A system of operative surgery: based upon the practice of surgeons in the United States, with a bibliographical index and historical record of many of their operations during a period of two hundred and thirty-four years (Volume 2).

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BIBLIOGRAPHICAL INDEX AND HISTORICAL RECORD OF
MANY OF THEIR OPERATIONS,

DURING A PERIOD OF TWO HUNDRED AND THIRTY-FOUR YEARS.

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OPERATIVE SURGERY.

PART III.

OPERATIONS ON THE FACE AND NECK—CONTINUED.

CHAPTER X.

OPERATIONS UPON THE CHEST.

SECTION I.

SURGICAL ANATOMY OF THE CHEST.

THE extent of the chest as a surgical region is usually regarded by anatomists as limited, above, by a circular boundary formed by the upper extremity of the sternum, the first rib and first dorsal vertebra, or, in other words, by the bony constituents of the thorax; and below, by the curved line formed in the arrangement of the cartilages of the ribs, the chest being at this point completely separated from the abdomen by the diaphragm.

There is, however, a portion of the body of great importance to the surgeon, which is not included in these limits, and which is yet not included in those assigned to the upper extremities, to wit, the structures about the clavicle; and it will, therefore, answer better for the purposes of description, at present, to define the chest as that portion of the body intermediate to the neck and abdomen, the upper portion being intimately connected with the upper extremities, but the lower separated entirely from the abdomen by the diaphragm. As most of the constituents of this section of the body are unimportant, consisting merely of skin and muscle, they do not present any points requiring either a precise regional description, or a minute account of their connections with subjacent parts. The

reader may, therefore, be referred for their description to the anatomical account of this part, which every one gains in the course of a medical education; as its surgical details are also limited, such a brief account as may readily be presented in connection with the operations performed upon it, is all that is at present demanded.

§ 1.—SURGICAL ANATOMY OF THE PORTION OF THE CHEST ABOUT THE CLAVICLE.

The Clavicle, being fixed by the articulations at its sternal and acromial extremities, has for its function the preservation of the pectoral space, or the steadying of the shoulder, and the prevention of its approach to the sternum. At each of its extremities is found a perfect joint amply supported by ligaments, in addition to which may be noted two other ligaments, which are upon its under surface, and tend to hold the bone in its proper relations to the ribs; to wit, the costo-clavicular or rhomboid ligament, which, arising from the cartilage of the first rib, is inserted into the roughness on the under surface of the clavicle near its sternal extremity, and the coraco-clavicular or conoid ligament, which, arising from the coracoid process of the scapula, is inserted into the tubercle near the inferior and external surface of the bone. The ligamentum bicorne, or bifid ligament, is so closely connected with the subclavius muscle, that it may be regarded chiefly as its fascia, and a further account of it omitted.

The Muscles connected with the clavicle above are a portion of the sterno-cleido-mastoid at its sternal extremity, and a part of the trapezius at its humeral end, whilst the pectoralis major and part of the deltoid are in front, and the subclavius muscle below. The latter muscle, arising from the cartilage of the first rib, is inserted into the inferior face of the clavicle, from near the sternum to the conoid ligament, and therefore draws the clavicle towards the rib.

The Subclavian Artery and Vein are both placed between this muscle and the first rib, the vein being close to the artery, but in front of it.

The Brachial plexus of Nerves extends from the scaleni muscles to the axilla, passing along with the artery between the subclavius muscle and the rib. It has the axillary vein in front of it, but the different nerves surround the artery, as if plaited.

The fascia superficialis of the chest and neck, together with the skin, complete the coverings of this part.

SECTION II.

RESECTIONS OF THE CLAVICLE.

The resections practised upon the clavicle are such as are demanded for the relief of caries, necrosis, or osseous tumors, and may require either a partial or perfect division or resection of the bone. In describing the operation of resection of this bone, as well as in similar operations on other bones of the extremities, the reader should bear in mind that by the term "resection" is generally understood the removal of either a part or the entire structure of the bone, in such a manner as will yet permit the patient to have more or less use of the extremity to which it is attached. Any operation therefore which destroys this use, or also removes the limb, is to be regarded as an amputation and not as a resection.

That this definition of the operation of resection is correct, is apparent from the views expressed by the following excellent authorities. Thus, J. Cloquet and A. Berard,[1] in speaking of the peculiar characters of a resection, state that "the preservation of the soft parts constitutes the special character of this operation, which should be practised so as to avoid all lesion of the arterial or venous trunks, and injure the muscles and tendons as little as possible." Again they say: "It is for this reason that resections of the superior extremity by preserving, to a certain extent, the motions of the limb, are superior to amputations."[2]

Malgaigne, who is also good authority, remarks, when speaking of resections, that "we comprise under this title the removal of the articular extremities of bones, the resection of the long bones in their continuity, and the extirpation of certain bones entire, *without amputation of the soft parts.*"[3] All operations, therefore, which have not been performed with these restrictions should be strictly excluded from this class.

[1] Dictionnaire de Méd., tome xxvii. p. 402.

[2] *Ibid.*, p. 411.

[3] Op. Surg., Phil. edit. p. 188.

§ 1.—RESECTION OF THE ENTIRE CLAVICLE.

The removal of the clavicle, either entire or in part, is an operation that has been occasionally found necessary or expedient, in consequence of the development of osteo-sarcomatous growths upon it, and their encroachment upon adjacent parts; or for the relief of necrosis; the cases of caries, demanding rather the healing of the ulcer than the resection of the bone. Although the function of the clavicle appears to be essential to the proper action of the upper extremity, its removal has been accomplished without materially impairing the utility of the limb.

When in this resection it is found possible to retain a portion of the periosteum it should always be left, as in the operation performed by the celebrated French surgeon, Moreau, for necrosis; though the entire clavicle was removed, yet at the autopsy of the patient, made several months subsequently, the bone was found to have been entirely regenerated, so as to preserve its relations with both the sternum and scapula. There is, however, reason to think, from the account furnished of this operation, that it was rather the removal of a sequestrum resembling the former clavicle than a resection; and that the old bone, like the sequestra of other bones in a certain stage of necrosis, had been encased by the new osseous deposit consequent on the efforts of nature to remedy the disease, and hence the formation of the new clavicle.

The only cases of entire resection of the bone, not consequent on amputation, that I have been able to find recorded as performed in the United States, is one by Dr. Charles McCreary, of Kentucky,[1] who, in 1813, removed the entire clavicle for a scrofulous affection of the bone without impairing the functions of the limb, the patient living for thirty-five years subsequently without any return of the disease; one by Dr. Mott, of New York, in 1819; one by Dr. Warren, of Boston, in 1833; and one by Dr. Wedderburn, of New Orleans, in 1832.

In Europe, Travers has removed a large portion of the clavicle, leaving only the sternal end, in a boy who, twelve months subsequently, had the free use of his arm; and Chaumet, of Bordeaux, has also removed four-fifths of the bone on account of a tumor which originated in it, whilst Meyer and Roux operated on it on

[1] Gross, History of Kentucky Surgery, p. 180.

account of caries. The most perfect and difficult resections of this bone in its continuity unconnected with amputations are, therefore, those just referred to as performed by the four American surgeons there named.

EXTIRPATION OF THE ENTIRE CLAVICLE, BY DR. MOTT, OF NEW YORK.—A young man, nineteen years of age, had a conical tumor to form on the left clavicle, without his being able to assign for it any cause. At the time of the operation, it was about four inches in diameter at its base, of an incompressible hardness, firmly attached to the anterior portion of the bone, and with its apex covered with luxuriant fungous granulations, the consequence of former means of treatment, from which profuse hemorrhage took place from time to time.

OPERATION OF DR. MOTT.—An incision, being commenced over the sterno-clavicular articulation, was carried in a semilunar direction in the sound integuments to near the junction of the clavicle with the acromion process of the scapula, exposing the fibres of the pectoralis major muscle. These fibres were then carefully divided, so as to avoid injuring the cephalic vein, a small portion of the deltoid muscle being detached from the clavicle, and the vein drawn outward towards the shoulder. It being now found impossible, from the size of the tumor and its proximity to the coracoid process, to get under the clavicle in this direction, another incision was made from the outer edge of the external jugular vein over the tumor, to the top of the shoulder, so as to divide the skin, platysma-myoides, and a portion of the trapezius, by which means a sound part of the bone was laid bare near the acromion process. A director very much curved was then cautiously passed under the bone from above, great care being taken to keep the end of the instrument in contact with the under surface, and an eyed probe being conveyed along the director, a chain-saw was passed, and, after being carefully moved a little to see that nothing intervened, made to cut the bone entirely through at this point.

The dissection being now continued along the under surface of the tumor below the pectoralis major, a number of very large arteries and veins were cut and ligated; the first rib exposed under the sternal end of the clavicle; the costo-clavicular ligament divided and the sterno-clavicular articulation opened from below, thus giving considerable mobility to the mass. The sawed end of the clavicle being then elevated by means of strong curved spatulæ, the

subclavius muscle was divided at its origin, the remainder of it being obliterated in the tumor. The tumor was now separated from the cellular and fatty structure between the omo-hyoid and the subclavian vessels, at the upper and outer part of which, a number of large arteries required the ligature, especially a large branch from the inferior thyroid artery. The anterior part of the upper incision being then made from the sternal end of the clavicle over the tumor until it met the other at the external jugular vein, this vein was tied with two ligatures, and divided between them. The clavicular origin of the sterno-cleido-mastoid was also divided about three inches above the clavicle, and, the deep fascia being exposed, the mass was very cautiously dissected until the scalenus anticus was exposed; the subclavian vein, which was firmly adherent to the tumor, being most carefully detached, without injury, by the handle and blade of the scalpel. The external jugular vein being so connected with this part of the tumor as again to require two ligatures near the subclavian, and be again divided in the interspace, the whole mass was removed, the hemorrhage throughout being so free as to require more than forty ligatures, and the operation having occupied nearly four hours for its execution. The patient recovered in about eight weeks, and was subsequently enabled to use his arm by means of a mechanical contrivance which kept the shoulder off from the chest.[1]

Operation of Dr. J. C. Warren, of Boston.[2]—A man, aged twenty-four, after violent muscular effort, felt a severe pain at the junction of the right clavicle with the sternum. A year afterwards, his clavicle presented a tumor measuring seven inches from the sternal end, in a line with the bone, to its scapular extremity; from the clavicle to the nipple it measured five inches; the tumor being hard, with no evident fluctuation, though a slight pulsation could be perceived by the stethoscope. There was no sensible difference in the pulsation at the wrists; the patient complained of its occasionally pressing on his windpipe, and the constitution presented signs of the scrofulous diathesis.

Operation of Dr. Warren.—The patient being placed on the table, with the shoulders elevated, an incision was made from the acromial extremity of the clavicle to the sternal end of the opposite bone. This being crossed by another at right angles with it, begin-

[1] Amer. Journ. Med. Sciences, vol. iii. p 100, 1828.

[2] *Ibid.*, vol. xiii. p. 17, 1833.

ning just below the middle of the sterno-mastoid muscle, and extending to the face of the pectoral muscle below the middle of the clavicle, the four flaps were dissected from the surface of the tumor, and the outer extremity of the bone laid bare by dissecting the deltoid from its anterior, and the trapezius from its posterior edge. The coraco-clavicular ligament being then divided, an eyed probe, armed with a ligature, was passed under the clavicle, and a chain-saw attached to the ligature drawn after it under the bone so as to saw it entirely through.

A strong band being now passed around the outer extremity of the divided bone, the tumor was partly moved by it so as to give tension to the surrounding soft parts. (Plate XXXVII., Fig. 6.)

The pectoralis major muscle being then divided and dissected from the lower edge of the tumor, was drawn so as to expose the pectoralis minor and the cephalic vein. On continuing the dissection under the tumor, the subclavius muscle could be freed from the outer part, but was lost in the tumor at its sternal end, where the dissection necessarily proceeded over the surface of the subclavian vein. An adhesion of the tumor to the second rib, in which it was imbedded, prevented also its perfect separation at this part until the close of the operation.

The next step being to divide the attachments of the upper or cervical edge of the tumor, the posterior external jugular vein was divided and tied. Being filled with dense lymph, it discharged no blood.

The sterno-mastoid muscle was next cut across, and the sheath of the cerebral bloodvessels exposed, the internal jugular vein, which passed into the tumor, being, after much care, separated from it, and the carotid and par vagum drawn to one side. The anterior external jugular vein was found imbedded in the internal extremity of the tumor, and, though also filled with lymph, was tied, as a measure of safety, when the sternal end of the tumor was, with great caution, separated from the corresponding parts of the jugular and subclavian veins, the whole extent of the latter vessel, as well as the lower part of the internal jugular and par vagum nerve, being exposed and put in motion by the pulsation of the subclavian, carotid, and innominata arteries, when the extirpation was completed. But little blood was lost; only one or two arteries, and the veins just stated, requiring the ligature. The flaps were then brought over and retained by three sutures and adhesive plaster, so as to

cover the wound perfectly. On the thirteenth day after the operation, the patient was attacked with chills, and in the fourth week he died (as far as could be judged from the *post-mortem* examination) of constitutional irritation, being of a bad habit of body.

Operation of Dr. A. J. Wedderburn, of New Orleans.—A man, aged twenty-one years, was admitted, January 21, 1852, into the Charity Hospital at New Orleans, with caries of the clavicle, so extensive as to require the entire removal of the bone by disarticulating it at its two extremities.

Operation.—An incision being made in the integuments over the entire length of the clavicle, and sufficiently far beyond its extremities to permit the disarticulation, the soft parts over the superior and anterior borders of the bone were dissected off. The clavicle being now disarticulated at its acromial end, the dissection was continued on the under surface by keeping close to the bone, the adjacent structure being kept tense by elevating the clavicle from its scapular towards its sternal articulation. During this, the bone, owing to its being carious, broke in two at about one inch and a half from its sternal end, thus rendering the disarticulation at the sterno-clavicular articulation more tedious than it would have been if there had remained sufficient length of bone to have afforded a purchase. It was, however, safely accomplished.

After-Treatment.—After cleansing the wound, the cavity left by the removal of the bone was filled with lint, saturated with a solution of sulphate of quinia, in order to guard against erysipelas, which was then in the hospital, and the parts kept in this condition for twenty-four hours. The next day, the lint being removed, the wound was united with adhesive plaster, over which was placed a compress of lint, also wet with a solution of the quinia, five grains to the ounce of water. No other treatment was resorted to. The shock from the operation was so slight that the patient sat up within twenty-four hours after its performance, and on the 8th of April the patient was discharged, without any deformity, and with the perfect use of the arm.[1]

Remarks.—In the details of these operations, there may be noted some difference in the methods of operating, caused apparently by the peculiar circumstances of each disease, though in most of the important points they correspond. As such will doubtless be the

[1] New Orleans Monthly Medical Register, vol. ii. p. 1, 1852.

case hereafter, should the operation be again repeated, any estimate of the advantages of one plan over the other could only be theoretical, and not serve as a guide for future operators. In reviewing the accounts just given of these operations, it must be apparent that they create a great risk of life; but this a competent surgeon will doubtless always be prepared to meet, and if the patient's condition can be benefited by a repetition of these rare resections, no experienced operator should for a moment hesitate about their performance. A point worthy of being mentioned in connection with these operations as well as others involving the great veins of the neck, is the liability to the entrance of air into the large veins from even a very slight wound of the vessel, and when the constant action of the vessel, as affected by the expiration and inspiration of the patient, is recalled, the rapid passage of a bubble of air to the heart may be readily understood. But, though this circumstance has caused most speedy death, yet it has not invariably done so, and the use of anæsthetic agents, when judiciously conducted, will, it is thought, diminish very much this danger. When a patient is fully etherized, great tranquillity is obtained in the respiratory movement of the chest, and there is, therefore, less risk of a wound being accidentally inflicted; whilst, in consequence of the diminished inflation of the lungs, absence of all efforts at crying, and also of shock to the system induced by this valuable agent, the risks of the operation, when thus performed, must be less than they were formerly. With the heart beating about sixty in the minute, and the respiration slow and comparatively feeble, as is usually the case in etherization, it may be doubted whether these large veins would not be as free from danger as is possible in any dissection in the neighborhood of their parietes.

§ 2.—RESECTION OF A PORTION OF THE CLAVICLE.

Resection of a portion of the clavicle is an operation that may be occasionally demanded in cases of necrosis of this bone. It may be performed either at its sternal or humeral third, and is illustrated by the operations hereafter described.

RESECTION OF THE HUMERAL END OF THE CLAVICLE.—In a case of necrosis of the clavicle, Velpeau operated in the following manner:—

OPERATION OF VELPEAU.—A crucial incision being made with each branch four inches long, the flaps were dissected back, the acromio-clavicular ligament and some portions of the deltoid and trapezius muscles divided, and the necrosed bone raised by means of a bit of wood which was employed as a lever, until the sequestrum could be detached from the sound parts.[1]

RESECTION OF THE STERNAL END OF THE CLAVICLE.—The resection of this end of the bone was performed by Dr. Davy, of Bungay, England, in order to relieve the pressure upon the œsophagus of a young lady, consequent on a dislocation of this extremity of the clavicle by a disease of the vertebral column.

OPERATION OF DR. DAVY, OF ENGLAND.—An incision, two inches long and following the axis of the clavicle, being made on the extremity of the displaced bone, the articular ligaments were divided, and a piece of shoe-leather slipped under the end of the bone, so that it could be divided by sawing upon the leather without involving the deeper-seated parts. The wound healed readily, deglutition was restored, and the patient perfectly relieved by the operation.[2]

SECTION III.

RESECTION OF THE SCAPULA.

Resection of the Scapula has been performed, in several instances, for the removal of large tumors, either so as to leave the neck and glenoid cavity of the bone, with the exception of its neck, or so as to retain all the portion above its spine. The entire bone has also recently been removed by Dr. Gross, of Louisville.

§ 1.—RESECTION OF THE ENTIRE BODY OF THE SCAPULA.

OPERATION OF DR. S. D. GROSS, OF LOUISVILLE.[3]—A tumor, fifteen inches in its vertical diameter, and fifteen and a half inches

[1] Malgaigne, Philadelphia edit., p. 195. [2] Malgaigne, p. 196.
[3] West. Journ. Med. and Surg., vol. xi. 3d series, p. 420.

in the transverse, having been developed on the scapula, so as to impair the use of the arm and cause great pain in the limb, Dr. Gross removed it and the scapula in the following manner:—

A full dose of chloroform having been administered, an incision, sixteen inches long, was made obliquely downwards and inwards from the superior angle of the scapula to the inferior portion of the tumor. Another, which began about five inches below the upper end of the first was then carried in a curvilinear direction, so as to terminate about the same distance from its lower end, and, the dense integuments being dissected off, first towards the spine, and then towards the axilla, the levator scapulæ and trapezius muscles were divided. The acromion process being then sawed through just behind the clavicle, the latissimus dorsi and serratus anticus muscles were divided, so that the fingers could be carried underneath; the tumor was elevated so as to sever the connections which existed near the ribs, and the deltoid and other muscles of the arm being next incised, the neck of the scapula was sawn through, and the entire mass removed with comparatively little difficulty. About twenty-four ounces of blood were lost, several arteries near the neck of the bone requiring the ligature after the removal of the morbid growth. The immense wound being now united by sutures and adhesive strips, the parts were supported by a compress and broad body bandage, and nearly the entire wound healed by the first intention. At the end of three weeks the patient returned home, but, having taken cold on the journey, was attacked by pleuro-pneumonia which was followed by hectic fever, under which he sank in two months.

Operation of Hayman.[1]—A large tumor, which was attached to the scapula, was laid bare by two semicircular cuts through the skin and tendinous expansion, and cut away by rapid strokes of the knife, when the bone was sawn obliquely through its spine, so as to leave only the glenoid cavity and the parts immediately above the spine. This patient recovered, and could move the arm in most directions, except in elevation.

Operation of Mr. Luke, of England.—An incision being made through the skin, from the axilla along the axillary margin of the tumor and anterior costa of the bone, and round the inferior angle to within a short distance of the spine of the scapula, a second in-

[1] Chelius, Syst. Surgery, vol. ii. p. 762.

cision was carried along the lower margin of the spine, from the commencement of the first to its termination. The muscles in the supra and infra spinata fossa being then incised in a direction from a little behind the glenoid cavity to a little above the superior angle, the scapula was steadied and the bone sawed through near the root of the acromion process, when the whole structure was removed. The hemorrhage was very free, twenty or thirty arteries near the armpit requiring the ligature, and about a pint or a pint and a half of blood was lost. The edges of the wound being then closed by adhesive strips, the arm was secured to the side by a bandage, and the forearm placed in a sling. In two months, the wound had completely healed, and in eleven months after the operation "the motions of the arm, forwards and backwards, were perfect, and, in fact, more than ordinary, the limb moving with more than the usual pliancy, and yet possessing considerable power. Rotation outwards and inwards was possible, and the patient possessed tolerable strength, being able to lift with ease considerable weights, though elevation of the arm from the side could only be accomplished by the aid of the opposite hand.

REMARKS.—The resection of considerable portions of the body of the scapula has also been performed by Liston, Janson, Syme, Wutzer, Textor, and Travers, in Europe,[1] and are evidences of the progress of operative surgery in a department which has for its especial object the preservation of a certain amount of the usefulness of the limb. With the exception of some variety in the external incisions required by the development of the tumors which demanded the resection, these operations have all had some general points of resemblance, the preservation of the glenoid cavity being the great object of all of them, in order that the mobility of the limb might be retained. Among American surgeons, the most marked case is that of Dr. Gross, though excisions of the scapula, and even of the scapula and clavicle, have been performed by other surgeons in the United States, either in the act of amputating at the shoulder or in consequence of the development of disease in this region after amputations. As these latter operations are, however, properly amputations of the shoulder-bones, they will be referred to in connection with amputations of the upper extremity, in a subsequent portion of the work.

[1] Chelius, vol. iii. p. 763.

§ 2.—RESECTION OF THE ACROMION PROCESS OF THE SCAPULA.

The resection of the acromion process of the scapula is an operation so very similar to that of the acromial end of the clavicle, allowance being made for the position of the muscles as well as for the greater facility of access to the part, that it can be readily understood without further reference.

The resection of the inferior angle of the scapula would require the employment of such incisions as would freely expose the part, after which its removal could be accomplished by bone nippers or strong scissors passed beneath the bone.

SECTION IV.

OPERATIONS ON THE PARTS ABOUT THE CLAVICLE.

