of this diminished rate of mortality. These 267 amputations were performed by 123 different operators, and under all the varying conditions of civil and military practice.

The simplicity and efficiency of the method is evident in the fact that from the country practitioner with inefficient assistance and limited experience in major

† In the "Medical and Surgical History of the War of the Rebellion," there is given a list of all amputations at the hip-joint done in military practice to the date of the issue of that volume. They are divided into: 1. primary; 2. intermediary, and 3. secondary periods, and re-amputations.

There were 53 amputations in the primary period—within the first twenty-four hours after receipt of the injury—with two recoveries, a death ratio of 96.2 per cent. Of those done in the intermediary period, i. e., during the inflammatory stage and reckoned from the third to the thirtieth day, both inclusive, there were 32 cases, with 3 recoveries, a mortality ratio of 90.6 per cent. In the secondary period, i. e., after the entire abatement of the acute inflammatory stage and after the thirtieth day, there were 31 operations with 4 recoveries, a mortality ratio of 87 per cent.

surgery, to the metropolitan surgeon with all the accessories of the modern technique, it has almost without exception met with full approval and adoption. The few objections which have been advanced, as for instance the difficulty of disarticulation, and the free oozing from the large muscular surface divided, can no longer hold in the present improved technique of the operation. We all agree with Mr. Chavasse, who says, in his excellent article already quoted, that "it is quite possible and probable that cases operated upon by a variety of surgeons will show a larger mortality-rate than if one particular surgeon had had the entire experience, and we are justified in concluding that an improved modern technique of operating which includes the antiseptic and aseptic methods, has reduced the mortality of a formidable procedure to such really small dimensions that in suitable cases there is no longer any actual excuse for procrastination, and that we are justified in urging operation in cases which up to now we have been content merely to recommend."

REFERENCES.

1. Frederick Treves' Manual of Operative Surgery.
2. Principles of Military Surgery, Third Edition, p. 40.
3. International Encyclopedia of Surgery, vol. I, p. 669.
4. Dr. Louis Coronat: Archives Générales de Médecine, vol. I, 1897.
5. Medical and Philosophical Commentaries. By a Society in Edinburgh, vol. vi, part iii, p. 337. London, 1779.
6. Centralblatt f. Chir., 1874, p. 65.
7. Tritt lebhafte Blutung ein.
8. Archiv f. klin. Chir., 1881, B. xxvi, s. 861.
9. Cincinnati Medical News, April, 1887.
10. Prof. D. W. Yandell: American Practitioner and News, 1890.

THE OCULAR EXPRESSION OF INTRANASAL LESIONS.

ROBERT SATTLER, M.D.
CINCINNATI, OHIO.

Ocular symptoms are not uncommon attendants of focal suppuration of the nasal cavities.

Although admittedly more frequent, it is by no means established that such local suppuration starts invariably in one or several of the pneumatic accessories of the nose. Focal suppuration may also begin, in a smaller number of cases, in the mucosa without implication of the sinus cavities, especially in the inferior, anterior portion of the middle meatus and even of the septum nasi.

It is also certain that various ocular symptoms which attend so many intranasal lesions—because they are so frequently and commonly met with—are looked upon as transitory and uncertain reflex phenomena, and are regarded of little diagnostic importance. For this reason they do not receive the attention they deserve, and are often peremptorily disposed of as not worthy of much consideration. Nevertheless, telling evidence that a better knowledge of the interdependence of the symptoms of intranasal and ocular lesions is at hand, is being constantly furnished by numerous contributions from rhinologists as well as oculists—each from his point of view adding practical suggestions which must serve the common purpose of more accurate information of diagnosis and a more successful therapy.

Within the range of this brief communication, no reference will be made to the ocular symptoms in general. These are on the whole fairly well known. Mention will be confined to certain phases of more uncommon intranasal lesions which, so far as their ocular expressions

are concerned, have not been fully described. It must furthermore be stated that the observations and conclusions about to be mentioned, bearing on this point and of common interest to both specialties, are here considered wholly from the standpoint of the ophthalmologist; also, that the successful management of ocular symptoms in cases of this class is unsatisfactory or impossible until their dependence upon a nasal lesion is recognized.

Two classes only, of intranasal lesions, will be considered. They both furnish the oculist with perplexing experiences and with unlooked for disappointments.

The first group includes certain chronic lesions which invade the anterior region of the middle meatus of the nose—the most anterior cells of the ethmoidal labyrinth—bulla ethmoidalis, the region of the uncinate process, hiatus semilunaris and infundibulum.

The point of interest is that the morbid changes which are enacted and account for persistent ocular phenomena are attended by a lesser or even an entirely negative expression on the part of the nose. Often a most careful search must be made before a focal suppuration of the mucosa of the nose or of the air-cells of the locality is discovered. In some cases cystic distention of the cells, with choking of their contents and plugging of their ostia, caries of their bony walls and even the remote sequences of former morbid processes—solidification or rarefaction of the framework of the bone—are found; in others, all tangible evidences are absent until revealed by an exploratory operation undertaken mainly for purposes of diagnosis.

It must also be remembered that the region in question is often the seat of an anomalous individual development to which a congenital legacy of syphilis or scrofulous and rachitic manifestations during early life, afford the necessary predisposition. The growth and subsequent development of the ethmoidal labyrinth are so altered that excessive and abnormal crowding or impaction of the anterior and lateral air-cells results. It can furthermore be assumed that in such cases more or less interference with the physiologic purposes must follow, and that the declaration of any morbid process may be attended by rather uncommon symptoms.

Clinical Expressions of Lesions.—Two principal clinical expressions of lesions of this region of the nose on the part of the eyes are met with:

1. Persistent injection of the vessels of the ocular conjunctivæ with prominence and distention also of the muscular branches, often accompanied by passive edema of the retrotarsal folds. The palpebral conjunctiva does not ordinarily participate in this vascular engorgement. There is no abnormal secretion in quantity or quality, but there is present much functional distress of the eyes. Not infrequently there is observed a retraction of the upper lid and that peculiar stare which is so generally associated with a retarded lid action due to disordered innervation of the sympathetic fibers.

2. The other or second clinical expression dependent on the same or a similar intranasal disturbance, consists of a group of far more unmanageable and persistent symptoms. In cases of this class, the most persistent neuralgic phenomena, not conspicuous because of their severity, but mainly for their persistent nagging features, are present, associated with the most distressing functional disturbances of the eyes.

Any continued effort in reading, or other close work, produces prolonged and severe suffering. This is most pronounced during the early part of the day and wears

* Presented to the Section on Laryngology and Otology, at the Fifty-first Annual Meeting of the American Medical Association, held at Atlantic City, N. J., June 5-8, 1900.