In the portion of the chest immediately about the clavicle only one operation of importance is ever requisite, to wit, the ligature of the axillary artery, or, as it is sometimes, though incorrectly, termed, the ligature of the subclavian artery beneath the clavicle.

§ 1.—LIGATURE OF THE AXILLARY ARTERY BENEATH THE CLAVICLE.

The Axillary artery in this portion of its course may be found in the triangular space which is bounded above by the clavicle, below and on the outside by the pectoralis minor muscle, and below and on the inside by the sternal origin of the pectoralis major.

ORDINARY OPERATION.[1]—The patient being laid upon the table, with the shoulders slightly raised, and the elbow carried a little off from the body, so as to stretch the skin, an incision should be made three inches long, and about three-quarters of an inch below the clavicle, parallel with the bone, so as to terminate outside of the line of junction of the pectoralis major and deltoid muscles, dividing only the skin. The superficial fascia of the chest and the fibres of the pectoralis muscle being then carefully cut, and attention given

[1] Malgaigne, Philad. edit. p. 147.

to the position of the cephalic vein, a director should be introduced beneath the posterior portion of the sheath of the muscle; then, after bringing the arm to the side, so as to relax the parts, tear the cellular tissue about the vessels with the point of the director, and carry the index finger behind the upper border of the pectoralis minor muscle, and, pushing it downwards and outwards, the vessels will be seen in the following order: 1st. On the inside, the axillary vein swollen at each expiration, and partly covering the artery. 2d. Outside, and a little behind the vein, the axillary artery. 3d. More externally and behind, the nerves of the brachial plexus. The vein being drawn inwards by a blunt hook, the aneurismal needle should be passed between the vein and the artery from within outwards, above the origin of the acromial and mammary arteries, which would otherwise interfere with the formation of the coagulum. (Plate XXXVI., Fig. 4.)

Operation of Lisfranc.—Abducting the arm forcibly from the body, so as to render distinct the clavicular and thoracic origins of the pectoralis major muscle, Lisfranc incised the skin in an oblique direction from the clavicle downwards and outwards. The fascia superficialis being then carefully divided, and the line of separation of these two parts of the muscle apparent, their adhesions were separated by the finger or knife-handle, the arm brought close to the side, and the artery sought for and tied, as in the plan just described. Malgaigne[1] gives as a "rule" a direction which I have always found to be a good one, and that is, after the laceration of the posterior part of the sheath of the pectoralis major muscle, to search on the inside of the wound for the vein, which is the first vessel met with, and is an infallible landmark. Carrying it inwards, the artery will be found a little outside and a little behind.

Remarks.—The ligature of the axillary artery by either of the above plans will be found to be a very troublesome operation, and in the case of an aneurism or wound lower down, which are the principal disorders likely to require it, a most difficult one to perform in consequence of the infiltration of the parts, or the enlargement of the thoracic vessels. The after-treatment will also be troublesome, and require special attention at each dressing, in order to prevent collections of pus within the wound, or the travelling of matter into the axilla, or beneath the pectoral muscles, in consequence of the

[1] Philad. edit. p. 148.

depth of the wound. The position of the brachial nerves, or any anomalous distribution of the vessels, is also liable to lead the operator into error, although the rule laid down by Mr. Malgaigne would obviate this in the hands of a careful surgeon and good anatomist. As the artery may be more readily tied in the axilla (as will be shown in connection with the operations upon the upper extremity), and is not so difficult to ligate above the clavicle as it is below, the latter place is now seldom selected for the application of the ligature. The results attending the ligature of the axillary artery by surgeons in the United States may be seen to a limited extent in the Bibliographical Index, and will be again referred to in connection with the operations on the extremities.

In studying all operations, but especially the ligature of arteries, the student will find it much to his interest to practise them upon the subject in the manner that has just been described. The French surgeons are particularly fond of this kind of practical exercise, and it is one reason why their directions in relation to the ligature of arteries are especially valuable. In every operation upon the blood-vessels, those who are accustomed merely to the practice of the dissecting-rooms should, however, recollect the additional difficulties that they may have to encounter from the changes in the relative position of the parts in consequence of disease, as well as the increased dangers always to be encountered from the thin coats of veins being distended with blood in the respiratory efforts of the patient.

CHAPTER XI.

OPERATIONS UPON THE MAMMARY GLAND OF THE FEMALE.

THE mammary gland of the female is peculiarly liable to the development of tumors of various kinds which may require either to be separated from the gland and removed by themselves, or may be of such a character as will render the extirpation of the entire breast the most advantageous operation. To decide on the extent of an operation of this kind, the surgeon should be perfectly familiar with the peculiar tendencies of the different kinds found in this organ.

All tumors of the breast have been divided, by Sir Astley Cooper, into those which are benignant and those which are malignant, the first being often curable by remedial measures, or by the extirpation of the tumor itself; the latter being liable to invade the whole gland and render its entire extirpation proper, except when developed in the breasts of those who from age or other circumstances may find it desirable to retain the bosom, even at the risk of being compelled to submit to a repetition of the operation. The removal of any of the benignant tumors may be accomplished by such incisions through the skin as will expose the new growth, when, after passing a ligature through it, or obtaining a good hold upon it in some other manner, the surgeon should carefully dissect it from the surrounding structure, so as to leave no particle of it. The extirpation of the entire gland will be more fully detailed subsequently, in connection with the anatomical relations of this part.

At present, attention may be advantageously directed to the general pathology of tumors of the breast, in order to enable the operator to decide which operation may be advisable.

SECTION I.

PATHOLOGY AND DIAGNOSIS OF MAMMARY TUMORS.

In the extended work of Sir Astley Cooper,[1] in that of Dr. Warren, of Boston,[2] and in an able article by Velpeau,[3] may be found much valuable instruction in relation to this class of complaints, to which those desiring more extended details than can be reasonably anticipated in a work of the general operative character of the present, are referred.

In the subdivisions of the benignant class of Sir Astley Cooper, are placed six different species of tumors. 1. The Hydatid. 2. The Chronic Mammary. 3. Cartilaginous and Osseous. 4. Adipose. 5. Large Pendulous Breast. 6. Scrofulous. 7. The Irritable Tumor. Of the signs of each Dr. Warren gives the following:—

1st. The Scrofulous Tumor is seen in early life in patients who present all the constitutional signs of scrofula. This tumor is large,

[1] Cooper on the Diseases of the Breast.
[2] Warren on Tumors.
[3] Dict. de Médecine, tome 19me.

irregular, indistinct, not painful, varies in size at different times, and corresponds with the tuberculous tumor of Velpeau.

2d. The Chronic Mammary Tumor occurs before the age of thirty-five, in healthy, but feeble constitutions; is circumscribed, of a rounded form, quite movable; not tender or painful; increases slowly, and is not malignant.

3d. The Irritable Mammary Tumor is seen before middle age in delicate and nervous habits; is not large nor well defined; is tender, painful, and sometimes accompanied with general swelling of the breast and fever. It is not malignant.

4th. Hydatids, or Hydatid Tumors, appear before middle age; are irregular; occupy the whole breast; are not tender, painful, or discolored; increase rapidly and attain a great size, when they may be readily distinguished by the globular bodies which form on the surface, as well as by their magnitude and freedom from pain.

5th. The Adipose Tumor is seen in healthy females, and easily recognized by it great size, elasticity, freedom from sharp pain, and regular surface.

6th. Cartilaginous and Osseous Tumors, which are rare, may be known by their extreme hardness.

7th. Cancerous Tumors are usually seen between the ages of thirty and fifty; often in those whose relatives have suffered from cancerous complaints.

8th. Encephaloid growths occur in young subjects; are large and soft; consist of two or more globular bodies; increase rapidly; ulcerate; create a fungus, and bleed.

Velpeau, with the accuracy of detail which is so characteristic of an extended experience, divides all mammary tumors into three classes: 1st. Those arising from simple hypertrophy, either of the gland or its envelops. 2d. Those due to degeneration of the natural tissues; and 3d. Those which are the result of abnormal deposits, as shown in the following table:—

- 1. Simple hypertrophy.
  - 1. Of the mammary gland.
  - 2. Of the cellular tissue.
  - 3. Of the fat.
- 2. Degenerations.
  - Fibrous.
    - In laminæ.
    - In mass.
    - In radii.
  - Fibro-scirrhous.
    - Of the glandules.
    - Of the gland.
    - Of the milk-ducts.

- 3. Abnormal productions.
  - Liquid cysts.
    - Serous or hydatid.
    - Gelatinous.
    - Sanguinolent.
  - Solid.
    - Fibrinous.
    - Tuberculous.
    - Buttery, milky, or cheesy.
    - Osseous.
    - Scirrhous.
    - Encephaloid.
    - Colloid.
    - Melanotic.

In the above well-arranged table may be found a designation of nearly all the tumors of this portion of the body, and the following description, which is mainly condensed from the information furnished by his valuable paper, will sufficiently fill up this brief enumeration. To those desirous of investigating the views of other surgeons, and especially those describing the microscopical character of these tumors, I would recommend the works of Walshe, Lebert, Berard, and Birkett; further reference to which my space compels me to omit.

§ 1.—TUMORS DEPENDENT ON HYPERTROPHY.

HYPERTROPHY OF THE MAMMARY GLAND is only seen in the unmarried female, is most apt to appear soon after puberty, and sometimes creates such a development of the organ as is almost incredible, some having been reported in which the gland hung down to the knees and weighed thirty pounds, and others having been forty-two inches in circumference. In the only case that I have seen in Philadelphia, the breast reached nearly to the umbilicus, and was larger than a man's head, as tested by an attempt to surround the gland with a hat.

This complaint is universally admitted to be rare, and yields no further inconvenience, in many instances, than such as can be remedied by stays, and, in many instances, disappears on childbearing. The natural appearance and feel of the gland will usually prevent diagnostic errors.

THE FATTY TUMOR, or hypertrophy of the adipose and cellular tissues around the breast, is not intended to include the ordinary lipomatous growth which is occasionally seen in the breast, as well

as elsewhere, and which is a circumscribed, lobulated, and pediculated tumor, but designates a rare form of disease in which the adipose structure of the entire breast is much augmented, creating a mass of considerable size, of a broad base and not pediculated. This tumor is apparently dependent on an extreme development of the adipose cells in the interlobular septa of the breast as well as in the subcutaneous layer of fat. The mass is nearly always lobulated, or as if subdivided into numerous secondary masses, by the fibro-cellular septa which create the lobules of the breast. When incised, there is seen an almost homogeneous mass furrowed by a few whitish fibrous bridles, intermixed with many glandular lobules which are greasy and unctuous to the touch, of a yellow color, of the consistence of lard, and which may be broken down by the finger.

Dr. Warren[1] reports an instance of this kind of tumor which he removed, and which weighed eight pounds. No appreciable cause could be assigned for its production.

Fibro-Cellular Hypertrophy is an abnormal development of the natural partitions, and fibrous or cellular laminæ which separate or envelop the lobes of the breast, and is generally due to some inflammation of the breast which has previously existed, such as an acute or chronic mammary abscess. On examining the breast after this complaint, the gland is often found to be decidedly harder, less elastic, less lobulated, and more homogeneous than is the case in its natural condition. The subcutaneous cellular and fatty tissue, together with the divisions of the lobules, are now found to be confounded in one regular mass, in the midst of which the natural structure of the gland seems to be lost. This disorder has been described by Sir Astley Cooper and Dr. Warren as the chronic mammary tumor, and is difficult to distinguish from the early stages of carcinoma. It may, however, be diagnosticated from scirrhus by the previous history showing that it was consequent on one or more attacks of inflammation; by the absence of pain, heat, and redness; by its density, by its mobility, notwithstanding the appearance of adhesions between the tumor and the skin; by the good constitution of the patient and their self-satisfied condition, as well as by its remaining stationary, rarely or ever increasing. This fibro-cellular hypertrophy often disappears of itself by a complete and gradual resolution, even after it has existed a long time; seldom or never

[1] On Tumors, p. 229.

degenerates, and does not usually demand operative interference. In a patient, at present under my treatment, the left breast has been thus indurated during a period of four years, as the consequence of an inflammation of the gland, which, in accordance with the advice of Mr. Cusack and other surgeons of Dublin, has been untouched by the knife. During two different lactations, acute inflammation has shown itself about the structure, the first of which was relieved by an antiphlogistic and resolutive treatment, and in the second by a free suppuration, which, though causing some diminution of the surrounding enlargement, did not materially change the character of the original deposit.

§ 2.—TUMORS DUE TO DEGENERATION OF TISSUE.

The class of tumors of the breast, designated as those due to a degeneration of tissue, is intended to include such as present the elements of the gland either in a condition of induration which has been compared to the hardness of wood, or to that of fibro-scirrhous deposit. The first may be found arranged either in laminæ, in mass, or in radii, constituting a variety of scirrhus, and deserving of special consideration in order to render the diagnosis of the tumors of this part more accurate, as well as to present a more definite account of the changes of structure than could be furnished under the general term "scirrhous degeneration."

I. LIGNEOUS, OR WOOD-LIKE SCIRRHUS.

The ligneous variety of scirrhus may be seen either in laminæ, mass, or radii.

In the laminated class, the disease usually occupies a disk, which is more or less regularly circumscribed by a tegumentary envelop, and, as a general rule, seated in the skin, though sometimes it consists in isolated points which are deep-seated. In the first case, the skin is hard to the touch, a little wrinkled, thickened, and of a grayish or red color, which is altogether unnatural, looking as if the part had been tanned. In other instances, the disks are much smaller and disseminated, the two varieties occasionally existing in the same patient, a large disk being surrounded by an infinite num-

ber of small ones. Sometimes they rise above the surface of the skin, whilst at others they are disseminated in the subcutaneous layer. This sort of degeneration continues, usually, notwithstanding the most judicious treatment; is reproduced with extreme obstinacy, and cannot be operated on with any chance of success. At other times, this ligneous degeneration shows itself as small shot or pea-like tumors, in or under the skin, which have their seat in the subcutaneous cellular tissue, and apparently result from the transformation of this tissue. These tumors are also reproduced with extreme obstinacy, and are not benefited by an operation.

In a paper by Dr. Joseph Parrish,[1] the condition of parts, in this form of scirrhus, has been distinctly noted, his attention having been called to it by Dr. Physick. It is there described as giving the sensation of a granulated surface as if the skin were filled with small shot. Dr. Physick considered this as the most dangerous form of true scirrhus, and thought that he had never known an operation to prove ultimately successful, an opinion in which Dr. Parrish coincided.

II. FIBRO-SCIRRHOUS DEGENERATION.

This class includes most of the tumors which are designated in common language as cancerous. They may be seen either as affecting the septa which surround or separate the different lobes of the breast; as extending to the proper structure of the gland, or as connected with the milk-ducts. On incising a breast affected with the first (septa), it is seen to be partitioned by hard, pearl-like laminæ, which creak when cut, and this variety is the most difficult to eradicate of all the forms of scirrhus, as these apparent roots, by prolonging themselves in every direction, can seldom be entirely removed.

III. THE ORDINARY CANCEROUS TUMOR OF THE BREAST.

This tumor, as described by Dr. Parrish,[2] commences with a small distinct lump, which runs its course either with great rapidity, or

[1] North Amer. Med. and Surg. Journ., vol. vi. p. 295, 1828.

[2] *Opus citat.*

remains indolent for months or years. When it becomes active, the first symptom is generally a lancinating, or an exceedingly distressing burning pain.

When the tumor increases in size, it embraces the adjacent parts, and identifies them with its own peculiar structure. As at first perceived,[1] it is a hard irregular lump without definite limits, is movable, that is, moves with the portion of the gland in which it is situated, but does not move in that portion like the chronic mammary tumor before spoken of. As it contracts adhesions with the skin, the latter becomes wrinkled and puckered, or is slightly swollen, and the nipple is retracted or depressed below its ordinary level; whilst, as adhesions form with the pectoral muscle, the whole mass becomes, as it were, a part of the thorax. The skin, changing color, becomes of a dark red, cracks, and gives exit to a thin serum, which is followed by ulceration. Hectic fever comes on, the disease involves the adjacent lymphatic glands, and an operation for its removal becomes unjustifiable.

The pain which attends the development of cancerous tumors is evidently due to the compression of the nerves of the part by the scirrhous substance, and usually follows the course of the thoracic nerves into the axilla. This pain, combined with the peculiar cachexia, is an important aid in diagnosticating these complaints.

§ 3. ABNORMAL PRODUCTIONS IN THE BREAST.

Of the abnormal deposits in the mammary gland, there are found two kinds, to wit, such as are liquid and such as are solid.

The liquid deposits embrace the whole class of encysted tumors, and are comparatively simple in their character, requiring either the removal of the cyst and its contents, or the development of such an action as will modify the process of secretion.

The solid tumors may be either benignant or malignant. Of the first, we have the fibrinous, tuberculous, cheesy, and osseous, all of which may be extirpated with but little chance of return; whilst the scirrhous, encephaloid, colloid, and melanotic will most frequently be reproduced at some period, or in some other spot, after extirpation. The variety seen in these productions must, however, prevent

[1] Warren on Tumors, p. 236.

a more detailed allusion to them, and the account of the progress and result witnessed in the numerous tumors found in and about the mammary gland may, therefore, be briefly summed up in the following facts:—

1st. All tumors of the breast are, or are not, susceptible of malignant transformation.

2d. Those not susceptible of cancerous transformation are the encysted class, as the hydatids, the serous or sanguinolent effusions, and the fibrinous, tuberculous, cheesy, and osseous tumors.

3. All those included in the preceding table under the head of degenerations, as the ligneous, fibro-scirrhous, &c., are liable to conversion into cancer, whilst the other solid abnormal productions are well known to be malignant.

SECTION II.

EXTIRPATION OR AMPUTATION OF THE MAMMARY GLAND.

The mammary gland is covered by the integuments in front and adherent behind, by a loose cellular tissue, to the fascia covering the pectoralis muscle, being chiefly supplied with blood from the branches of the external mammary artery, whilst its veins run up into the axillary vein. Its removal may be readily effected by incising the skin in such a form as circumstances may demand, but the subsequent dissection of the gland should be conducted in the line of the fibres of the pectoralis muscle, that is, from the sternum towards the axilla.

Operation.—The patient being etherized and placed upon a table, rather than upon a chair, with her head and shoulders slightly raised, the arm of the affected side should be carried off from the body, and held by an assistant, so as to keep the skin and pectoral muscle upon the stretch. Then, standing on the side of the disease, or by the shoulders of the patient, place the four fingers of the left hand upon the skin, so as to make it tense, whilst an assistant does the same with the integuments of the opposite side of the tumor. After thus steadying the skin, make a semi-elliptical incision with its concavity upwards and the nipple near its centre, either by cutting from the axillary margin of the gland, or lower portion of the anterior border of the axilla towards

PLATE XXXVIII.

OPERATIONS PRACTISED ON THE CHEST.

Fig. 1. Extirpation of the mammary gland of the female. The patient is seen lying down with the arm carried off from the body, and the lowest of the two elliptical incisions has been made from the axilla towards the sternum. The parts being intended to heal by granulation, much more of the integument is about to be removed than is usual in the United States.

1, 2, 3. First or lowest incision. 1, 4, 5. Line of second incision.

After Bernard and Huette.

Fig. 2. Represents the completion of the operation of extirpation of the breast, as usually practised. The left hand of the surgeon grasps the gland and draws it towards the sternum, whilst the thickened cellular tissue or lymphatics are being dissected from the margin of the axilla.

After Nature.

Fig. 3. A view of the arrangement of the adhesive straps after the operation. The straps should be long, and pass obliquely around the chest, so as to leave intervals between the different strips. A piece of linen has been introduced between the edges of the skin at the lowest angle of the wound, in order to secure a vent for the matter.

1. Line of union of the wound left by the incisions. 2. Mesh to favor escape of the pus. 3, 3. Posterior course of the adhesive strips.

After Bernard and Huette.

Fig. 4. Operation of empyema upon the right side of a man. The patient is represented lying down, and slightly inclined to the left side, while the surgeon makes an opening between the eighth and ninth ribs.

After Bernard and Huette.

Fig. 5. Resection of two of the ribs on the left side. The patient lying down and inclined towards the right, a crucial incision has been made over the seat of the disease, the flaps 1, 1 turned back, the ribs 2, 2 sawed across or broken, and the posterior extremities elevated by a bandage, previous to their removal. The thickened surface of the pleura 3 is seen behind the seat of the disease.

After Nature.

Plate 38.

Fig. 1.

Fig. 2.

Fig. 3.

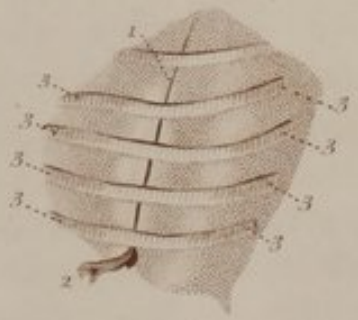
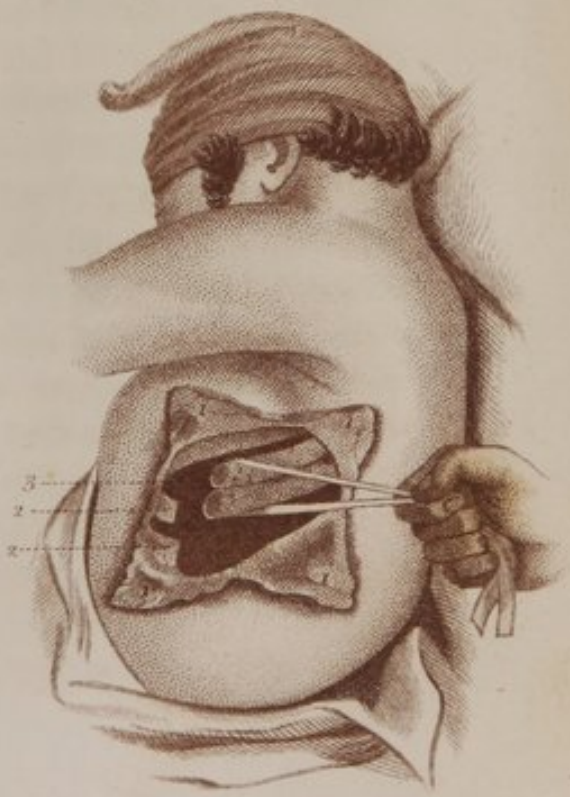


Fig. 4.

Fig. 5.



the sternum, if standing on the diseased side, or by beginning on the sternal side and extending the cut towards the axilla if standing at the shoulder of the affected side, holding the scalpel in the first position (Plate II., Fig. 1), and bearing on it with tolerable firmness, so as to divide the integuments thoroughly by the first stroke of the knife. Then, while the breast and skin are drawn in different directions, dissect the integuments free from the gland on its lower portion, and make another elliptical incision with its concavity downwards, on the upper side of the gland, so as to meet the first one at its sternal termination, but not quite reach it at the axilla, including between these two incisions as much integument as will remove any excess of skin (Plate XXXVIII., Fig. 1). Then dissecting the upper flap off from the gland in the same manner as before, seize the mass firmly, either with the tumor forceps, or by means of a ligature passed through it, or by the fingers, which are usually the best instruments; and dissect it from the sternum towards the axilla, either by working from above downwards or the reverse, according as it is found most convenient, though the dissection from below exposes the operator to the risk of getting beneath the fold of the pectoral muscle in approaching the axilla. As the various branches of the mammary arteries (external thoracic) are divided, the hemorrhage, if profuse, or if the patient is feeble, should be checked, by ligating each vessel as it is cut. But, if this is not the case, the bleeding may be overlooked for the moment, or temporarily checked by compression of the arteries by the fingers of an assistant, when they will often contract and give no further trouble.

In prosecuting this dissection, the left forefinger and thumb should constantly examine the surrounding textures, in order to detect any hardened portions, the dissection being always carried so far into the healthy tissue as to leave a margin of the latter to be extirpated along with the breast. On approaching the axillary end of the ellipse, grasp the breast in the left hand (Plate XXXVIII., Fig. 2), and draw upon it so as to insure the removal of any of the condensed laminæ, or fibres of indurated cellular tissue which are connected with it. If the axillary glands also show any signs of hardening, they may now be readily removed, by slightly prolonging the incisions into the axilla, and working from above downwards; but this part of the operation requires considerable care in some instances, in order to avoid injuring the axillary vein. To prevent this, it will

be found advantageous not to elevate the patient's arm to any great extent, as this position rather puts the axillary vessels on the stretch, and brings them near to the point of the knife. When any of the thoracic veins appear to be connected with the lymphatic glands or indurated tissues, or when the disease is thought to approach near to the main vein, it will be safer, instead of dissecting it out, to surround the axillary portion of the structure with a strong ligature, and cut off the part connected with the tumor on the mammary side of the thread, leaving the remainder to slough or ulcerate out.

After being fully satisfied that every diseased particle is removed, the wound should be cleansed, any arteries that continue to bleed ligated, and the ligatures brought out at the sternal extremity of the incisions.

The arm being now brought to the side, the edges of the skin may be approximated and held together at the central point by a single suture, supported by long adhesive strips, or the whole may be closed by the interrupted suture without resorting to the use of the plaster. In either case, it is a good practice to introduce a little mesh of linen into the lower orifice of the incision (Plate XXXVIII., Fig. 3), in order to secure a vent for the pus by preventing the entire union of the skin before the ligatures come away, or before adhesions have formed in the deeper-seated parts. When adhesive strips are employed, they should be applied from below upwards, obliquely across the line of the wound, so as to leave spaces between each strip for the escape of matter (Plate XXXVIII., Fig. 3). After this, a compress should be firmly retained against the part by a spiral reversed bandage of the chest, so as to prevent the pus collecting within the lower flap, whilst the arm of the side operated on should be supported in a sling, or kept close to the side, so as to preserve perfect rest of the pectoral muscle until union has occurred.

If the disease has involved a part of the pectoral muscle, this portion should also be removed, though, as a general rule, it is best to avoid incising even the anterior fascia of the muscle, lest it subsequently interfere with the free motions of the arm. Should the gland be known to be adherent to the muscle before operating, the chances of the cure will be so much diminished that the surgeon may well hesitate before he advises his patient to submit to the knife.

In cases of open or ulcerated cancer, such as are not deemed suitable for an operation, or where the disease returns and creates a painful ulcer in or near the cicatrix, it will prove advantageous to

dress it by covering the sore from time to time with the coating formed by the application of the solution of gutta percha in collodion, as suggested by Dr. Dugas, and spoken of under cancer of the lip (page 355). In the case reported by Dr. Dugas,[1] there was a cancerous ulceration, of several months' standing, of the size of the areola, in the depressed centre of which were seen the remains of the nipple. The axillary glands were also much enlarged, and the patient a prey to continual pain, which was especially severe at night. Under the application of a coating of the solution of gutta percha, applied over the whole breast at first every twenty-four hours, and then, as the discharge diminished, once in a week, the patient was gradually relieved of all pain about the breast, and even in the axilla, slept quietly at night, and enjoyed her meals, a change which must have proved highly serviceable in arresting the progress of the disease.

Remarks on Amputation of the Breast.—The simplicity of the operation of extirpating the breast is often such that the detailed account of it just given, may by many be deemed unnecessary, and to the man of experience such will doubtless be the case in this as in most other operations; but to others it will, it is thought, prove useful. The frequency of the operation demands also that those whose experience is limited should, if possible, be made aware of the difficulties which are occasionally met with; whilst, in an operation for the removal of a growth which is so very liable to return, too much care cannot be taken to excise every portion that is diseased, and this can only be accomplished by following the details of a proceeding similar to that just stated.

In what seemed to be a simple case of extirpation of the mammary gland, as performed by Dr. Warren, of Boston, everything did well until it became necessary to remove some of the indurated lymphatic glands of the axilla. When the separation of these was nearly effected, "a vein was divided, which gave exit to a small quantity of venous blood, when almost instantly the patient struggled, her complexion changed to a livid color, and a bubbling, gurgling noise was indistinctly heard, showing the entrance of air into the vein. The axilla was, therefore, instantly compressed, but the patient became insensible, and breathed as if in apoplexy. The tumor was at once separated, the patient laid down, brandy poured

[1] New Orleans Medical Register, vol. ii. p. 7, 1852.

down her throat, and ammonia introduced into her nostrils, but the pulse became less distinct every instant," and although every other possible means of exciting animation were tried, even to opening the larynx and inflating the lungs by a pair of bellows, and continued without intermission for twenty minutes, the patient never breathed again. In the history of this case, Dr. Warren[1] suggests that the entrance of air into the axillary vein in this operation may be prevented by keeping the arm towards the side, so as to relax the coats of the vessel, instead of extending them, as is done when the arm is elevated during the progress of the dissection towards the axilla. But when the surgeon is aware of the risk of this accident, and is cautious, he will be better enabled to see the parts that he is about to cut when the axillary dissection is made with the arm slightly elevated. In all such cases it is, however, the safest plan to secure the chain of glands and cellular tissue with a ligature, and leave the pedicle to slough out, instead of dissecting into the axilla, in order to remove them.

The selection of the different external incisions, or their direction, is, it is thought, a matter that must be settled at the moment by the peculiar circumstances of the case. The elliptical incision in the line of the fibres of the pectoral muscle is that most frequently resorted to, and answers perfectly well in most instances. The propriety of arresting the hemorrhage as the arteries are divided, or simply twisting or compressing them during the operation, is also a point on which surgeons differ, and must be left to the decision of the operator, who should be guided in his course by the strength of the patient, and by the number and size of the vessels that are divided. I have seen many instances where only from one to four ligatures were demanded, whilst, on the other hand, I have been compelled to apply fifteen or twenty before the bleeding was checked.

Statistics.—A very important question connected with this operation is the advantages likely to result to the patient from its performance. To decide this point correctly, it is essential that the subsequent history of the cases operated on should be known, and this, from various causes, it seems to be almost impossible to obtain. In order to gain reliable statistics of the results of surgical operations for malignant diseases generally, the American Medical Association recently referred this subject to a committee, of which Dr. S. D.

[1] Warren on Tumors, p. 260; also Am. Cyclopedia Pract. Med. and Surg., by Hays, vol. i. p. 263, article Air, 1834.

Gross was chairman. This gentleman accordingly furnished[1] a very elaborate and full report, embracing the opinions of surgeons in every section of the globe, and containing a large amount of valuable details. As the extent of this paper requires that it should be consulted in its unity, I can only express my opinion of its value, and add as illustrative of its results the following brief synopsis of some of the conclusions at which it arrived:—

"1st. Cancerous affections, particularly those of the mammary gland, have always, with a few rare exceptions, been regarded by practitioners as incurable by the knife and escharotics.

"2d. That excision, however early and thoroughly executed, is nearly always, in genuine cancer, followed by a relapse at a period varying from a few weeks to several months from the time of the operation.

"3d. That the profession have always been, and still are averse to any operation for the removal of cancer after it has ulcerated, contracted adhesions, &c., because it then almost invariably returns and progresses more rapidly than when allowed to pursue its own course.

"4th. That extirpation is improper in acute or rapidly developing cancer.

"5th. That all operations for encephaloid growths are more rapidly followed by relapses than those performed in hard cancer."

* * * * *

"14th. That life has occasionally been prolonged, and even saved by an operation after a relapse; but that, as a general rule, the second operation is as incompetent to effect a permanent cure as the first."

The following points are considered by Dr. Gross as unsettled, opinions being divided in respect to them.

"1st. The propriety of excision is doubtful in cases which are of hereditary origin.

"2d. It is doubtful whether a very young patient should be operated on, if the disease is of rapid growth, as the operation will only expedite the fatal issue.

"3d. It is doubtful if a case attended by suppression or irregularity of the menses should be operated on.

"4th. A quickened state of the pulse, if occasioned by the local irritation, should forbid the operation.

[1] Transact. Am. Med. Association, vol. vi. p. 155.

* * * * *

"6th. It is supposed, but not proved, that the excision of carcinomatous tumors only tends to hasten the patient's death.

"7th. It is doubtful whether an operation on a recent cancer is more successful than that on an older one, other things being equal."

Dr. Gross, therefore, sums up his report, which is chiefly based on the experience of others, by expressing his individual practice to be to discourage a resort to the knife in all malignant diseases, except those of the skin or the cancroid variety.

Prior to the appearance of this report, the professional opinion of the result of surgical operations was formed from limited accounts, and from the *recollection* of operators, that, in the majority of cases of well-marked cancer, the operation did not cure the patient, though it was supposed to prolong her days, and the latter assertion has always been urged by those who advocated the operation in all cases. The prolongation of life is, I think, a doubtful matter, as I have known advanced cases of ulcerated cancer to live months (in one instance three years) under a local antiphlogistic and palliative treatment, combined with the free use of chalybeates, according to the plan directed by Justamond and others.

The following seem to be the opinions of the other surgeons hereafter quoted, so far as I have been able to collect them, and as they furnish the views of many eminent men, might have been very much augmented if it had seemed desirable. But with the conclusions stated in the paper of Dr. Gross, such an enumeration without a digest would have tended to confuse rather than elucidate the subject, and I therefore present them very briefly.

Rhazes,[1] A.D. 924, opposed all operations for cancer when the tumor was not entirely free from the surrounding parts.

Albucasis,[2] A.D. 1100, strongly doubted the propriety of operating in cancerous tumors, declaring that he never cured or saw cured a single case.

Monro, in England, and Delpech, in France, are believed to have been opposed to the operation. Velpeau,[3] on the contrary, regards most of the cancerous, encephaloid, or colloid tumors as a primary local complaint, the rest of the system being only involved second-

[1] History of Surgery, p. 20, vol. i. of this work.

[2] *Ibid.*, p. 21.

[3] Dict. de Méd., tom. [illegible]me, p. 97.

arily. He thinks, therefore, that every case of cancer should be operated on, and operated on as early as possible, without delaying in order to try remedial measures.

Dr. Joseph Parrish, of Philadelphia, admits that, after considerable observation and experience, he was much discouraged by the final success of the operation, and never resorted to the knife (unless at the particular request of the patient) where the disease had penetrated into the axilla, or fixed upon the parts beneath the breast. When the breast alone was affected, he advised the operation, though believing it to offer but a doubtful prospect of escape.

Dr. Warren,[1] of Boston, is satisfied that many cases may be cured by the operation, and, according to the best of his information, thinks that one in three has been cured without a relapse, and that when the tumor is not ulcerated, and there are no signs of a constitutional disorder, it is best to try the experiment.

Dr. Dudley,[2] of Lexington, reports to the Committee on Surgery, of the American Medical Association for 1850, "that he never removed a scirrhous breast without a return of the disease at a subsequent period."

Dr. Paul F. Eve[3] "never operated when the diagnosis was unequivocal, that the affection did not return."

Dr. J. Kearny Rodgers,[4] of New York, gives, as the result of his experience, that "no two cases survived the operation, in good health, two years; the majority being in their graves in less than twelve, and many in six months."

Dr. Mussey,[5] of Cincinnati, who was the chairman of the committee of the American Medical Association on these statistics in 1850, in speaking of his own experience, says that he "has operated for cancer of the breast, in many instances, without learning the sequel; but of those ascertained there were only two in which the disease did not return in some part of the system within four years, and most of them within one year."

Drs. Twitchell,[6] of New Hampshire, entertained the same views; so also did Dr. Knight, of Connecticut; but the latter thought that in some instances life has been prolonged by the operation.

[1] On Tumors, p. 278, 1839.

[2] North Am. Med. and Surg. Journ., vol. vi. p. 300, 1828.

[3] Transact. Am. Med. Association, vol. iii. p. 332.

[4] *Ibid.*

[5] Chairman of committee, *op. citat.*

[6] Transact. Am. Med. Association, vol. iii. p. 332.

Dr. Flint[1] has seen one case of undoubted encephaloid disease of the breast, in which the patient was well seven years after the operation.

The result of Dr. Mussey's report is, therefore, "that soft as well as hard cancer of the mammary gland is, in some instances, a local disease, and that the operation *may* prolong life."[2]

Dr. Gross in his late report to the American Medical Association,[3] just referred to, also expresses the opinion as based upon the views of surgeons in every section, that it is improper to operate in any case when the disease is *hereditary*, as such cases are peculiarly virulent and intractable, and tend rapidly to a fatal termination.

Leroy D'Etiolles[4] gives, as the result of his statistics, that, in four hundred and twelve cases, the mean result of cancer in women (not limiting the disease to the breast) was three years and six months life, without the operation, and two years and six months after it. "Extirpation of cancer does not, therefore, prolong life." Of cancerous tumors in the breast alone, Leroy gives the following result: "Of two hundred and four, twenty-two died in the year after the operation, and eighty-seven had a return of the complaint, making the whole number one hundred and nine, or more than one-half." He, therefore, discountenances the operation.

Mr. Broca,[5] in a prize essay on the pathological anatomy of cancer, has added other melancholy illustrations of the subsequent position of patients who have been operated on for cancer. In this essay he shows that of 39 really cancerous patients (the tumors having been examined microscopically), 11 died from the consequences of the operation, and 28 survived these. Of 19 of the latter who were kept in view, every one relapsed; 16 dying within the first twelve months after the operation; 2 in the course of the second year; and 1 at the end of the 25th month.

"Sir Benjamin Brodie[6] also states that the late Mr. Cline, senior, and Sir Everard Home, would scarcely ever consent to the operation under any circumstances."

[1] *Opus citat.*, p. 334. [2] *Ibid.*, p. 337.

[3] Trans. Am. Med. Assoc. vol. vi. p. 174, 1853.

[4] Chelius's Surgery, vol. iii. p. 510, note by J. F. South.

[5] Brit. and For. Med.-Chirurg. Rev. and Charleston Med. and Surg. Journ. vol. viii. p. 413, 1853.

[6] Chelius's Surgery, vol. iii. p. 539.

"Bransby Cooper gives, as his recollection of the sentiments of Sir Astley, that he acknowledged there were only nine or ten out of a hundred extirpations that he had performed in which the disease did not return."

The same surgeon, however, reports one of his own cases where it was eleven and a half years before the disease showed itself; and Mr. Callaway, a case where the patient did not die till twenty years subsequent to the operation.[1]

My own observation, though limited in comparison with the experience of the distinguished men just named, is decidedly adverse to the cure of cancer of the breast by an operation, not one out of ten, to the best of my knowledge, having escaped a return of the disease.

On summing up the opinions thus quoted, it seems that nearly four are opposed to the operation for every one who favors it, though, even among those quoted as favoring it, the recommendation is only either as an experiment, or in the hope of prolonging life.

Under the statement exhibited in the present statistics, and with the knowledge furnished by the valuable labors of Dr. Gross, a surgeon had therefore better state to his patient the little danger that is to be apprehended from the performance of the operation, but also state the chances of a return of the complaint, and leave the decision to her own willingness to endure the pain of the wound. As far as can be judged from a somewhat extended research, there is, I think, reason to believe that the course of the disease has sometimes been hastened by the operation in this country, whilst Leroy thinks life was certainly shortened about twelve months in the cases that he operated on in the Parisian hospitals.

SECTION III.

REMOVAL OF TUMORS OF THE CHEST.

In addition to the tumors just referred to in connection with the mammary gland of the female, the surgeon may be called upon to extirpate degenerations of the same gland or its resemblance as found in the male. This, as well as the ordinary lipomatous, fibrous,

[1] Chelius's Surgery, vol. iii. p. 540, note by J. F. South.

or other tumors found upon the side of the chest, may be readily excised by the means described in connection with the treatment of tumors in the neck, that is, by making an elliptical, crucial, or other suitable incision through the skin over the tumor, introducing the loop of a ligature into it, in order to obtain a firm hold upon the growth, and then dissecting it with as little injury as possible, from the surrounding parts. The after-treatment should be the same as that described in connection with the operation on the female mamma.

When the tumor is a cyst with liquid contents, it may be cured by means of the seton, according to the usual plan.

The following case may serve as an illustration of the character and means of treatment occasionally useful in these tumors.

§ 1. CONGENITAL ENCYSTED TUMOR ON THE RIGHT SIDE OF THE CHEST SUCCESSFULLY TREATED BY A SETON.

An infant, three weeks old, of good development and health, had a tumor at birth of a globular shape, six inches in its vertical diameter by seven and a quarter in the transverse. Its circumference at the base was thirteen inches, and it reached from within an inch and a half of the sternum in front, to the spine behind, and from the axilla, as low as the tenth rib. It was soft, elastic, fluctuating, and transparent, like a hydrocele. Its surface was somewhat lobulated, of a bluish color, and traversed by large veins, the skin being sound, and the part free from pain.

Operation of Dr. Gross, of Kentucky.[1]—After ascertaining, by an exploratory puncture with a cataract needle, that the contents of the tumor were liquid, a small trocar was introduced, and seven ounces of serum, colored like Madeira wine, were drawn off, leaving about one-third of the contents in the tumor. The puncture was then closed by adhesive plaster. Three days subsequently, six ounces of liquid were evacuated in the same manner, emptying the sac entirely; after which the collapsed walls were approximated by a compress and bandage. Four days subsequently there was a partial reaccumulation, which was drawn off, and a few silk threads

[1] Am. Journ. Med. Sciences, vol. xvii. N. S. p. 22. 1846.

introduced to act as a seton, as in the treatment of hydrocele. At the end of forty-eight hours, sufficient inflammatory action being excited, the seton was withdrawn, and the patient, after a convulsion and serious constitutional disturbance, recovered. (See note.[1])

CHAPTER XII.

OPERATIONS PRACTISED ON THE WALLS OF THE THORAX.

Owing to the existence of caries, necrosis, spina ventosa, or other diseases of the bones of the thorax, or from the formation of matter within the cavity of the chest, it has occasionally been found necessary to resort to such operative measures as will facilitate the removal either of the affected ribs, or of the liquid that may have accumulated within the pleura, so as to interfere seriously with the action of the lung.

SECTION I.

SURGICAL ANATOMY OF THE THORAX.

The parietes of the thorax have been subdivided into the anterior, posterior, and lateral portions, to the latter of which the surgeon is chiefly limited in the operations about to be described. The greatest portion of the thorax being formed of the ribs, and parts immediately connected with them, that part of the chest which is bounded by these bones has been named the Costal Region.

This region presents two faces; the one which is concave, smooth, and lined by the pleura, being designated as the pulmonary surface; whilst the other, which is external and convex, is only covered by the integuments and muscles.

The Muscles of the Chest are found both between the ribs as well

[1] By an error in the Bibliographical Index, a paper by Dr. Foltz is quoted as vol. xii. instead of vol. xi. of the Journal. The tumor also was on the side of the pelvis, and not, as there stated, on the chest.

as exterior to them, and are mainly concerned either in respiration, or in the motion of the body.

Of these muscles the intercostal fill up each intercostal space, and present their fibres in different directions, those of the outside passing from above downwards and from behind forwards, and those which are within, taking the opposite line.

On the outside of the lateral portion of the chest, we find the serratus magnus muscle, which, arising from the nine upper ribs, is inserted into the base of the scapula. At the same part, there may also be noted some of the digitations of the external oblique muscle of the abdomen; which, arising from the eight inferior ribs, are interlocked in its five upper heads with the serratus magnus. The diaphragm, after being attached to the lower edge of the thorax, rises up within the chest by a convex surface, which is on a level with the fourth rib.

The Intercostal Arteries pass from behind forwards, and are found on the lower margin of each rib between the two intercostal muscles from the third rib down.

The Veins and Nerves follow pretty much the course of the arteries, and all of these parts, as well as the inner surface of the bones, are lined by the serous membrane known as the Pleura Costalis. The adhesions of this membrane to the ribs is often exceedingly firm, especially when diseased, though at other periods it has been found to be much thickened, and yet quite distant from the ribs, in consequence of the formation of exterior abscesses depressing it upon the pulmonary cavity.

SECTION II.

OPERATIONS ON THE CHEST.

Resection of one or more of the ribs, or perforation of the sternum, or the extraction of liquid from within the cavity of the pleura or pericardium, are the principal operations to which attention may now be given.

§ 1.—RESECTION OF THE RIBS.

Resection of the ribs has been demanded in cases of serious diseases of these bones.

In a patient of Dr. George McClellan,[1] a spina ventosa was developed upon the sixth and seventh ribs of the right side, which extended from their cartilages nearly to the dorsal vertebræ, so as to form a tumor not less than ten inches in its longest diameter. This tumor projected four inches on both the internal and external surface of the ribs, so as to push back the pleura, and nearly destroy the function of the lung.

Operation of Dr. G. McClellan, of Philadelphia.—By two elliptical incisions, which included a portion of the skin, the integuments over the tumor were removed from over this point, and the sixth and seventh ribs found to be so involved in the disease as to have caused the destruction of most of their central portions, their extremities projecting at either side into the substance of the tumor. On removing the mass, by means of the chain-saw and bone-nippers, the hand could be readily passed within and behind the ribs, so that the soft pulpy contents of the tumor, mingled with the expanded and bony fragments, could be rapidly scooped out, the remainder being carefully detached from the pleura by the fingers and handle of the scalpel until the whole mass was removed. The hemorrhage, which was free, was then checked by lint, slightly moistened with creasote.

The cavity left by the disease was now seen to be quite large, being capable, without exaggeration, of admitting with ease a child's head of the ordinary size at birth.

The patient, immediately after the operation, did well; the wound filled rapidly with granulations, and the lung gradually recovered its function, the patient being sufficiently recovered to dress and walk about his room, when an attack of bilious remittent fever caused death ten weeks after the operation.

A remarkable case of resection of the fifth and sixth ribs, performed by Dr. Antony, of Georgia, may also be found by reference to the Bibliographical Index.[2]

In the systematic description of resection of these bones, usually

[1] McClellan's Princ. and Pract. of Surg., note by Dr. J. H. B. McClellan.

[2] Bibliography, p. 98.

presented in the various works on operative surgery, the following directions are given:—

OPERATION.[1]—Lay bare the diseased portions of the bone either by a straight, curved, or crucial incision. (Plate XXXVIII., Fig. 5.) Divide the intercostal muscles above and below the rib, either from without inwards, or the reverse, on a director passed under them. Then detach the pleura from the rib with the handle of a scalpel, and saw through the bone with a chain or Hey's saw. The pleura being usually thickened, there is but little danger of wounding it, though occasionally this membrane is almost healthy.

REMARKS.—The comparative rarity of a disease which could create such effects as would lead a surgeon to think of the resection of the ribs, as well as the risk of injuring the pleura, has rendered this operation not only uncommon, but also one from which many surgeons would at first recoil, as not being likely to benefit the patient. But this is not by any means a modern operation, nor are such cases as that reported by Dr. Antony, unique, as may be readily seen by a brief reference to the history of the operation. In an article on the Resection of the Ribs, by J. Cloquet and A. Bérard,[2] and in one by Velpeau,[3] there may be found a reference to numerous instances in which this operation has been performed, the periods varying from the time of Galen up to the present day. Velpeau mentions a case reported in the ancient *Journal Encyclopédique*, in which Suif excised two ribs, and removed a portion of the lung in such a manner as to be able to introduce his fist into the chest, and yet the patient recovered. In a case reported by Richerand, in 1818, the middle portions of four ribs were removed to the extent of four inches, and the thickened pleura also excised, so that the pulsations of the heart in the pericardium could be seen. The patient lived several months, but ultimately died of a return of the cancer, for the relief of which the operation was performed. According to Velpeau, Severin, J. L. Petit, Duverney, David, Lapeyronie, and Dessault have all done the same thing in cases of caries and necrosis. He has also performed the operation himself in three instances with success.

Dr. Warren, of Boston, also reports having successfully excised

[1] Malgaigne, Philad. edit. p. 207.

[2] Dict. de Médecine, tome 9me, p. 147.

[3] Operat. Surg., by Mott, vol. ii. p. 738.

the seventh, and in another case the sixth and seventh ribs successfully for caries, and Drs. McDowell of Virginia, Mott of New York, and McClellan of Pennsylvania, in three other instances, performed this resection with varying success. As an operation, its execution may therefore be said to be comparatively easy, the thickened condition of the pleura obviating most of the risk likely to arise from opening the pulmonary cavity. But it should be remembered that caries and necrosis can both be cured by the mere efforts of nature, or by slight surgical assistance, and nothing can, therefore, justify a repetition of any of these operations, unless the sufferings of the patient, and the effects upon his respiration, should be most urgent. Indeed, in this, as in many other cases, surgical skill and judgment are often best shown when the surgeon can cure the complaint without resorting to the knife.

Caries or necrosis of the sternum may usually be relieved when an operation is demanded, by trephining the bone, this operation being the same in principle as that described in connection with the injuries of the head.

§ 2.—PARACENTESIS THORACIS.

The evacuation of liquid from the cavity of the chest is among the most ancient of surgical operations, being referred to by Hippocrates, B. C. 460, as well as by many others at different periods subsequently.

PATHOLOGY OF LIQUID EFFUSIONS INTO THE CHEST.—The word empyema (ἐν, in, πύον, pus), though originally employed to designate a collection of pus in any cavity, and especially in the chest, is now often used to express the presence of any liquid, or even the operation that is required to evacuate it. The operation of paracentesis thoracis being, however, intended especially for the relief of collections of pus within the pleural cavity, or for the removal of the fluid of hydrothorax, a brief reference to the pathological condition of the parts concerned may advantageously be made to precede the description of the operation.

A collection of pus, either within or without the pleura, is usually the result of such circumstances as induce an inflammatory action of the part, such as external injuries, or pleuritic attacks, or it may be produced by the bursting of large vomica, or from the discharge

of abscesses in the liver. When the complaint results from external violence, the purulent collection will often be found to be nothing more than an abscess exterior to the pleura, though the effusion may also ensue upon the development of caries or necrosis of the adjoining ribs, the tumor which indicates the collection being made by pus which comes from within the pleural cavity. In most instances, however, whether of external or internal empyema, the pleura exhibits the ordinary signs of inflammation of the serous tissues, such as opacity, thickening, false membrane or pus, and sometimes adheres to surrounding parts so closely as to create cysts. Occasionally, it has also happened that the pleura has been thickened to the extent of three or five superimposed layers of lymph, exhibiting a honeycomb-like arrangement, or a genuine fibrous, cartilaginous, or osseous degeneration. When the effused liquid is in great quantity, and within the pleural cavity, the lung will be found compressed to the top of the chest, though occasionally strong adhesions to the pleura costalis may retain it much lower, and expose it to be wounded in the operation of paracentesis.

An account of the diagnostic signs of such a condition as would justify the operation would carry these remarks too far, and it must, therefore, suffice merely to state, that auscultation and percussion of the chest should be skilfully employed in every instance, before the surgeon attempts the operation.

The operation of paracentesis thoracis has been variously performed, but the object of all the plans is to evacuate the liquid contents of the part, without admitting air into the pulmonary cavity. To accomplish this, it has been suggested to puncture the parietes of the chest with a trocar and canula, or with a trocar and syringe, or to make a direct dissection, layer by layer, from the skin to the pleura. In all the plans that have been recommended for the accomplishment of this object, surgeons have differed mainly in regard to the best point for the puncture; but, as the patient is usually compelled to sit up, and as the general anatomical relations of the region especially favor a certain point, it is sufficient to state that, when circumstances admit of it, the space between the fourth and fifth, or fifth and sixth ribs, and a little posterior to their middle, should be selected.

In order to avoid wounding the diaphragm, which is presumed to be pushed up by the liver, it is generally advised to puncture

the right pleura one rib higher than that advised for the left. Such a position is, however, far from being established as correct, the idea being based rather on the descriptions of the normal condition of the part than on the diseased state, and it is most probable that the weight of the fluid collected within the right pleura will more than counteract any elevation of the liver when the patient is in the erect position. In counting the ribs in a person of moderate flesh, but little difficulty will be found in tracing them from below upwards; but in those who are fat, or in those who have the side œdematous and swollen, it may be impossible to distinguish these spaces, and under such circumstances the rule has been given to select a spot which is about six finger-breadths below the inferior angle of the scapula.[1] But by directing the patient to take as full an inspiration as possible at the moment of puncturing the pleura, the diaphragm will be secure from injury.

Ordinary Operations of Paracentesis Thoracis.—The patient being propped up in bed, and a little inclined to the sound side, so as to separate the ribs as much as possible on the diseased side, divide the skin to the extent of one and a half inches in a direction parallel with the superior edge of the lowest rib on the intercostal space, that is selected for the puncture. Then, after dividing the superficial fascia, and any portion of a muscle of the chest that may intervene, as well as the external and internal intercostal muscles, the pleura will generally be found to bulge into the wound, and being distinctly felt by the forefinger, so as to establish the fact that only a fluid is behind it, puncture the membrane with the point of a bistoury, and enlarge the opening gradually as the liquid escapes[2] (Plate XXXVIII., Fig. 4). If the pleura is very much thickened, care will be requisite to avoid the error of pushing it before the instrument, for such a case has been seen, as may be found by referring to the Bibliographical Index.[3] Velpeau entertains the opinion that, in cases which require the operation of paracentesis, the effused liquid, or even an abscess, will remove the lung from the point of puncture, and thus secure it from being wounded. He, therefore, objects to the details just given, and advises that the side of the chest be at once opened by a deep puncture with the bistoury in the same manner as an ordinary abscess.

[1] Malgaigne.

[2] Velpeau, Op. Surg., by Mott, p. 515, vol. iii.

[3] Bibliography, p. 100.

Operation of Dr. Metcalfe, of New York.[1]—The patient being placed on a stool of convenient height, an exploring needle was passed between the seventh and eighth ribs immediately beneath the angle of the scapula, and the presence of serum rendered positive. A bandage being then passed around the chest, a short incision was made in the skin with a lancet, and the trocar of Schuh passed into the chest to the depth of one inch and a half. The cock of the canula being now turned and serum escaping, a flexible catheter was adjusted to the mouth of the canula, and its free end immersed in a little clean water, the fluid being thus allowed to escape from the chest without the admission of any air into the pleural cavity. In this manner, seventy-two ounces of serum were evacuated, the steady tension of the bandage preventing any discomfort from the evacuation of the fluid. The operation lasted half an hour, and the patient was then able to take a long, full inspiration, and was temporarily relieved, the object of the operation in the present case being only palliative. The instrument employed was a modification of Schuh's instrument, and consisted of a trocar three and a half inches long by about one line in diameter, resembling the ordinary instrument for tapping hydrocele, which was fitted into a canula in which was a cock at the distance of two and a quarter inches from the end which entered the chest. A roughened handle projected at right angles to the axis of the tube at its external extremity. The canula was of the same diameter throughout, and had no cup as in the ordinary canula, so that an elastic catheter could be readily attached to it. Its simplicity over the trough of Schuh is its chief recommendation in the opinion of Dr. Metcalfe. In order to tell when the serum from the chest passed out of the end of the catheter which was immersed in the water, a crumb of bread, pressed between the fingers to render it heavy, was dropped near the end of the catheter, and by its motion indicated the current caused by the effused liquid.

After-Treatment.—If circumstances render it desirable to keep the wound open, a tent may be introduced, and removed from day to day; but if the whole of the liquid be evacuated, the opening may be at once closed with adhesive strips, a compress, and bandage. If the subsequent discharge continues copious, or becomes very fetid, advantage may be derived from washing out the cavity

[1] New York Med. Times, vol. ii. p. 377, 1853.

with warm water, or warm barley-water; weak astringent washes, or those of an antiseptic character, as dilute solutions of the chloride of soda, being subsequently employed.

In order to evacuate the liquid, and yet prevent the entrance of air, various contrivances have been employed. Pelletan employed a syringe for this purpose, and Reybard placed a piece of gold-beaters' skin, or the intestine of the cat, over a canula introduced into the pulmonary cavity, by means of a perforation in the rib, so that the matter might flow out and yet the air not enter.

Dr. Wyman, of Cambridge, United States, has also invented a brass suction-pump with an exploring canula, in order to permit the evacuation of the fluid without allowing the air to enter the pleura,[1] and has reported numerous instances of the success of this mode of operating, all the patients being immediately more or less relieved, and two being perfectly successful, though the patients were very ill at the time with hectic, &c. This mode of operating by the canula he thinks is preferable to the ordinary mode of incising the soft parts.

Estimate of the Operation.—In estimating the value of any of these modes of operating, the difficulties or objections applicable to each should not be overlooked. When the intercostal spaces are prominent, and the presence of liquid certain, the direct puncture of Velpeau is the best; when there is any doubt of the position of the liquid, then the ordinary operation by dissection of layers would be preferable. Where, however, the diagnosis is positive, and the chances of failure from the accident of pushing forward the thickened membrane, instead of perforating it, is guarded against, the instrument of Dr. Wyman, of Massachusetts, may prove advantageous. In Boston, the experience of the profession is said to be favorable to it. Under all circumstances, the surgeon may anticipate an anxious and long-continued convalescence of the patient, and one which will exact all his skill as a practitioner, to conduct the case to a favorable result.

The employment of a trocar is the most objectionable of the various instruments employed, as it is not so shaped as to obtain a keen edge, whilst the point of the canula, even when closely fitted to the shoulder of the instrument, is very liable to tear or push the pleura before it, as is occasionally seen in cases of hydrocele accom-

[1] Transact. Am. Med. Assoc., vol. iv. p. 245.

panied with thickening of the tunica vaginalis. When the surgeon recalls the constitutional effects liable to result from opening closed cavities, and especially those containing pus, and covered by a pyogenic membrane, he can readily foresee the consequences of opening the pleura in cases of empyema. The natural tendency of such collections is either to be absorbed or discharged by the efforts of nature. If discharged by nature, the inflammation of the surrounding parts, and the character of the opening made by ulceration, are well known to be more favorable to a cure than is the case when the surgeon punctures it. I would, therefore, express the opinion that this operation should not be resorted to until the latest possible moment; that, when done, air should be prevented from entering the cavity of the chest; that the pus should be slowly and only partially discharged, the wound closed, and the operation repeated, if necessary. If, however, the entrance of air cannot be prevented, it will be better to evacuate the whole of the liquid, and treat the case subsequently like one of cold abscess. The results obtained in the following table show pretty correctly what may be anticipated from the operation, when resorted to after the diagnosis has been made with the aid of auscultation:—

STATISTICS OF THE OPERATION OF PARACENTESIS THORACIS.

	CURED.	DIED.
Of 24 cases treated in the United States,[1] there were, counting two reported as relieved,	17	5
Of 72 cases reported by Velpeau[2]	41	31
Of 44 " " " Roe[3]	32	12
Of 26 " " " Roe[4] for hydrothorax .	17	9
Of 16 " " " T. Davis[5]	12	4
Total, 182	119	61

From this table it appears that about two-thirds of the cases operated on have been cured.

Remarks.—Although the above table shows the results of more recent cases, it is only an evidence of the fact that carefully chosen cases will be attended with fair success. The value of the operation has, however, been very differently estimated at various periods, most

[1] Bibliographical Index, p. 99.

[2] Velpeau, Méd. Opératoire.

[3] Am. Journ. Med. Sciences, vol. xxiii. N. S. p. 38. Paper by Wm. Pepper, M. D.

[4] *Ibid.*

[5] *Ibid.*

of the surgeons, up to the time of the discovery of Laennec, having regarded it as either doubtful or dangerous, and especially from the difficulties attendant on the diagnosis. Since the more general resort to auscultation, many of these difficulties have been removed. Disease of the lungs are now no longer confounded with those of the pleura, and a skilful auscultator can, in most instances, render the knowledge of the presence of a liquid in the chest absolutely certain.

But, though the cases can now be better selected than they were formerly, a successful result is not always obtained. The true value of the operation may, it is thought, be correctly stated thus: Paracentesis will always afford temporary relief, and about one-half of the cases will recover; but whether these patients would have died without it, is difficult to tell.

The idea is certainly erroneous that paracentesis thoracis is an eminently easy and successful operation, and though its results have sometimes been such as to justify its performance, the prognosis should be guarded.

In the preceding statistics which I have collected from various sources, it is shown that the mortality has been considerable, and the objections that were raised against the operation in former days should, therefore, not be slightly disregarded. They are thus stated by Velpeau:—

If the lung has been forcibly compressed by the liquid, and yet is permeable, the evacuation of the liquid without the entrance of air into the pulmonary cavity may distend it so rapidly as to excite violent inflammation. If, on the contrary, the lung has shrunk so much as to yield but slowly to the entrance of air, the void which is immediately left about the parts is very liable to derange the respiration and pectoral circulation, whilst the introduction of air into the cavity of the pleura, though obviating this, yet exposes the patient to danger by exciting inflammation, and creating unhealthy pus, thus giving rise to adynamic symptoms, under which many have died.

§ 3.—EFFUSIONS IN THE PERICARDIUM.

A collection of fluid within the cavity of the pericardium, when the result of chronic disease, has occasionally been deemed a proper

subject for an operation, and several surgeons have, from time to time, reported instances in which they have successfully opened the investing membrane of the heart, and given exit to the fluid which had been the source of such great distress to the patient. As, however, this relief can only be temporary, and as the patient is exposed to considerable danger from various steps in the operation, surgeons have not been disposed to advocate it. In fact, the rare occurrence of such condition as would justify a resort to the operation has not offered a sufficient number of cases to test its value. Velpeau, in analyzing the few cases that have been reported, expresses the opinion that doubt may be attached to all except the one performed by Dr. John C. Warren, of Boston, and reported below. His operation has also been reported to me[1] as successful, and is, it is thought, the first positively successful case on record.

Operation of Dr. Jno. C. Warren[2] for effusion in the Pericardium.—A respectable female, aged about thirty-five years, having suffered considerably from palpitation and dyspnœa, with the other signs of hydrops pericardii, Dr. Warren operated as follows: An incision being made on the face of the seventh rib, the integuments were drawn upwards to the sixth intercostal space, and the tumor or prominence, which was very marked, carefully punctured with a small trocar and canula, the pericardium being easily reached. Between five and six ounces of serum being thus evacuated, the wound was carefully closed, the chest bandaged, and the patient recovered sufficiently in a few weeks to leave the Massachusetts General Hospital, but was not heard of subsequently.

Operation of Mr. Schuh.—Another successful case of tapping the pericardium is related by Mr. Walshe,[3] in which Mr. Schuh introduced the trocar and canula in the fourth intercostal space, or between the fourth and fifth ribs, and drew off upwards of a pint of reddish serum, which flowed in gushes that corresponded with the systole of the heart. This patient was also very much relieved, and in the course of the month bid fair to be cured, but six months subsequently died of an encephaloid growth near the trachea. The *post mortem* showed that the operation had been perfectly successful, and that the pericardium was adherent to the heart by thick cellular tissue.

[1] Dr. Warren in MS., Nov. 1853.

[2] Dr. Warren in MS.

[3] Walshe on Cancer, p. 366, Lond. edit.

CHAPTER XIII.

OPERATIONS UPON THE PARIETES OF THE ABDOMEN.

THE parietes of the abdomen are liable, like similar tissues elsewhere, to the development of tumors of various kinds, the fatty, fibrous, and lipomatous being those most frequently met with. As the removal of these tumors is to be accomplished by precisely the same means as those already designated in the account of the neck, this slight allusion to them may be sufficient to preserve the continuous arrangement of the subject adopted as the order of the present work.

Within the walls of the abdomen there are, however, such a variety of organs that its contents require a more detailed consideration; and, whilst reserving the account of Hernia for another chapter, and the operations upon the genito-urinary organs through the abdominal parietes for Part IV., there yet remains to be described the surgical treatment adapted to the relief of certain conditions of the peritoneum, liver, stomach, and intestines.

As the surgical anatomy of these organs does not offer any points worthy of special consideration, when we exclude such details as are generally presented in an account of the special anatomy of the region, the operations for the relief of affections of the peritoneum may first claim attention; after which, those demanded by some of the disorders of the abdominal organs will be referred to.

In doing this, I shall, however, limit my descriptions to such as are generally recognized as justifiable; extirpation of the spleen, or scirrhus of the pancreas, not being included in this class.

SECTION I.

PARACENTESIS ABDOMINIS.

The accumulation of such an amount of serum within the peritoneal cavity as seriously interferes with respiration has usually been deemed sufficient cause to justify its evacuation by an operation, although little more than temporary relief can be anticipated.

ORDINARY OPERATION.—Having prepared a good flat trocar and canula, surround the patient's belly with a broad bandage, the ends of which should be cut into tails, crossed upon the back, and drawn tight by assistants, in order to keep up constant pressure upon the abdominal cavity as the liquid escapes; or the same pressure may be effected merely by the pressure of the assistant's hands. The surgeon, being then perfectly satisfied of the correctness of his diagnosis, has only to push the trocar through the abdominal parietes near the median line of the abdomen, about two inches below the umbilicus, and, withdrawing the trocar, to allow the fluid to escape through the canula until he is satisfied that sufficient has been evacuated, when, removing the instrument, he may close the wound by a piece of adhesive plaster, and cover this with a compress and bandage.

REMARKS.—Simple as this operation evidently is, surgeons have differed somewhat in regard to the details of its performance. Thus, some have advised that the patient should be seated, others, that he should be lying down; some have recommended the entire evacuation of the fluid at the first operation, whilst others direct the removal of only a part of it; some have selected the trocar and canula, as mentioned in the preceding account of the operation, and others preferred the use of a lancet and catheter. As these differences are chiefly the result of individual opinion, the surgeon, in deciding upon the advantages of one method over another, must, of course, be guided by the peculiarities of the case. Dr. Physick[1] always advised making the puncture with a lancet, and then introducing a flat canula or female catheter, and this will be found to constitute a safe and easy mode of operating. The use of the catheter has, however, been recently claimed for Mr. Fleming, of the Val de Grâce,[2] though it had, as is shown above, been employed many years before his suggestion was announced.

DR. PHYSICK'S OPERATION.—The patient lying down near the edge of the bed, with a piece of oil-cloth under him, a lancet is to be inserted through the abdominal parietes in the line of the linea alba, about two inches below the navel, the fluid being allowed to escape through the puncture as soon as it is removed. After the liquid has partially escaped, and the stream begins to diminish, a female catheter should be introduced into the peritoneal cavity, in order

[1] Dorsey, Surgery, vol. ii. p. 365.

[2] Malgaigne, Philad. edit. p. 387.

to favor the further evacuation of its contents. The subsequent dressing is the same as in the ordinary operation.

ESTIMATE.—The advantage of the operation recommended by Dr. Physick, will be found in the slight pain caused by the puncture; in the greater tendency of the parts to heal; in the impossibility of pushing the peritoneum, especially in encysted dropsy, in advance of the instrument; in the patient being less likely to faint when lying down than when sitting up; and in the more gradual evacuation of the fluid permitting the abdominal parietes to accommodate themselves to the vacuum otherwise liable to be left in the abdomen unless the belly is kept well bandaged. As it is also well known that incised wounds are less liable to inflammation than punctured, the chances of peritonitis are hereby diminished. Whether the proposal to excite inflammatory action in the sac of the peritoneum by injecting iodine, or similar articles, will ever be generally adopted, is a matter of doubt. Velpeau has long been sanguine of success from this means; but his opinion is based mainly on theoretical views; and no other surgeon, so far as I know, has attempted it, though several have favored a resort to his suggestion.

The horizontal posture of the patient throughout the operation, has long been regarded with favor by many in the United States, and I have frequently resorted to it, and so has Dr. Storer, of Boston, during the last ten years. In Europe, however, it appears to be regarded as a novelty, and has been lately advocated by Dr. Simpson, of Edinburgh, as a new suggestion.

SECTION II.

HEPATIC ABSCESSES.

The production of inflammatory action in the liver, as the result of disease, has not unfrequently resulted in the formation of pus, which, if allowed to accumulate, has a tendency to cause a disintegration of the secretory portion of the gland. This purulent collection, like abscesses elsewhere, will often be evacuated solely by the efforts of nature, the matter sometimes escaping through the diaphragm, lung, and bronchia, whence it is expectorated; or into the cavity of the pleura, so as to constitute one source of empyema; or the abscess may open into the stomach, bowels, or cavity of the

PLATE XXXIX.

OPERATIONS PRACTISED ON THE ABDOMEN.

Fig. 1. Evacuation of an hepatic abscess. An eschar has been formed near the abscess, in order to favor the adhesion of the adjacent serous surfaces, after which the puncture has been made by the bistoury. 1. The eschar produced by caustic. 2. The bistoury puncturing the abscess. 3. Pus escaping through the puncture. After Bourgery and Jacob.

Fig. 2. Manner of enlarging an abdominal wound in order to favor the restoration of the prolapsed intestines. After the fingers of one hand have gently separated the intestinal convolutions, and the forefinger is insinuated at the upper angle of the wound, the bistoury is to be passed along the finger with its back towards the finger-nail, and, being introduced, enlarge the wound by slightly incising the abdominal parietes upwards. After Bourgery and Jacob.

Fig. 3. A longitudinal wound of the intestines, closed by Pellier's suture. Whilst the left hand of the surgeon holds the two ends of the thread, the right hand is occupied in replacing the protruded bowel, commencing at that part which last escaped from the abdomen, and retaining the ends of the suture to attach the wounded intestine to the abdominal parietes. After Bourgery and Jacob.

Fig. 4. Transverse wound of the intestines about to be treated by the method of Reybard. 1. The wound. After introducing the plate through the intestinal opening, and applying the suture, the parts are to be restored. After Bourgery and Jacob.

Fig. 5. Enteroraphy as performed in the method of Ledran. 1. The puckered surface of the intestine. 2. Line of the wound. 3. The various sutures collected together, and twisted into a cord. After Bourgery and Jacob.

Fig. 6. Taxis, as practised upon an external inguinal hernia of the left side, the surgeon standing on the right side of the patient, and manipulating the tumor as directed in the text. After Bourgery and Jacob.

Fig. 7. Taxis, as performed upon reducible crural hernia, on the right groin of a man, the operator being placed on the patient's left side. The palm of the hand inclosing the tumor pulls it towards the saphenous opening, whilst the fingers of the same and opposite hand press the viscera vertically upwards towards the femoral ring. After Bourgery and Jacob.

Plate 39.

Fig. 1.

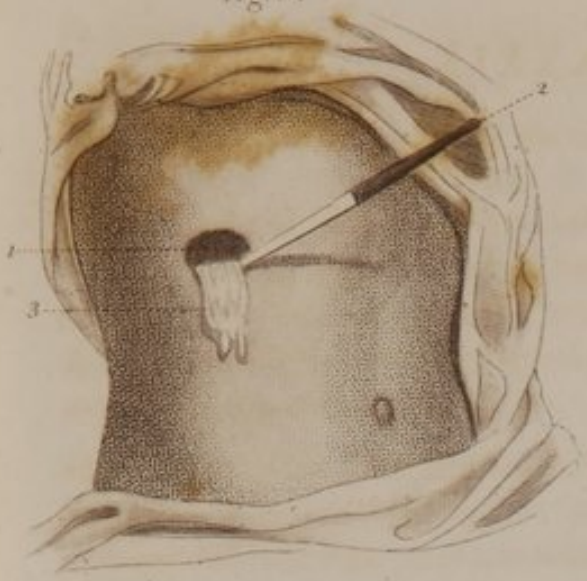


Fig. 2.

Fig. 5.

Fig. 3

Fig. 4.

Fig. 6.

Fig. 7.

abdomen, or it may tend towards the abdominal parietes, and be evacuated externally like a superficial abscess. As it is a matter of some consequence to prevent any great increase in the amount of the collection, which is apt to be the case if the complaint is left too long to the powers of nature, the surgeon may be required to aid the progress of the pus to the surface by means of an operation, care being taken to insure the adhesion of the liver to the abdominal parietes, before attempting any puncture.

DIAGNOSIS.—When an abscess of the liver tends to point outwardly, it creates a swelling or tumor, which is quite apparent through the abdominal parietes. This may show itself at various points; sometimes it has been found on the back near the vertebral column; at others the matter has travelled nearly as low as the spinous process of the ilium, though most frequently it has been found under or near the false ribs.

Other tumors may, however, occupy the same point, and it has been found so difficult to distinguish hydatids, encysted, or fatty tumors of this region, from the swelling caused by a hepatic abscess, that Récamier has proposed to test the contents of such tumors by the exploring needle. As such a test exposes the patient to the risks of peritonitis, from the escape of even a small quantity of pus into the surrounding parts, this means of diagnosis is generally discountenanced. The best means of arriving at a correct conclusion will be found in studying the history of the case, and watching for the signs of fluctuation and inflammation about the part.

When a diagnosis is firmly established, it is of much importance to evacuate the collection promptly; and to do this, resort may be had either to caustics or puncture, or to both (Récamier), or to a dissection and puncture, after adhesions have formed between the peritoneum, covering the liver and that lining the abdominal walls. (Begin.) To the latter mode of operating I would give the preference.

OPERATION OF BEGIN, OF FRANCE.—Make an incision two or three inches long upon the most prominent part of the swelling, and divide with great caution the layers of the abdomen (as is done in hernia), until the peritoneum lining the abdominal parietes is reached. Raise this carefully with the forceps and nick it, dividing it subsequently upon the director. If the intestine presents itself, it may be gently pushed to one side; but it should be remembered that when the patient is well etherized, there is but little

tendency in the bowels to move towards the wound, and that this direction will therefore be seldom needed. On reaching the surface of the tumor, the operation should be temporarily arrested, the wound filled with lint, and the parts closed by a compress and bandage. After three or four days, or when adhesions have taken place between the swelling and the peritoneum, the abscess may be opened, the diet being always strictly regulated. (Plate XXXIX., Fig. 1.)[1]

Operation of Dr. Savery, of New Hampshire.[2]—An intemperate man, aged sixty, after laboring for some years under chronic hepatitis, presented a circumscribed swelling in the right hypochondrium, which became pointed and painful, and gave an obscure sense of fluctuation. An incision was therefore made into the abscess, and nearly a gallon of sero-purulent fluid discharged, the last portion evacuated having all the properties of bile. A broad band, having been carried around the body some time previous to the incision, was then gradually tightened as the swelling diminished, so as to keep the parts in apposition. The discharge continued for a few days, and then ceased; but considerable constitutional irritation existed during the first week, and required the free use of wine and quinia, with other appropriate remedies.

Remarks.—The opening of an hepatic abscess would be a very simple measure, were it not for the doubts that are often excited as to the actual existence of pus, and the difficulty of judging whether adhesions have formed between the parietes of the liver and those of the abdomen. Until the latter exist, the evacuation of the pus must expose the patient to the risk of the peritonitis, consequent on its escape into the peritoneal cavity. The application of the bandage, as employed by Dr. Savery, may, therefore, be regarded as a valuable addition to the operative proceeding recommended by Begin, as it not only tends to approximate the abdominal parietes and the liver, but also diminishes the cavity of the abscess by compressing its walls, and thus favoring its adhesion.

The necessity of an active constitutional treatment in connection with this operation need only be mentioned, as every surgeon would doubtless resort to it under such circumstances.

[1] Dict. de Méd., tome 13me, p. 249.

[2] See Bibliographical Index, p. 102.

SECTION III.

HYDATIDS OF THE LIVER.

The occasional development of hydatids of the liver demands that a few words should be said in relation to the operation which is sometimes required for their removal.

Although rarely met with, the existence of hydatids in the liver gives rise to a train of symptoms, which, when tested by "exclusion," has enabled the surgeon to diagnosticate their presence, and operate for their relief. In a case reported by Dr. J. Edward Weber, of N. Y.,[1] a tinsmith had suffered for nine years from an enlargement of the right side, over the region of the liver, which felt hard, and was more apparent when he had abstained from food. Being sometime subsequently attacked with severe pain, he became conscious, during each inspiration, of a sensation in the side, which gave to his hand an impression similar to that caused by the purring of a cat. The diagnosis of hydatids of the liver having been satisfactorily established, Dr. Weber determined to evacuate the cyst so as to unite its walls, or cause them to shrink, and he decided to do so by an operation, which he performed as follows:—

Operation of Dr. Weber, of N. Y.—The bowels having been freely moved, an exploring trocar was thrust a few inches through the integuments into the most prominent part of the swelling, the sensation caused by the passage of the instrument being similar to that perceived in paracentesis abdominis. On withdrawing it, a fluid resembling whey, dropped from its orifice, the microscopical examination of which revealed nothing remarkable. A longitudinal incision, two inches long, being then made down to the liver, a direct puncture of the liver with the trocar, gave the same results. As there was no union of the peritoneal surfaces, a well-oiled tent was introduced upon the peritoneum, in order to produce a limited inflammation, the end of the tent being left in the lower angle of the wound. During six days the patient complained of slight pain in a circumscribed space, of the size of the hand. Eighteen days subsequently, as it was supposed that adhesions had taken place, the second operation was commenced. The first incision

[1] New York Med. Times, May 1852.

having contracted, it was enlarged upwards of an inch, when, the finger having detected perfect adhesions between the abdominal peritoneum and that covering the liver, an incision was made through the parietes of the liver into the cavity of the cyst, which was thought to be of the size of the adult skull. The contents, which consisted of a fluid and small cyst, being now very cautiously evacuated, another oiled tent was introduced as before, and after a tedious recovery, and the presence of an hepatic fistula, the patient recovered in about twenty two months after the first operation.

SECTION IV.

GASTROTOMY OR ENTEROTOMY.

Gastrotomy (γαστηρ, the belly, and τομη, incision) is a term which has been somewhat indefinitely applied to any incision upon the parietes of the abdomen, by which its contents could be exposed. The word is, therefore, sometimes employed to designate the opening of the uterus in the Cæsarian section, or the incision practised for the removal of ovarian tumors, though it should be limited to such operations as directly expose the stomach; enterotomy designating the similar operations practised on the intestines, ovariotomy the removal of ovarian tumors, and herniotomy that employed for the relief of protrusions of the bowels.

Either gastrotomy or enterotomy must, however, continue to be very rare operations, the risks of general peritonitis, as well as the possession of less difficult plans of treatment, rendering surgeons indisposed to resort to them. These operations have therefore been chiefly performed in order to remove such foreign bodies as were not likely to pass through the alimentary canal, as in the three cases quoted by Dr. Watson, of New York,[1] from the German Epherides, in one of which a knife which had been swallowed with the blade open, and ten inches long, was extracted by a longitudinal incision two inches long in the left hypochondriac region, and the patient recovered; in another, in which a knife seven inches long was also successfully removed by a similar incision, the cure being very prompt; and in a third, a knife of nine inches being successfully removed in the same manner. Enterotomy has also been performed in order to overcome the intestinal obstruction in cases of volvulus.

[1] Am. Journ. Med. Sciences, vol. viii. N. S. p. 330.

§ 1.—GASTROTOMY.

Gastrotomy, or the incision of the abdominal parietes, in order to open the cavity of the stomach, is an operation that has been recently suggested in cases of impermeable stricture of the œsophagus, in order to permit the introduction of nutriment, and has, as just stated, also been resorted to for the removal of foreign bodies of such size as to preclude all reasonable hope that they could otherwise be evacuated, as in the case reported by Dr. Marcet, where a sailor swallowed a number of clasp-knives. Although gastrotomy is an operation that could seldom be justifiable, yet under such circumstances as have been referred to in the account of Œsophagotomy,[1] and with our knowledge of the wonderful recoveries of patients under extensive wounds of this viscus, of which several cases are cited in the Bibliography,[2] it must be admitted that there are instances in which the surgeon might be induced to advise its performance.

Operation of opening the Stomach.[3]—As the mere operative proceedings connected with the exposure of the stomach cannot require any extended detail for the instruction of one who is familiar with the anatomical relations of the stomach, it seems to be only requisite to state that the general course of proceeding would be very similar to that just detailed for the treatment of hepatic abscess; or, in more definite terms, cut through the abdominal parietes with caution, over the front of the stomach in the line of the linea alba, extending from an inch below the ensiform cartilage, to an inch and a half above the umbilicus, until the peritoneum is exposed; carefully open the portion which lines the abdomen; hook or seize the front surface of the stomach between its curvature; stitch it fast to the abdominal parietes, and then wait, if possible, for adhesion to occur, before puncturing the viscus, lest its liquid contents should escape into the peritoneal cavity, when, if the patient is able to sustain the constitutional shock, or peritonitis that may ensue, it will subsequently be necessary to treat the wound so as to create a fistula, through which food might be introduced, as was done by Dr. Beaumont, in his experiments on digestion, as practised in

[1] Vol. i. p. 494.
[2] Bibliographical Index, p. 102.
[3] Chelius, vol. iii. p. 103.

the celebrated case of St. Martin.[1] Should gastrotomy, however, be attempted for the removal of a foreign body, such as a knife, or other large substance, similar to those that have been accidentally swallowed, and referred to by Dr. Watson, of N. Y.,[2] Marcet, and others, the wound should be made to unite as soon as possible, by a treatment analogous to that reported hereafter, in the case which occurred in the practice of Dr. Ashby, of Virginia,[3] or in that now quoted.

In a case reported by Barnes,[4] of a young peasant, who, whilst endeavoring to produce vomiting with the handle of a knife, let it slip into his stomach; it was removed by a surgeon named Shoval, in the following manner:—

Shoval's Operation in 1635 for the Removal of a Knife from the Stomach.—A straight incision being made in the left hypochondrium, two fingers' breadth below the false ribs, first through the skin and cellular tissue, and then through the muscles and peritoneum; the stomach was exposed, but slipped from the fingers whenever it was attempted to be seized. Being at length caught with a curved needle, and drawn out of the wound, a small incision was made into it, through which the knife was easily extracted, when the stomach immediately collapsed. After thoroughly cleansing the external wound, it was united by five sutures, and tepid balsam poured into the interstices, and tents impregnated with balsam completed the dressing by closing the wound thoroughly. Two sutures being removed next day, and two more on the following day, the wound healed on the fourteenth day after the operation and the patient completely recovered. The knife, as seen by Dr. Oliver at Konisberg, in 1685, was six and a half inches long.

§ 2.—Enterotomy.

Enterotomy, or the division of the abdominal muscles, and their peritoneal lining, so as to permit the opening of a portion of the intestinal canal, has also been resorted to for the removal of foreign bodies, as in the case of Dr. White, of Hudson, hereafter reported,

[1] See Bibliography, p. 101.
[2] *Ibid.* p. 100.
[3] Am. Journ. Med. Sci., vol. viii. N. S. p. 330.
[4] Chelius, vol. iii. p. 106.

for the cure of volvulus, and in some instances for the relief of obstinate constipation, or for obstruction of the rectum in the formation of an artificial anus. Like the operation of gastrotomy, that of enterotomy can only be thought of in very desperate circumstances, although the success which has attended the instances in which it has been employed, has been sufficiently marked to have attracted attention. In a paper published by Mr. Phillips, of England,[1] it is stated that of 27 patients operated on for the establishment of artificial anus, 13 recovered. Of 53 cases referred to as operated on, for obstruction of the bowels, including both infants and adults, 17 were cured. Mr. Phillips, therefore, advocates the operation in obstruction where three or four days have passed without relief from other means.

In cases of volvulus, the difficulty of the diagnosis must render the resort to an abdominal incision a most hazardous and uncertain operation; yet such operations have been performed, and, when the patient is under the influence of an anæsthetic, might be again employed with less risk and difficulty than has heretofore been the case. Although I doubt very much the propriety of these operations, as a general rule, and would urge the utmost caution in respect to diagnosis on the part of any surgeon who might be placed in such circumstances as apparently demanded it, I am convinced that it presents some chances of success; and as such a concatenation of circumstances may occur as will demand its consideration hereafter, there seems to be a good reason for exhibiting the few facts that have been presented in connection with the subject. By referring to the Bibliographical Index,[2] several cases may be found in which the intestinal canal has been most rudely treated without causing death. In the case reported by Dr. Brigham, of Utica,[3] a patient survived the removal of seventeen inches of the intestinal canal; in one reported by Dr. Dugas, of Georgia, the intestines were cut in two by a bowie-knife and sewed up, yet the patient recovered; and in the others there referred to, they sustained the rudest handling, and were even severed without causing death. But, though success followed these cases, it is presumed that no judicious surgeon would take any of them as a precedent for an operation which is universally regarded as a forlorn hope, except under

[1] Brit. and Foreign Med. Review, April 1849.

[2] Bibliography, p. 100.

[3] Am. Journ. Med. Sciences, vol. ix. N. S. p. 355.

the urgent circumstances in which an operator is fully satisfied that the patient's chances of life are less before than they would be after the performance of the operation.

ENTEROTOMY SUCCESSFULLY PERFORMED BY DR. J. E. MANLOVE, OF TENNESSEE.[1]—In July, 1844, Dr. Manlove was called to see a negro, aged seventeen years, who had had no evacuation of the bowels for twelve or fifteen days, and was laboring under fever, &c. After making every possible effort by constitutional means to relieve him, but without success, he was on the fourth day found to be in the following condition: Abdomen enormously distended; breathing difficult; extremities cold; pulse very feeble and quick, and countenance anxious. A consultation decided that, although the operation of enterotomy promised but little benefit, yet the certainty of death without it justified its performance.

MANLOVE'S OPERATION OF ENTEROTOMY.—An incision being made in the median line of the abdomen, commencing about two inches below the umbilicus, and extending down towards the pubis four or five inches, the peritoneum and bowels along the lower half of the incision were found adherent. An opening of about a fourth of an inch in length was therefore made into the bowel nearest the wound, from which there escaped large quantities of flatus and liquid feces, as well as some of the medicine which had been taken a short time previously. A further examination showing that the intestines were united to the peritoneum by extensive adhesions at various points, within reach of the finger and probe, and that there was therefore but little probability of the escape of any liquid into the peritoneal cavity, the wound was closed by sutures and adhesive strips, except at the intestinal opening. The amendment in all the symptoms was prompt, the extremities becoming warmer, and the pulse fuller and slower within an hour afterwards. On the next day the appetite was good, and the patient continued to improve, discharging the contents of the bowel through the artificial anus thus made until the seventeenth day, when he had an evacuation per vias naturales, the wound having nearly closed. Nine months after this, he was presented to the Tennessee State Medical Society for inspection, being perfectly well. The adhesions were supposed to have been the result of a contusion of the abdomen, received six months previously.

REMARKS.—In the paper just quoted, Dr. Manlove also states

[1] Boston Med. and Surg. Journ., vol. xxxii. p. 492.

another marked instance of the success of this operation, in which Dr. Wilson, of the same county, performed enterotomy in a case of volvulus, drew out the intestines until he reached the obstruction, dissected the adhesions found at the invaginated portion, overcame the obstruction, replaced the bowels, and the patient rapidly recovered.[1]

Successful Enterotomy, and Removal of a Silver Teaspoon, by Dr. Samuel White, of Hudson, New York.[2]—A man, aged twenty-six years, suffered in May, 1806, from rheumatism, when, after a severe relapse, he became delirious and bent upon self-destruction. On the 7th of July, he procured a full-sized teaspoon, with some fruit jelly, and forcing the spoon down his throat in the absence of his nurse, was enabled to swallow it, by pressing his fingers against the handle. He was then greatly agitated, talked much, and declared that no attempt could save his life. On the 9th, a spasmodic affection of the stomach, alternating every fifteen minutes with stupor, showed itself, during which he would throw himself violently about. This lasted during two hours, while the spoon probably passed the pylorus, when he suddenly fell asleep, became rational, and expressed great anxiety for relief. On the 25th of July, a cutting sensation, confirmed by the pressure of the hand when the abdomen was relaxed, led to the discovery of the spoon in one of the convolutions of the ileum near the line dividing the right iliac and hypogastric regions. It remained fixed in this position, with increased heat and irritation in the adjacent parts, till August 7th, when, fearing the consequences of further delay, it was decided to attempt its removal.

Operation of Dr. White.—An incision, three inches long, being made through the abdominal parietes, and parallel with the epigastric artery, extending upwards to the level of the crest of the ileum, the peritoneum was opened with a lancet; the turn of the intestine, which contained the spoon-handle, protruded; the intestine pierced with the lancet over the end of the handle, and the spoon extracted by forceps. The divided edges of the intestine were then secured by the Glover's suture, and the external wound closed with adhesive strips and lint.

Under simple dressings, the wound healed by the first intention, and the patient recovered.

[1] Boston Med. and Surg. Journ., vol. xxxii. p. 495.

[2] New York Repository, vol. x. p. 367, 1807.

SECTION V.

GASTRIC AND INTESTINAL FISTULÆ.

From various causes, the creation of a fistula in the abdominal parietes, and a communication of it with the viscera of the part, may be produced. Like those resulting from strangulated hernia (artificial anus), these fistulæ nearly always present certain common symptoms, and may be relieved by very much the same general treatment. Most frequently, they will be found to give rise to more or less excoriation and inflammation of the skin of the abdomen, in consequence of the escape of the discharges externally, whilst they also affect the nutrition of the patient, and expose him to a protrusion or even strangulation of the inner coat of the bowels, in a manner analogous to that seen in prolapsus of the rectum. As illustrative of a simple plan of relieving this condition, the following case is cited:—

FISTULOUS OPENING OF THE STOMACH SUCCESSFULLY TREATED BY PRESSURE, &C., BY DR. COOK.[1]—A widow lady, æt. thirty-nine years, had been attacked with constipation and violent pain at the pit of the stomach, which resisted every remedy until the nineteenth day, when a fistulous orifice showed itself. Six months subsequently, she presented a fistula immediately by the side of the umbilicus, the external orifice of which was about the size of a buckshot, and, on removing the dressing, a gill of bile was suddenly discharged, after which a small quantity of (gastric?) fluid came slowly away. The acrid character of these discharges had excoriated and inflamed the abdomen, and rendered it intolerably painful. On drinking a glass of water, the whole of it was discharged through the fistula in twenty seconds, and an examination, by a catheter introduced into the opening, therefore, led to the conclusion that the opening was in the stomach near the pylorus.

TREATMENT.—A beef-bladder being cut open longitudinally, was spread with adhesive plaster and applied over linen spread with cerate, so as to cover the excoriated part, an opening being made in the dressing corresponding to the fistulous orifice, after which a firm bandage and compress were applied and the diet limited, nou-

[1] Am. Journ. Med. Sciences, vol. xiv. p. 271, quoted from Western Journ. Med. and Phys. Sciences, Jan. 1834.

rishing enemata being resorted to in order to sustain the patient. The external irritation soon healed; the bandage was gradually tightened, and a cylindrical compress employed, under which treatment the fistula was completely healed in thirty days, and the patient subsequently regained her health.

Remarks.—Should the orifice of such a fistula fail to heal under similar measures, the surgeon might derive advantage from the use of escharotics. As the experiments connected with digestion, performed by Dr. Beaumont upon St. Martin, who also labored under one of these fistulæ, have long been before the profession, the reference to his paper[1] before given will furnish sufficient evidence of the powers of nature under such circumstances, as well as the means employed by Dr. Lovell, U.S. army, to obviate the inconvenience resulting from the creation of the opening. As there is a marked tendency in the mucous membrane of the stomach or bowels to become everted and strangulated at the orifice either of the fistula, or of the wounds which open at this protrusion, it should always be guarded against by appropriate pressure during the treatment of the case, and especially in its early stages.

CHAPTER XIV.

WOUNDS OF THE ABDOMEN.

Incised wounds of the abdomen, if limited to the abdominal parietes, demand only the ordinary treatment of wounds, to wit, the prompt and neat approximation of the edges, and their retention in apposition until union occurs. To favor this, the patient should be confined to bed, and the abdominal muscles relaxed by elevating the shoulders and flexing the thighs on the pelvis. The most important of these wounds are those complicated with a protrusion of some of the abdominal contents, as the latter, when once protruded, are with difficulty replaced, not only in consequence of the contraction of the muscular fibres around the wound, creating strangulation, but also from the peristaltic action of the bowels, causing the protruded intestines to be filled with solid or gaseous deposits.

[1] Am. Med. Record., vols. viii. and ix., 1825.

SECTION I.

WOUNDS WHICH CAUSE PROTRUSION OR STRANGULATION OF THE STOMACH, INTESTINE, OR OMENTUM.

In treating such abdominal wounds as are followed by a protrusion of any of the viscera, it should be adopted as a universal rule of practice that, before resorting to any incision to facilitate the restoration of the protruded viscus, the surgeon should endeavor to replace it by manual means, aided by such a position of the patient, use of anæsthetics, and other constitutional measures, as will induce perfect relaxation of the tissues which form the anterior abdominal walls. Since the discovery of ether, the restoration of the stomach, intestines, or omentum which have protruded through an abdominal wound is much more easily accomplished than was the case formerly. The following plan of treatment will, therefore, often succeed.

TREATMENT.—Place the patient upon the back, with the shoulders elevated and the knees drawn up in order to favor the relaxation of the abdominal muscles, and then, by means of ether, produce perfect anæsthesia. As soon as this is accomplished, cleanse the parts thoroughly from all foreign matter by squeezing water upon them from a sponge, and then gently seizing, between the thumb and fingers, that portion of the viscus which had last protruded, compress it lightly so as to force back its contents, endeavoring to carry it into the cavity of the abdomen by pressing upon it with the forefingers. The peristaltic action of the digestive canal being entirely arrested during anæsthesia, the muscles of the abdomen perfectly relaxed, and the diaphragm partly quiescent, success will often crown these efforts.

When the protruded portion is returned, it then remains to unite the sides of the wound by a few points of the twisted suture, and support them by adhesive strips and a bandage. But if it should be found impossible to accomplish the restoration in this manner, it may become necessary to introduce a director, and enlarge the upper angle of the wound a little by means of the probe-pointed bistoury. (Plate XXXIX., Fig. 2.)

When the protruded portion is omentum, the treatment will be very much the same unless strangulation has occurred, in which

case it may become necessary to treat it as is done in a similar condition in hernia.

In cases in which the protruding viscus has been wounded, as has frequently happened, the opening in it should be carefully approximated by one or two points of the interrupted suture, so placed as not to include the mucous coat, and then leaving the ends of the threads attached to the viscus, its opening may be made to correspond with that in the abdominal parietes.

Operation of Dr. Ashby, of Alexandria.—In a very marked case reported[1] by Dr. C. W. Ashby, a boy, six years of age, fell upon the points of a pair of sheep-shears, which he had in his hand, and drove the instrument into the stomach obliquely from above downwards, so as to graze the left side of the sternum and edges of the ribs. The external wound was flap-shaped, and through this nearly the entire stomach protruded, discharging its contents through an aperture nearly three-fourths of an inch long. Having placed a single suture in the middle of the wound in the stomach, nausea and vomiting ensued from the handling of the viscus, and the boy became so unruly as to prevent the restoration of the stomach, although the abdominal wound was several times enlarged. At this period, anæsthesia was induced by chloroform, and, after slightly enlarging the abdominal wound, the stomach was readily replaced, although the boy vomited freely, as before, from handling the organ. The wound in the stomach being then brought directly opposite that in the abdominal parietes, it was gently retained within the verge of the external wound by a single stitch, lint, wet with cold water, and retained by a bandage, completing the dressing. A large dose of opium being then administered, the patient rapidly convalesced. On the fifth the wound discharged freely, and on the sixth the ligature came away, after which the recovery was rapid.

SECTION II.

WOUNDS OF THE INTESTINE.

When an intestine is wounded in such a manner that the injured part can be seen through the opening in the abdominal parietes, it becomes necessary to treat it by such means as may induce union,

[1] Stethoscope, vol. i. p. 660, 1851.

PLATE XL.

SUTURES OF THE INTESTINES AND ARTIFICIAL ANUS.

Fig. 1. Continued Suture for Longitudinal Wounds. 1, 1. Ends of the thread. 2, 2. Points perforated by the first stitch, showing the distance from end wound. 3, 4, 5, 6. Subsequent points, showing the distances to be observed between the several stitches, and their relations to the edges of the wound. After Bernard and Huette.

Fig. 2. Looped Suture of Palfyn, to unite the sides of a wound, and bring the peritoneal coat of the intestine in contact with the abdominal parietes. 1. Abdominal parietes. 2. Intestine. 3. Longitudinal wound of intestine. 4. Loop of the suture as seen in the intestine. 5. Ends of the thread brought out and knotted on the abdomen. After Bernard and Huette.

Fig. 3. Suture of Jobert for Transverse Wounds. 1. First thread passed through the intestine. 2. Second suture. 3. Edges of transverse wound of intestine. 4. Mesentery. 5. Point at which it has been incised in order to favor the union of the two ends of intestine. After Bernard and Huette.

Fig. 4. Suture of Lembert for uniting Transverse Wounds of the Intestine by approximating the adjacent serous surfaces. 1. The first insertion of the thread. 2, 2. Its point of exit and re-entrance, or the second suture. 3. The third point. After Bourgery and Jacob.

Fig. 5. Profile of this Suture. A. The suture as first formed. 1. End of the thread. 2. First loop. 3. Portion of thread over the wound. 4. Second loop. 5. Termination of thread. B. Profile of this suture as finished. 1. Exterior knot.

Fig. 6. Artificial Anus, in which the ends of the intestine open upon the groin by separate orifices. 1, 2. Ends of the intestine. 3. Mesentery between them. 4, 5. The two anal orifices. After Bourgery and Jacob.

Fig. 7. Artificial Anus where the two ends of the bowel open by a single orifice. 1, 2. Upper ends of intestine. 3. Septum formed by union of adjacent sides. 4. Lower orifice or point of artificial anus. After Bourgery and Jacob.

Fig. 8. Artificial Anus, showing the funnel-shape of the cavity near the orifice. 1. Cavity of peritoneum. 2, 3. Ends of intestine. 4. Intervening mesentery. 5. The septum. 6. Funnel-shaped orifice formed around artificial anus by the peritoneum. 7. Probe passed into orifice to show course of fecal contents. After Scarpa, from Bernard and Huette.

Fig. 9. Another view of the same. 1, 2. Intestines. 3. Septum. 4. Course of contents of bowel. After Bernard and Huette.

Fig. 10. The septum partially removed. 1, 2. Intestines. 3. Short septum. 4. Mesentery. After Bernard and Huette.

Fig. 11. A view of the Enterotome of Dupuytren as applied. 1. Abdominal parietes. 2. Instrument. After Bourgery and Jacob.

Fig. 12. Enterotome of Liotard applied. 1. Septum. 2. Instrument. After Bourgery and Jacob.

Plate 40.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

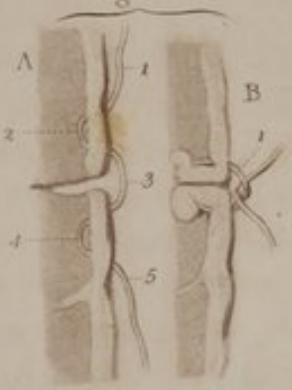


Fig. 6.

Fig. 7.

Fig. 8.

Fig. 11.

Fig. 12.

Fig. 9.

Fig. 10.

and prevent the escape of the intestinal contents into the cavity of the abdomen. These means vary somewhat, according to the extent of the wound, and its longitudinal or transverse direction, sundry suggestions having been made by surgeons at different periods, in order to accomplish this object, and yet diminish the risk consequent upon peritoneal inflammation.

Two kinds of wounds of the intestine require the application of sutures, the first being that in which the wound is longitudinal, the second that in which it is transverse, and the consideration of these various sutures will, therefore, be referred to separately, it being premised that, in every instance, it will facilitate the operation, and add to the patient's chances of life, to resort to the use of anæsthetic agents before commencing the operation.

When a wounded intestine presents itself, so that the injured point can be readily reached, the extent of the wound is the first point to which attention should be directed, the means of treatment being necessarily varied according to the nature of the injury. In small punctures, or those less than a third of an inch in extent, or those openings through the intestinal coats which are consequent on the strangulation and ulceration that ensue upon certain conditions of hernia, Sir Astley Cooper recommended that the sides of the opening should be gently gathered together, or pinched up, and then the adjacent portion constricted by tying a fine ligature around it, in the same manner that a divided artery is secured. This loop gradually ulcerating through the coats of the viscus, whilst lymph is effused upon the peritoneal surface, will be soon discharged by stool, without exposing the patient to the risks consequent on the escape of its liquid contents into the abdominal cavity.

But if the opening is more extensive, then resort must be had to some of the various sutures that have been recommended by surgeons at different periods: Albucasis, A. D. 1100, Guy de Chauliac, A. D. 1360, Le Dran, Ramsdohr, Shipton, Travers, Thos. Smith, Gross, and others, having advised peculiar methods of treatment.

The different sutures that have been employed by these surgeons are usually designated as the glover's suture, which was suggested by Guy, and supported by the opinion of Heister; the suture of the four masters, in which a foreign body (trachea of an animal) was introduced into the intestine, in order to support the sides of the

wound; the looped suture of Palfyn; that of Le Dran; and the continued or interrupted suture, as recommended, with various modifications, by Reybard, Jobert, Bertrand, and others.

§ 1.—SUTURES EMPLOYED IN LONGITUDINAL WOUNDS OF THE INTESTINE.

THE GLOVER'S SUTURE may be formed by means of a straight round needle and a waxed thread, by passing the needle obliquely through the sides of the wound when held together by an assistant, the first point of the suture being made at one line from the upper angle of the wound, and at an equal distance from its edges. The thread being then drawn through to within a few inches of its end, the needle should be repassed through the edges of the wound, from the same side as it commenced on, and the wound traversed obliquely from side to side, so as to carry the thread over and over, from stitch to stitch, as in "whipping a seam." On reaching the lower end of the wound, the needle should be removed, and three or four inches of the thread be left. This and the first end being then held by the assistant (Plate XXXIX., Fig. 3), the surgeon should proceed to reduce the intestine, and then drawing the ends of the thread towards the abdominal parietes, cause the outer coat of the intestine to approximate the peritoneum lining the abdominal parietes, so that it may be made to adhere to the surface of the abdominal wound. Five or six days subsequently, one end of the thread should be cut off close to the abdomen, when, by gently drawing on the other, whilst the edges of the wound are supported, the suture may be withdrawn without deranging the adhesions.[1]

THE LOOP SUTURE OF LEDRAN.—Having prepared as many ordinary sewing needles and threads as he wished to make stitches, the edges of the wound were approximated, and each needle passed transversely to the line of the wound, at a distance of about a quarter of an inch from each other. The threads on each side being then tied together, the two bundles were collected together and twisted into one, so as to pucker up the edges of the wound. (Plate XXXIX., Fig. 5.)

LOOP SUTURE OF PALFYN.—A ligature being passed through the

[1] Malgaigne.

middle of the wound in the intestine, so as to leave a loop on its inside, the ends were left out of the external wound, so as to draw the serous coat of the intestine up to the peritoneum lining the abdomen, after which the abdominal wound was closed, and the threads fastened upon the skin by adhesive strips. (Plate XL., Fig. 2.)

SUTURE OF REYBARD.[1]—A small, thin, and oiled piece of light wood, twelve to fifteen lines long, and four to six broad, being first introduced into the intestine at the wound with a piece of thread attached to it, each end of the thread was armed with a needle. After passing each needle from one side to the other, from the inside outwards through the thickness of the intestine, and also of the abdominal parietes, the wooden plate was drawn upon so as to compress the peritoneal coat of the intestine against the serous lining of the abdomen, thus closing the wound hermetically. When the adhesions thus excited seemed to be sufficiently strong, that is, in about two or three days, the thread was withdrawn, and the little plate of wood left to be discharged by stool.

SUTURE OF JOBERT.—After cleansing the edges of the wound, this surgeon turned in the serous surface on each side with the needle, and passed the threads transversely through them, at sufficient distances to keep the serous membrane of each side in contact. Then the ends being knotted and tied as in the interrupted suture, were left to come away by stool, or they were twisted and brought out of the wound, as in the suture of Ledran.[2]

SUTURE OF BERTRAND.—The lips of the wound being approximated, pierce them both rather obliquely about two lines from their edges and one from their extremity. Then repassing the needle in the same way on the opposite side, two lines further on, continue them in the same direction to the other end by a series of equal stitches. The intestine being reduced, fasten the end upon the abdomen, and three days subsequently cut off one end of the thread near the wound, and draw out the other.[3] (Plate XL., Fig. 1.)

§ 2.—SUTURE OF TRANSVERSE WOUNDS.

SUTURE OF RAMSDOHR.—Invagination of the two ends of the intestine being accomplished, this surgeon stitched them together by

[1] Mott's Velpeau, vol. iii. p. 623. [2] Malgaigne, p. 399, Philad. edit. [3] *Ibid.*

two or three points of the interrupted suture, reduced the intestine, and left the suture to the efforts of nature. If the mesentery interfered with the invagination, he excised it to a sufficient extent.

SUTURE OF JOBERT.—With a piece of silk passed at each end into a needle, Jobert operated as follows. After traversing the anterior part of the upper end from without inwards with one needle, he then passed both needles from within outwards through the lower end of the intestine, and after placing as many threads in this manner as were sufficient to unite the wound, invaginated the intestine by gentle traction upon the threads, and either knotted them on the outside of the inferior end, or brought them out of the wound in the abdomen. (Plate XL., Fig. 3.)

SUTURE OF LEMBERT.—After preparing as many threads, each armed with needles, as seemed requisite, one needle was pushed through the coats of the intestine as far as the mucous membrane, from without inwards, and then repassed from within outwards, so as to come out about one line from the edge of the wound. Then passing it across the fissure, he carried it from without inwards, at a similar distance from the opposite side of the wound, and brought it out again at a distance of about three lines from its point of entrance (Plate XL., Fig. 4). All the threads being passed in a similar way, the serous surfaces were brought in contact, so as to force the lips of the wound to double inwards, and form a sort of valve (Plate XL., Fig. 5), after which the knots were tied, the ends cut off, and the intestine reduced.[1]

REMARKS.—In the account of the different sutures just described, as adapted to the union of both longitudinal and transverse wounds of the intestine, a brief enumeration of such of the various plans as are deemed most available, has been given, most of the details having been collected from various surgical works. The importance of the subject, and the numerous experiments that have been performed upon animals in order to test the result of similar injuries in man, might perhaps have authorized my adding much to the above account, but as this would have transcended my present limits, it must suffice merely to mention a few of the points generally admitted as settled in the treatment of these injuries.

From the experiments of former surgeons, and especially of Mr.

[1] Malgaigne, p. 404.

Travers,[1] it appears that sutures of every description, when applied to an intestine and left unconfined at the external wound, ulcerate through into the bowel and are discharged by stool, the opening made by their escape through the intestine being closed by the effusion of lymph, and strengthened by adhesion of the edges of the ulcer to surrounding parts.

If a small portion of the intestine is encircled by a ligature, as was done by Sir A. Cooper, lymph is rapidly effused around the constricted point, and whilst the thread ulcerates into the bowel, the external coverings are replaced by new tissue. But if the ligature surrounding a portion of the intestine is attached externally, it does not ulcerate through, but comes away in the same manner that the loop of the thread does from an artery.

As these facts have been established by the observation of Dr. Smith, of Philadelphia,[2] Gross, of Louisville, Kentucky,[3] as well as by many surgeons in Europe, no one can doubt the advantages of that mode of closing a wounded intestine which cuts off the ends of the thread and leaves the suture to be discharged per anum.

In the application of every suture, it is important that the stitch should not, if possible, pass through the mucous coat, but rather between it and the muscular; that the wound should be so accurately closed that fecal matter cannot escape; that two peritoneal surfaces be brought in contact in order to promote adhesions; that the bowels be kept as still as possible, and that every means be employed to keep down general peritoneal inflammation. Under proper treatment, and with the exhibition of sound judgment, moderate wounds of the intestine are by no means a hopeless class of injuries, various cases having been reported, in which patients recovered after most extensive injuries, and even the loss of seventeen inches of the intestinal canal.[4] Although such a case could not be taken as exemplifying the ordinary result, yet it may be mentioned as a fact justifying the surgeon in forming a prognosis of a more favorable kind than might be the case if he trusted solely to general ideas on

[1] Inquiry into the Process of Nature in repairing Injuries of the Intestines, by Benjamin Travers. London, 1812.

[2] An Inaugural Essay on Wounds of the Intestines, for the degree of M. D. in the University of Pennsylvania, by Thomas Smith, Member of the Philadelphia Medical Society, 1805.

[3] An Experimental and Critical Inquiry into the Nature and Treatment of Wounds of the Intestines, by Samuel D. Gross, M. D. Louisville, 1843.

[4] Bibliographical Index, p. 102.

the subject, and induce him to exert his skill towards the preservation of life in even the most desperate cases.

ESTIMATE OF THESE DIFFERENT SUTURES.—For a small punctured wound, there can be no question that the application of the ligature as advised by Sir A. Cooper, is the most advantageous; that the loop suture of Palfyn and Ledran comes next, according to the extent of the wound, and then the process of Jobert. In the union of transverse wounds, the interrupted suture is probably equal to any other. The plan of Ramsdohr is generally deemed objectionable from the difficulty of invaginating the part; from the necessity of incising the mesentery in order to permit it, and from the great tendency of the intestinal contents to escape into the abdominal cavity, owing to the want of accurate adjustment. The modifications usually spoken of as the plans of Denans, Duverger, or Amussat, in which a foreign substance is introduced to preserve the relative position of the two ends of the intestine, though more useful, are yet not without serious objections. The union of a transverse wound by the suture of Lembert is, therefore, thought to present the best prospect of an accurate agglutination of surface.

CHAPTER XV.

HERNIA IN GENERAL.

BY the term "Hernia," is usually understood the formation of a tumor in consequence of the protrusion of some portion of the abdominal contents through a natural or preternatural opening, into some tissue which naturally covers it, or into an adjacent cavity, as that of the thorax. In order to relieve the symptoms which supervene on the occurrence of this complaint, it is necessary so to act, that the return of the viscus may obviate the effects of its displacement upon the life or comfort of the patient.

Hernial tumors may form at any portion of the abdominal parietes, that is, either above, through the diaphragm; below, through the openings about the pelvis; in front, through the abdominal muscles; in the course of the bloodvessels to the lower extremities, or through the muscles of the loins or of the perineum when wounded.

When the displaced viscus can be returned simply by manipulation, the complaint is said to be relieved by "Taxis;" but in other cases, where this manipulation fails, it will require more or less division of the tissues which cover it, in order to reach the seat of the obstruction, and this division is the object of the cutting operations termed "Herniotomy," and practised for its cure.

The cases of hernia that most frequently require the performance of Herniotomy, are those in which the return of the tumor is obstructed, or its contents strangulated at some one of the openings, usually designated as the Inguinal, Femoral, or Umbilical Rings. As the existence of hernial protrusions is very common, about one in every eight being believed to labor under them, and as the complaint is one which either rapidly destroys life or exposes the patient to constant annoyance, it is not surprising that it has claimed and received so large a share of professional attention. From a very laudable desire to investigate the anatomical relations of a tumor which involves parts of such vital consequence, the examination of the structures connected with hernia has also been conducted with a degree of minuteness that has hardly left any shred or portion of the tissue concerned without a name. These details have consequently thrown a mist around the descriptions, that has confused and puzzled the brains of many students, who, under a less artificial account of the parts, would promptly have seized on all the facts possessing a practical value. The anxiety that has thus been shown to individualize tissues that in other parts of the body were scarcely noted, together with the habit of attaching to cellular tissue the inappropriate name of "fascia," has also tended not a little to add to the cloud that surrounds this complaint as first presented to the mind of a young student; and though by subsequent study he may find that the various names, given by different writers, often designate the same part, it is long before the impression of extraordinary difficulty, which has been associated with the very term of hernia, wears away. That the profession have materially benefited from the details furnished by the distinguished men whose names are identified with the subject of hernia, cannot be denied; but that the student or inexperienced surgeon has been misled, when, knife in hand, he undertook to investigate the structure for himself, will, it is thought, be admitted by those who can recall the earlier moments of professional experience.

A very material defect in the usual account of hernia, as adapted

to the wants of the surgeon, may also be seen in the tendency of anatomical teachers to adopt the descriptions furnished by normal anatomy, instead of those presented in the pathological changes of the complaint; whilst, instead of describing the alterations of structure produced by disease, they present a perfect and minute detail of the disposition of the parts as found in subjects where no hernia has existed.

In an account like the following, which is furnished for the practical information of an inexperienced operator in the hour of need, it is thought to be inexpedient to dwell long upon the special anatomy of these parts. No one qualified for the study of operative surgery can be presumed to be ignorant of the principal facts in special anatomy; and in the effort which will now be made to present a concise account of the pathological and surgical anatomy of hernia, it will be assumed that the reader is familiar with the great points of reference usually described by the anatomist. In the following account there will, therefore, first be presented those general facts which are applicable to the complaint wherever found; after which, such special descriptions will be given as may be demanded for the explanation of the peculiar condition of tissues found in the three most common varieties of the complaint, to wit, Inguinal, Femoral, and Umbilical Hernia.

SECTION I.

GENERAL PATHOLOGY OF HERNIA.

Any portion of the contents of the abdomen, as the bladder, uterus, or other organ, which protrudes through a natural or preternatural opening, constitutes a hernia, though, in the majority of instances, the protruding part is composed of the intestines or omentum. These viscera being so situated within the cavity of the abdomen as to have the great sac of the peritoneum in front and around them, it follows that their protrusion at any point will also generally involve a prolapse of this membrane, as well as of such other tissues as may be so situated as to be acted on by the mass. The envelops of every protrusion become, therefore, the first portion of the structure to be examined.

§ 1.—ENVELOPS OF HERNIA.

The coverings of any hernia, which protrudes in front through the abdominal walls, necessarily consist of a portion of every tissue which is to be found between the skin and the peritoneum, unless violence has destroyed the continuity of the layers, or nature left in them a deficiency or opening through which the tumor could pass; or unless the distension of the structure has been so great as to lead to its absorption, or to its being so thinned as to escape our observation. Following the natural course of a hernia, and tracing it from the abdomen outwards, we have, therefore, first to notice the Sac.

The prolapsed portion of peritoneum, or the "*Sac*," presents on its inside the smooth shining surface of a serous membrane, but, when irritated, displays the usual characteristics of the serous tissues, by giving rise to effusions of serum which often fill it, or to effusions of lymph which glue together its sides and its contents, or very much increase or diminish its density from that seen in the normal condition of parts. Outside of the peritoneum is generally found a cellular layer of greater or less thickness, according to its position, which varies somewhat in its attachments to the peculiar region in which it is placed; thus, at the sides of the pelvis and groins it is loose and movable, whilst in front its adhesions are firmer and less easily overcome. In this extra-peritoneal cellular substance, or outer layer of the sac, are found the more important of the bloodvessels directly connected with the operations of strangulated hernia, and in it are also found the particles of fat which have occasionally been mistaken for omental hernia.

The changes made by disease in this cellular structure are varied. When moderate pressure is made upon it, it becomes more developed, thickened, and laminated, acquiring a density and fibrous appearance which qualify it for the name of "fascia," which it has received; but when the pressure is very great, it becomes thinner and atrophied.

In the protrusions which are found to escape at the groin, this cellular layer constitutes either the fascia transversalis abdominis, or the fascia propria, according to the views of different writers. Outside of this tissue are occasionally noted layers of muscular fibre, which are held together by the cellular tissue always more or less

PLATE XLI.

SURGICAL ANATOMY OF THE PARTS CONCERNED IN HERNIA.

Fig. 1. A Sketch of the Exterior of the Abdomen, showing the general outline of the muscles, as well as the general points of reference required in operations upon this region. 1. The umbilicus. 2. Hypogastric region. 3. A line drawn from the anterior-superior spinous process of the ilium to the umbilicus, and crossing the course of the epigastric artery. At one period, the puncture in ascites was advised to be made in this line, but was given up, owing to the risk of wounding the artery.

After Bernard and Huette.

Fig. 2. The same parts as shown, after the removal of the skin, fat, and superficial fascia, by a careful dissection. 1, 1. The linea alba. 2, 2. Rectus abdominis muscle, and lineæ transversæ. 3. External oblique. 4. Its tendon, also the position of the internal abdominal ring. 5. Round ligament of the uterus at its exit from the external abdominal ring. 6. Epigastric artery. 7. Peritoneum covering the intestines. 8. Section of fascia transversalis everted. 9. Transversalis abdominis muscle. 10. Internal oblique muscle. 11. External oblique. 12. Section of the rectus.

After Bernard and Huette.

Fig. 3. A View of the Superficial Fascia of the Abdomen and Thigh, as shown by a careful dissection of the skin. 1, 1. The fascia superficialis, arising on the thigh and extending over the abdomen, as one continuous layer. 2, 2. Branches of the arteria ad cutem abdominis. 3, 3. Branches of the corresponding superficial veins. After Bernard and Huette.

Fig. 4. Another view of the same as seen after a closer dissection, but especially in its relations to femoral hernia. 1. Fascia superficialis. 2. Perforations in the superficial fascia of the thigh, for the passage of the superficial vessels. 3, 3. Extension of the superficial fascia over the cord and testicles. 4, 4. Superficial arteries. After Bernard and Huette.

Fig. 3.

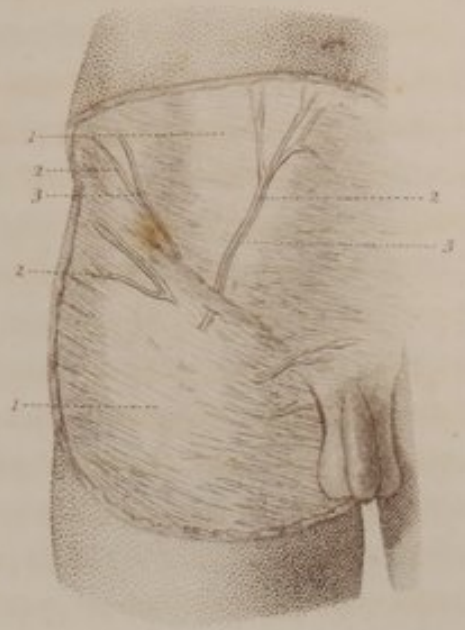


Fig. 1.

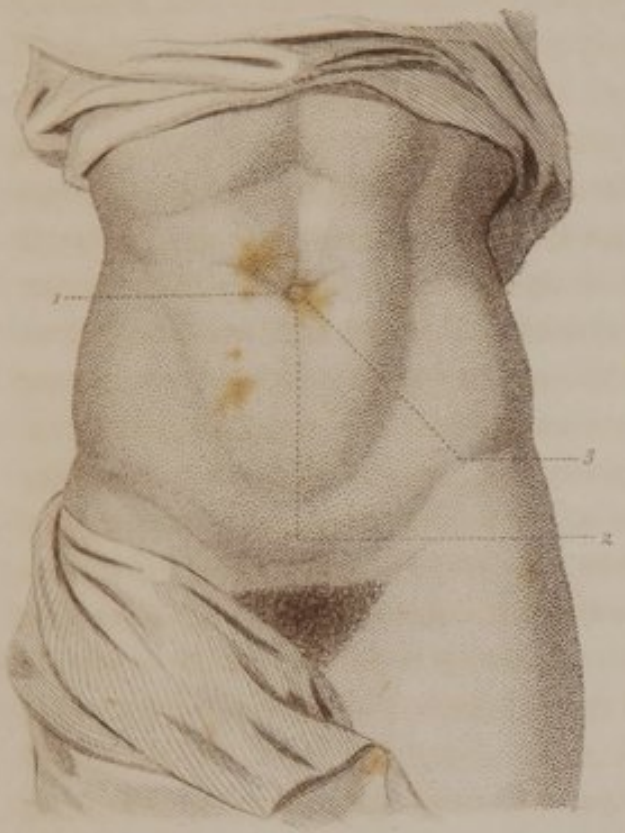


Fig. 2.

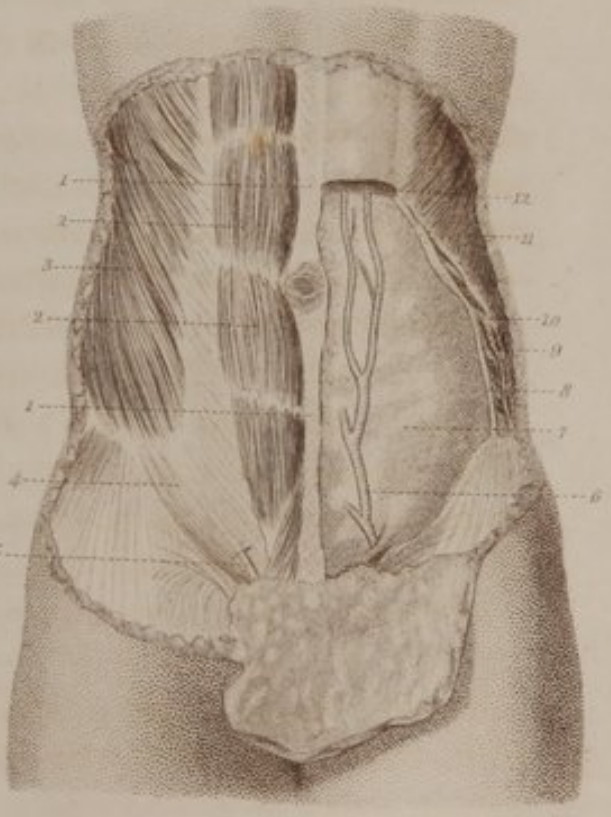


Fig. 4.

spread around them, or by the condensed cellular structure which fills up the spaces left around the vessels. Outside of this again is found the fascia superficialis, or second grand tegumentary covering of the body, and outside of this is the skin.

When, however, long-continued pressure or inflammatory action has existed for some time, all these layers, which, in the normal condition, are easily distinguished, will be found so blended and thickened as to have lost most of their ordinary characters and position, being fused, as it were, into one, or they may have their laminæ so increased that nearly twice as many can be made over a hernia, as might be looked for in the natural envelops of the part. When muscular fibre forms one of the layers covering a hernia, there is less change observed in it than is the case with some of the other tissues. Its presence may, therefore, be generally told by its normal characteristics, and by these a distinction may be made of the different envelops of the tumor which otherwise it would be very difficult to recognize, the extra-peritoneal and the subcutaneous fascia, or the cellular tissue outside of the peritoneum, and that underneath the skin, being sometimes so blended as to appear to the operator like a thickening of one and the same structure. The special coverings of each hernia will be again referred to in connection with the particular class to which it belongs.

§ 2.—SEAT OF HERNIA.

The abdomen being a closed cavity, accurately filled by its contents, the different tissues which enter into the composition of its parietes naturally sustain an amount of pressure, which varies according to circumstances. Above, or at the upper boundary of this region, the pressure is resisted by the diaphragm, but this septum is seldom the seat of rupture, in consequence of its mobility, though some of the intestines have occasionally been forced through it into the cavity of the chest.[1] When it occurs, it is of course beyond the relief of operative means. Below, the abdominal contents are sustained by the bones of the pelvis and their connections, the resisting nature of which is so marked that hernia are also rare in this direction, though they have been seen at some of its weaker parts, and especially at the point of exit of its arteries,

[1] See Bibliography, page 99.

as at the obturator foramen, or at the opening for the thyroid artery (thyroidal hernia); at the sacro-sciatic notch (ischiatic hernia), where the gluteal artery passes out, and also alongside of the vagina of the female (vaginal hernia), or through a laceration of the perineum of the male (perineal hernia).

Posteriorly, the abdominal walls are composed of the muscles of the loins and of the vertebræ, the former of which can alone give exit to hernia, a few rare cases having been reported by Petit and Cloquet, and named lumbar hernia, where the intestines protruded through the muscles immediately above the pelvis, after the parts had been wounded, or submitted to extreme pressure.

As the natural tendency of gravity is to cause the abdominal contents to press against the anterior parietes of the abdomen when the patient is in the erect position, and as many weak points exist in them for the transmission of the various organs of the male and female, this region is by far the most common seat of hernia in both sexes. In that part of the anterior parietes which is immediately at the line of the groin, there is also found openings for the escape of the spermatic cord or of the round ligament of the uterus as well as of the femoral vessels, and it is at this point the Inguinal and Femoral herniæ are seen.

Another class of anterior hernia, which is usually designated as Umbilical, presents a variety, which, though often supposed to be due to the passage of the viscera through the opening left by the umbilical vessels of the fœtus, seldom or ever is so. This hernia, from having been rather loosely described, is liable to mislead such as do not carefully attend to the normal relations of the part, the fact being that hernia seldom escapes by the umbilicus. In the fœtus, a perfect opening exists in this portion of the abdominal parietes, which is correctly designated as the umbilicus, through which the vessels of the cord are transmitted; and whilst the latter exist, or shortly afterwards, a hernia may pass directly along the course of these vessels, but in the adult it is otherwise. At the latter period, the former aperture is so closely contracted, and the vessels which occupied it so perfectly solidified, that this point offers greater resistance than the linea alba itself, and a hernia through the umbilicus proper is, therefore, almost impossible. An examination of the linea alba shows, however, even in the normal condition, at many points, but especially in the neighborhood of the former umbilical vessels, a weakness of the structure around the

course of the vessels, as well as a number of minute orifices in the tendinous parietes, which give exit to bloodvessels and nerves. When, therefore, one or more of these openings have yielded to the relaxation consequent on pregnancies or to such other causes as produce distension of the part, the tumor may be designated as an umbilical hernia, because occurring in the neighborhood of the umbilicus, though, unless the aperture is found close to that through which the fœtal vessels have passed, it would be more correct to designate it as a ventral hernia.

§ 3.—EFFECTS OF THE FORMATION OF HERNIA.

When the escape of a hernia from the abdominal cavity has caused a protrusion of the peritoneum, and formed what has been termed the sac, the effects of the complaint will vary according to circumstances. Thus, if the protrusion has been gradual, there will generally be seen an elongation of all the tissues in front of it; whilst if the rupture has been the result of a sudden effort, or of direct violence, it may lacerate one or more of them, and pass directly through. The majority of hernia being produced by the application of forces, which are continued for a longer or shorter period, most of the tissues connected with the seat of the tumor are elongated, rather than torn, and acquire a peculiar pouch-like form, especially the peritoneum, and hence the protruding portion of the latter has been called the Sac. In order to distinguish points of the sac, it has been divided into different regions, so as to enable writers to define more accurately the part to which reference is made, thus its "mouth" is the portion which is continuous with the abdomen; the "neck" that which adjoins the opening in the abdominal parietes, through which it protrudes; whilst its "body" is the main cavity, and the "fundus" its inferior portion, or that which is most distant from the abdomen. But, though these names generally indicate the regions of the sac, and, therefore, to a certain extent its outline, they are not universally applicable. Sometimes there are two distinct sacs, or the body of one sac is contracted in the middle, so as to present a kind of hour-glass contraction, and create two necks, or two bodies, as may be seen by reference to the plates connected with this subject. Under ordinary circumstances, when a sac has been formed, it is possible, if seen immediately after

its protrusion, to replace both it and its contents in the abdominal cavity: a little later the contents may be returned; but the external surface of the sac, having contracted adhesions to the extra-peritoneal fascia (fascia propria), the sac remains (reducible hernia). Sometimes both the sac and its contents contract adhesions and are permanently fixed (irreducible hernia), or the contents may be so constricted as to arrest the circulation, and lead to the development of a certain train of symptoms designated as those of strangulated hernia. It is for the relief of the latter that the operation of herniotomy, as it is sometimes termed, or the incision of the parts around the protrusion, is demanded. Before proceeding to the details of this operation, it will prove useful to refer to the general symptoms of each variety of hernia as they are most frequently noticed.

§ 4.—REDUCIBLE HERNIA.

All herniæ, whether reducible, irreducible, or strangulated, are composed either of intestine or of omentum, or of both, and give rise to tumors which vary in shape, size, and position. When the tumor can be restored simply by the taxis, it constitutes the variety of the complaint which is designated as "Reducible Hernia."

SYMPTOMS OF REDUCIBLE HERNIA.—The constitutional disturbances caused by reducible hernia are such as may be chiefly referred to derangement of digestion, as constipation, belching, rumbling, dragging pains in the belly, and occasionally a disposition to nausea or vomiting, all of which are relieved when the contents of the tumor are replaced in their natural position, as sometimes happens when the patient lies down, or when pressure, or the taxis, is properly exercised upon the protruded portion. The other symptoms being often the result of the peculiar position of the hernia, will be detailed under their special heads.

§ 5.—IRREDUCIBLE HERNIA.

A prolapsed intestine, or portion of omentum, or both, which cannot be restored to its proper position, but continues as a permanent tumor, constitutes the form known as the "Irreducible Hernia."

Symptoms of Irreducible Hernia.—The tumor caused by this class of hernia is more or less permanent, varying in size and symptoms according to circumstances; thus constipation, flatulency, the erect posture, corpulency, or pregnancy, may increase it, by filling the cavity of the bowels, or by obstructing the circulation and giving rise to infiltration of the omentum, these conditions being shown at the time by the pain, and other symptoms detailed in connection with the reducible class. But colic is more common in the irreducible hernia than it is in the reducible class, on account of the greater tendency of feculent matter to lodge in the protruded intestine. The patient is also more apt to suffer from attacks of nausea and vomiting, in consequence of the fixed position of the omentum or intestine interfering with the distension and upward movements of the stomach, especially after a full meal. Irreducible hernia may also give rise to symptoms which are the result of injury to the contents of the tumor by external causes, as well as to those which will be hereafter detailed as the result of strangulation.

§ 6.—STRANGULATED HERNIA.

When, from any circumstances, a reducible or irreducible hernia is constricted by the surrounding structures to such a degree as to interfere with the passage of the contents of the bowels through it, or when the circulation becomes interrupted either in the bowel or in the omentum, a certain class of symptoms are induced which are regarded as positive evidence of the existence of strangulation or constriction. These symptoms may arise either in consequence of a sudden protrusion of intestine through a small aperture; from the distension of the part by accumulations of flatus, feces, or blood; from swelling of the narrow portion (neck) of the sac; from spasm of the parts around it, or from the formation of bands at its mouth as the result of inflammation.

Symptoms of Strangulated Hernia.—The symptoms of strangulated hernia will be found to vary with the tightness of the constriction, and the length of time that it has continued; they will also vary when the strangulation results simply from obstruction to the passage of matter through the protruded part, or when it is the result of inflammation.

When the consequence of simple obstruction, the patient expe-

PLATE XLII.

A VIEW OF SOME OF THE PARTS CONCERNED IN INGUINAL AND FEMORAL HERNIA.

Fig. 1. Surgical relations of the Bloodvessels in Inguinal and Femoral Hernia. 1. Skin, fascia, external oblique, internal oblique, and transversalis muscles incised. 2. Fascia transversalis and peritoneum covering the intestines. 3. Position of internal inguinal ring. 4. Epigastric vessels. 5. Section of rectus abdominis. 6. Tendon of external oblique or Poupart's ligament. 7. Fascia lata femoris. 8. Femoral artery. 9. Femoral vein. 10. Sheath of vessels. 11. Saphena vein.

After Bernard and Huette.

Fig. 2. Envelops of an oblique Inguinal Hernia. 1. Skin and superficial fascia. 2. Tendon of external oblique distended by the hernia. 3. Cremaster and tunica vaginalis communis, or the fascia propria of the hernia. 4. Sac. 5. Omentum. 6. Intestine.

After Bernard and Huette.

Fig. 3. View of a direct Inguinal or a Ventro-Inguinal Hernia. 1. Integuments of abdomen. 2. Tendon of external oblique. 3. Fascia transversalis and peritoneum. 4. Spermatic cord. 5. Sac laid open. 6. Position of epigastric artery in this variety of hernia. 7. Intestine. 8. Position of the crural ring. 9. Saphena vein. 10. Saphenous opening of fascia lata.

After Bernard and Huette.

Fig. 4. Plan to show the relation of the parts of the Sac. 1. Abdominal parietes and ring. 2. Neck of sac. 3. Its fundus. 4. Its mouth. 5. Peritoneal cavity.

After Bernard and Huette.

Fig. 5. Peculiar form of a Sac, as occasionally seen. 1. Abdominal parietes and ring. 2. Fundus of sac. 3. Body of the sac above an hour-glass contraction. 4. Cavity of the peritoneum.

After Bernard and Huette.

Fig. 6. Commencement of the changes seen in the formation of a Hernial Sac. 1. Abdominal parietes. 2, 2. Knuckle of intestine protruding at the ring, and forcing the peritoneum before it so as to form the sac. 3. Fundus of sac.

After Bernard and Huette.

Fig. 7. Next step of the formation, as seen in a recent Hernia. 1. Abdominal ring. 2. Intestine as protruding and constricted by the ring.

After Bernard and Huette.

Fig. 8. A view of the parts as seen in a more advanced Hernia. 1. Abdominal parietes. 2, 2, 2. Intestine. 3, 3, 3. Continuous line of peritoneum.

After Bernard and Huette.

Plate 42

Fig. 1.

Fig. 2.

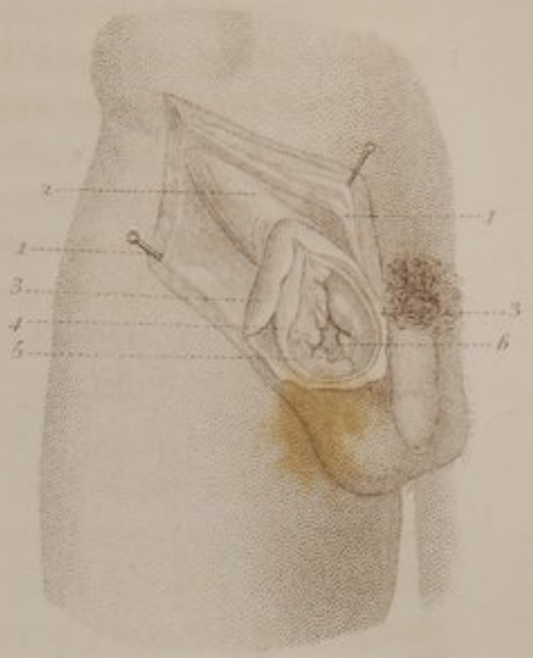


Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.

riences a sense of uneasiness, fulness, or constriction, in the part or in the abdomen, as if a cord was drawn around the latter, accompanied with flatulence, more or less violent colicky pains, a desire to go to stool or to strain, but without any, or at least slight evacuations. This is followed by nausea and vomiting of the contents of the stomach, then of mucus and bile, and subsequently by distressing retching, restlessness, moisture of the skin, irritation and excitement of the pulse, and the other usual symptoms of a bad attack of colic. If promptly relieved by a reduction of the tumor, these symptoms will all disappear, the patient obtain immediate relief, and have a free evacuation of the bowels; though there may remain a certain amount of soreness of the region, or even of the whole abdomen. But if the obstruction remains, and inflammation is induced, then the symptoms just detailed will be followed by others of a more serious character. In some cases of strangulation, these violent symptoms may be the first indications given of the existence of constriction, patients often suffering from some of those just detailed without deeming them more than the ordinary inconvenience likely to result, or which has previously resulted, from their complaint.

The symptoms of strangulation, in very marked cases, consist in a greater tension and tenderness of the tumor; in increased tenderness and swelling of the abdomen; in increased vomiting, which often brings up stercoraceous matter, accompanied or followed by hiccough, and in a change in the color of the tumor, which becomes dark red or livid, and gives a doughy or crackling sensation to the touch. The pulse becomes more frequent, small, and wiry; the skin more wet, cold, and sodden; the countenance expressive of distress and suffering; the mind desponding and anxious, though presenting occasionally intervals of apparent relief, till at last the suffering ceases; the patient is apparently easy, though very feeble; the pulse fails; respiration becomes short and labored, and death closes the scene. On examining the parts *post-mortem*, there is no difficulty in recognizing the previous existence of such an acute inflammation as has resulted in a more or less advanced stage of mortification.

Occasionally, however, patients rally even after mortification has been developed; the external coverings of the tumor ulcerate and open; the slough separates from the most diseased portion of the intestine; but, the adjacent parts being glued to the side of the seat

of the protrusion by the lymph resulting from the inflammation, the peristaltic action of the bowel forces its contents out at the opening thus made, and gives the patient the complaint designated as Artificial Anus.

SECTION II.

TREATMENT OF HERNIA.

The symptoms above detailed having shown that the dangers of hernia, though imminent, depend to some extent upon the existence of strangulation, or on the period during which the protruded part has remained constricted, it is evident that the whole treatment must be resolved into either a prevention or removal of this constriction.

In every case, therefore, it becomes the surgeon's duty to attempt the restoration of the contents of the tumor at as early a period as possible, bearing in mind, in all his efforts, the great liability of the protruded parts to be bruised or injured by pressure, as well as the possibility of lacerating, in certain cases of strangulation, such portions as are in a state of softening or mortification.

§ 1.—REDUCTION OF HERNIA.

The manual treatment requisite for the reduction of hernia is, as has been stated, designated by the term *Taxis* (ταςςω, to arrange), this word signifying the replacing of the contents of the tumor in the abdominal cavity.

General Plan employed in practising Taxis.—The details of the taxis, as required by each form of hernia, being hereafter given, this account will be restricted to such means as are applicable as adjuvants to the taxis in all cases. To perform the taxis with success, it is desirable that the parts constricting the tumor, as well as the muscular system generally, should be placed in as perfect a condition of relaxation as possible, both by the position of the patient and by constitutional measures, and that the pressure of the fingers should be made in the axis of the tumor, unless its peculiar position requires some slight modification of the rule, as will be shown in connection with the special cases. At present, the general

or constitutional treatment likely to facilitate the reduction of all hernia, where difficulty is experienced, can alone claim attention.

The earliest causes of difficulty in the reduction of most hernia being the accumulation of either fecal, gaseous, or vascular products within the protruded portion, the first point to be attended to is, to empty the bowels by enemata, and relieve the stomach by emetics, especially if a full meal has preceded the difficulty, in order that a freer circulation may be established in the protruding portion. At the same time, the bladder should be voided of its contents, in order to give as much room as possible within the cavity of the abdomen.

The next point of danger being the tendency of the constricted portion to inflame, blood should be freely drawn from the arm, and will prove useful, not only by diminishing the general force of the circulation, but also by relaxing the system and promoting a freer circulation through the adjacent parts. If, in any hernia, the constriction is supposed to be the result of muscular contraction, perfect relaxation of the whole system should be produced, and the patient placed in such a condition as will tranquillize the action of the diaphragm and respiratory muscles. To accomplish this, nothing, in my experience, is comparable to perfect etherization, especially in the hernia of children, as these patients, when etherized, always lie perfectly quiescent, and have a respiratory movement of so slight a kind (compared with the efforts which they usually make to resist the taxis, either in consequence of pain or fear), that the facility of the reduction is much increased. Indeed, a resort to ether is often sufficient, of itself, to accomplish the reduction of adult hernia without the abstraction of blood, the warm bath, or any of the other means usually employed; but the entire evacuation of the contents of the stomach should always precede the employment of the anæsthetic. Should the want of ether prevent a resort to this powerful adjuvant to the taxis, then the practitioner must employ some of the other means of inducing the same degree of muscular relaxation, such as the warm or hot bath, or the use of tobacco or tartar emetic. The employment of tobacco, in the form of infusion, in the proportion of a drachm to the pint of water, one-third or one-half of which is thrown into the rectum every hour, is a very powerful means of inducing general relaxation, but is liable to the objection of exciting a longer and more thorough depression of the system than is desired, in consequence of the continued absorption

of the infusion if the rectum does not expel it, as will sometimes happen in consequence of the relaxation of its muscular coat, even though the sphincter ani muscle offers no impediment to its escape. A much safer and more controllable method of applying tobacco will be found in the following plan:—

Macerate a drachm of tobacco for a few minutes in a sufficient quantity of hot water to soften it; then tie the mass up in a bag made of a small piece of gauze (bobbinet), previously soaked in water, and leave the end of the string that is tied around the mouth of the bag attached to it. Push the bag into the rectum like a suppository, and, when a sufficient constitutional effect is induced, draw it out by means of the string which has been left pendulous at the anus.

Various local means have also been recommended as adjuvants to the taxis, such as warm applications to relax the cause of the constriction or cold articles to favor the contraction of the protruded portion; but as the three principal varieties of hernia escape most frequently through aponeurotic openings, which are attached to muscular fibres, little or no relaxation near the seat of stricture can be anticipated from the application of heat, whilst by causing an afflux of blood to the part, it must tend to increase the local congestion in the vessels of the tumor, especially if omentum constitutes a part of it. Cold, on the contrary, will diminish this congestion, and reduce the size of the protruding tissues, by exciting contraction of the fibres of the cremaster muscle, or peristaltic action in the muscular coat of the bowel, so as to favor the reduction of the tumor, whilst it cannot affect the condition of a tissue so purely fibrous in its character as that found in the usual position of the hernial rings. In applying cold as a means of restoring hernial protrusion, or as an adjuvant to the taxis, it will be found most useful when its action is limited to the contents of the tumor. To effect this, apply it as follows: Take a cold cloth or small lump of ice and apply it *directly to the lowest portion of the tumor*, without permitting it to touch the upper portion, or that near the neck of the sac, so that it may induce a contraction of the contents of the sac from below upwards, when, if the case is one of scrotal or inguinal hernia, the effect will be promptly apparent, the scrotum and fibres of the cremaster muscle contracting so rapidly as to render the change in the position of the tumor very apparent. If the hernia contains intestine, the cold thus applied, by hastening the peristaltic movement, will also tend to

empty the bowel of its contents or of its blood, thus diminishing its size, and aiding very materially in its restoration. When the cold is applied to the largest portion of the tumor, or a lump of ice is so placed upon it, that its weight may aid the effect of the cold, or when it is indiscriminately applied all over the tumor, it is liable to produce contraction of the muscular parietes of the abdomen, and by thus constricting the parts near the mouth of the sac, to do more harm than good.

When a hernia has been reduced, a good truss should be well adjusted to the opening, in the manner directed in the special forms of hernia, in order to prevent future protrusions.

§ 2.—PALLIATIVE TREATMENT OF REDUCIBLE HERNIA.

The removal of the weight of the intestines from a hernial tumor having enabled its contents to return to the cavity of the abdomen, as frequently happens when the patient takes the horizontal position, or when pressure is made on its contents in order to replace them in the abdomen, as in the operation of Taxis, their future descent should be prevented by resorting to some of the bandages capable of making constant pressure at the point of exit.

These bandages are very varied, and, under the name of "Trusses," have received every possible modification in the means of attaching them to the part, composition of the pad, or variety of adaptation to particular seats of hernia. From a very early period, the employment of the form of a truss best adapted to the treatment of hernia has been governed by the peculiar views of the surgeon at the moment, or by other accidental circumstances. As the manufacture of these bandages has also led many unprofessional men to study the complaint, great ignorance, and often a want of common honesty, have been exhibited in the formation and laudation of such instruments as it is apparent cannot possibly accomplish the object that is desired, namely, the perfect retention of a hernia within the abdominal walls. In the United States, the variety in the instruments recommended for this retention has been fully equal to, if it has not exceeded, that found in Europe, and it would be a useless labor to attempt either an enumeration of the different kinds, or an examination of their merits and defects. Nearly all trusses are liable to the serious professional objection of

being patented, in consequence of which an unnecessary cost is charged upon those who require them. I am, therefore, unwilling, in a professional treatise, to specify any one truss as being a better or more scientific instrument than another, lest improper advantage be taken of the recommendation.

I. THE GENERAL CHARACTER OF TRUSSES.

A good truss is an instrument formed of a spring of sufficient elasticity to retain a "pad" at the seat of the hernial protrusion, and resist the action of the diaphragm and abdominal muscles. To prevent its chafing the skin, it should be well stuffed, and, if it is not well fitted to the patient's pelvis, so arranged with straps attached to the spring that the latter may be readily adjusted, or prevented from slipping when once placed in a proper position.

In order to adapt a truss to a patient, the surgeon should pass a piece of tape or soft wire directly around the pelvis at the seat of the protrusion, and, allowing one additional inch for the stuffing of the spring and thickness of the pad, select an instrument of the length of the string or wire.

The spring of a truss will be strong enough when it will press firmly on the hernia and yet not cause the pad to indent the tissues after it has been worn a few hours. If it does more than this, it will do harm by leading to atrophy of the structures; or, if the pad is incorrectly shaped, it will favor the recurrence of the hernia when the truss is omitted, by enlarging the "rings."

The pad of a truss, being the most important point, has generally received the most attention, and been made of every conceivable shape and material; some being round, oval, oblong, pyriform, pyramidal, conical, truncated, and square, and composed of horsehair, or cork, wood, ivory, metal, glass, and wire-springs, covered by kid, buckskin, leather, caoutchouc, linen, or cloth. A good pad should have the following characters: A perfect adaptation to the shape of the region that it is to cover; sufficient firmness to maintain its proper surface without variation; and be either composed of, or covered with, some substance that is capable of preventing irritation of the skin or its excoriation from the constant absorption of the perspiration causing the pad to macerate the cuticle like a poultice. If the pad and spring are well adapted to the part, a simple circular

strap will retain them in position; but if they are not, or the patient is very thin, a vertical or perineal band may also be demanded. My own preference is for a spring of moderate strength, and well stuffed to fit the bony projections of the vertebræ or edge of the pelvis, whilst for the pad I prefer cork or light wood, covered by a thin layer of finely polished calfskin, between which and the skin there should always be worn, and especially in warm weather, a fold of linen.[1] When a patient desires to bathe, a similar truss covered with oil-silk may be employed, or an oil-silk sheath be slipped over the truss as usually worn. The pad should generally be permanently attached to the end of the spring, or be so fastened by screws that it can only be shifted by the use of a screwdriver. The much lauded "movable," "self-adjusting," "self-regulating," "ball and socket" trusses I regard as among the follies of the day, and worse than useless. Every pad should have its surface so bevelled as to adapt it to the natural inclination of the abdominal or femoral parietes; or, if the patient is very corpulent, the pad should be so inclined upon the end of the spring as to enable it to press gently from below upwards. With the knowledge possessed by every reputable cutler in the United States, any surgeon can have a proper truss constructed for each case as it is wanted; and it is to be hoped that the profession, by pursuing this plan generally, and giving their attention to the subject, will be able to do away with the practice of employing such instruments as are patented and sold by "bandage-makers." The hair-stuffed pads so often sold for the treatment of hernia have two serious objections: 1st, the hair yields to the pressure, and the pad loses its proper shape; and 2d, it and its covering, by absorbing perspiration, often become exceedingly foul.

II. FITTING OF TRUSSES.

To apply a truss accurately to the retention of an inguinal hernia, the patient should be first placed in the position for the taxis, and the entire contents of the tumor restored to the cavity of the abdomen; then, whilst a finger is applied at the internal ring in an "oblique inguinal hernia," or at the external ring in a "direct hernia," place the pad at this point by slipping the spring under the patient's

[1] Similar trusses may be obtained of Rorer, cutler, Sixth Street, above Market, Philadelphia.

back and around the pelvis, fasten the circular strap, and, letting the patient rise, notice whether any portion of the hernia escapes by the side of the pad. If it does not, direct the patient to move about a little and cough, so as to see if the pad retains its place, or whether it is disposed to slide up, as is sometimes the case. If it does, then apply the perineal strap to hold it down; but otherwise it will not be required. Some caution is also necessary in applying a truss to the male, lest the pad be so shaped or so placed as to touch the pubis and compress the cord, thus exposing him to the danger of having one testicle atrophied. Except in a direct inguinal hernia, there is no occasion for a pad to touch the pubis; on the contrary, it should close the internal rather than the external ring. In the direct variety, or the more rare form of inguinal hernia, as the external ring must be the point for the pressure, the pad should be always so rounded or curved on its inferior edge that, whilst it approaches the pubis, it shall not be able to compress the cord against it.

In employing a truss for the retention of hernia, some surgeons have experienced the following evils which may occasionally result from the use of this instrument: thus, if a portion of the hernia escapes and is compressed by the truss, the patient will be exposed to the risks of strangulation; if it presses very firmly on the rings, it may lead to absorption of the adipose and cellular tissue around them; if it produces excoriation of the skin, it may necessitate the removal of the instrument, and do away with the possibility of making any pressure, whilst if it compresses the spermatic cord against the pubis, it will induce the atrophy of the testicle just referred to.

A truss that is well made and properly applied will, however, be free from these objections. It may be said to be well applied if the patient feels comfortable under all movements, and has the sensation of increased strength in the part, and it will be well made if its spring is strong enough to support the hernia, without making such pressure as would indicate the position of the pad by the indentation left on the skin after the truss has been removed. Nor should the truss, as a general rule, be applied with the idea of inducing adhesive inflammation in the subjacent structures. Its object is mainly that of a supporter, which, by preventing the descent of the bowel into the inguinal canal, affords an opportunity

to the tissues to contract towards their original condition. A truss that possesses the characters that I have detailed,[1] and which is constantly worn night and day, will render a patient perfectly secure from strangulation, and though I believe it will be unable, in most adult cases, to cure a hernia radically, it yet presents us with the following advantages. 1st. The pad may be readily and accurately shaped to fit the anatomical relations of the region. 2d. From its being formed of firm materials, its shape is never changed, as is the case in trusses with soft pads. 3d. The screws upon the neck, by fastening the pad of the instrument to the spring, except when shifted by a screwdriver, materially facilitate its accurate adjustment to the part, and insure the safety of adjacent bloodvessels. But in choosing any instrument, the surgeon should be especially observant of the force of the spring; generally they are too stiff, the cutlers having no idea but that of sufficient force "to push up the bowel," whereas a good instrument should have only sufficient power in the spring to prevent the descent of the contents of hernia, after it has been replaced either by the fingers of the patient or of his surgeon. If a spring seems to be too stiff, its power may be diminished by gently bending it backward, or from its natural curve, care being taken to apply the pressure near the neck of the instrument, and not to bend it so far backward as to break it.

The selection of a truss is a subject that deserves, and has received, careful attention from a large number of surgeons, and whether we entertain a high opinion of its efficacy in effecting a radical cure, or only believe in its utility in the palliative treatment of this complaint, it should be well made and accurately fitted, or it will do neither.

In treating hernia by a truss, I would advise, under any circumstances, that the instrument should be applied in every case except when the complaint is met with in children under eighteen months, as from this term to eighteen years of age, the truss alone will often effect a cure, whilst the more advanced adult will be safe from the dangers of strangulation whilst wearing one, and may perhaps, after a few years, be able to lay it aside. But when a truss is once applied, the patient should be directed to wear it constantly, and especially cautioned against taking it off at night, lest he suffer from sudden strangulation, such as I once saw in a patient, who, having removed

[1] See page 102.

his truss on going to bed, was attacked with strangulated hernia during sexual intercourse.

The further consideration of the truss will be found in connection with the radical cure of hernia, whilst the other points connected with the treatment of hernia will be detailed in the special account of each of the three principal classes of this complaint.

CHAPTER XVI.

OF INGUINAL HERNIA.

In inguinal hernia, the tumor is found at the external or internal abdominal rings, after having, as in the class known as "oblique hernia," passed along the line of the spermatic cord, or of the round ligament of the uterus (inguinal canal); or at the external ring without having passed through the inguinal canal, as in the variety designated as direct or ventro-inguinal hernia, in consequence of the protrusion occurring more directly through the parietes of the belly. Inguinal hernia, when reducible, may be treated either by the palliative or by the radical plan of treatment, the entire contents of the sac, in either case, being carefully restored by the taxis, as hereafter directed in strangulated inguinal hernia.

§ 1.—RADICAL CURE OF REDUCIBLE INGUINAL HERNIA.

Although after the reduction of a hernia and the application of a good truss, the patient is for the time secure from the dangers of strangulation, yet his liability to omit the use of the instrument as well as the inconvenience which sometimes ensues upon its employment, has frequently induced surgeons to search for some means of closing the opening, so as to secure him permanently against the recurrence of the complaint. These means have, of course, been very varied, though generally predicated on the development of such an inflammatory action in the part as would create adhesions of the sides of the opening, or plug up the orifice through which the hernia escaped, by such articles as would remain in consequence

of their fusion with the structures around the rings. Reserving an opinion of the value of these plans of treatment until they have been enumerated, I shall now present a brief account of a few of such American and European suggestions as seem plausible or have been attended with some success.

Operation of Dr. Pancoast, of Philadelphia.[1]—Having noticed that benefit accrued from making one or two rows of punctures with an acupuncture needle across the neck of the sac, Dr. Pancoast decided to employ some more positive means of exciting inflammation, which he accomplished in the following manner:—

A minute trocar and canula being prepared together with a small graduated syringe well fitted to the end of the canula, and capable of containing a drachm of fluid, as well as a good truss for making compression; place the patient on his back, and, restoring the contents of the tumor, apply a truss accurately over the internal abdominal ring, so as to keep up the hernia, and prevent even the small quantity of liquid that is to be employed as an irritant, from entering the cavity of the abdomen. Then pressing with the finger at the external ring so as to displace the cord inwards, bring the pulp of the finger to bear on the spine of the pubis, and enter the trocar and canula with a drilling motion at the outer side of the finger, until the point is felt to strike the horizontal portion of the pubis near the inner side of its spine. The point being now slightly retracted and turned upwards or downwards, introduce the instrument further, until the freedom of its movements shows that it is fairly lodged in the cavity of the sac. Then turning it into the inguinal canal, scarify the inner surface of the upper part of the sac as well as that just below the internal ring, and withdrawing the trocar, and ascertaining by a probe that the canula is not disengaged from the cavity of the sac, apply the syringe to the end of the canula and throw in slowly and cautiously half a drachm of either Lugol's solution or of the tincture of cantharides, or of some other stimulating liquid, so as to lodge it just below the orifice of the external ring, when, on removing the canula, a compress should be applied above the upper margin of the ring and retained there by the application of the truss. The patient being now placed in bed for ten days, with his thighs and thorax flexed, keep him in this position, whilst as much pressure is made with the truss as can be borne

[1] Op. Surg., 3d edit. p. 285.

without increasing the pain, in order to prevent the viscera descending and destroying the new-formed adhesions.

Remarks.—Of thirteen different cases in which this plan was tried by Dr. Pancoast, there was only one who had sufficient peritoneal inflammation to excite apprehension, and in this one it yielded to leeches and poultices. In several cases, a single operation appeared to be perfectly successful; in others, where the sac was large, or the patient less careful in using the truss, the effect was merely to narrow the sac, a repetition of the operation being necessary, but Dr. Pancoast states that he is unable to testify to *the permanency of the cure during several years*, in consequence of the patient's being lost sight of. In the few who remained near him a few months, he did not see the return of the tumor though they did not wear a truss.

Operation of Dr. Bowman, of Kentucky.[1]—A puncture being made, a syringe with a very fine nozzle was introduced, and inflammation of the parts around the abdominal canal and ring by the use of Lugol's solution or other articles. Dr. Bowman has employed this treatment in six or eight cases, about one-half of which were successful. Jobert, of Paris, has recently reported[2] the cure of a patient by this means.

Operation of Dr. John Watson, of New York.[3]—The patient lying on his back, with the scrotum and left spermatic cord drawn slightly to the right side, and with the integuments over the left external abdominal ring slightly on the stretch, the point of a delicate bistoury was introduced directly down to the crest of the pubis so as to touch without dividing the insertion of Poupart's ligament. Being then made to work freely in the loose tissue immediately in front of the ring, but without wounding the spermatic cord, the nozzle of a small syringe, charged with about a drachm of tincture of cantharides was introduced, and the liquid injected to the bottom of the cut, the hand of an assistant pressing in the meantime over the inguinal canal so as to prevent the fluid from entering it or passing through the sac into the abdomen. A compress and spica bandage being then applied and an anodyne administered, the patient was kept on his back, and in a few minutes began to complain of pain, which was most severe along the spermatic cord, but by the

[1] Gross, History of Kentucky Surgery, p. 90.

[2] Med. News, vol. xii. July, 1854, p. 127.

[3] New York Journ. Med., vol. ix. p. 200.

next morning had nearly subsided. Eighteen days subsequently, he was able to walk without his truss, no tendency to the protrusion being noticed, but as he left the hospital, the future result was unknown.

Operation of Dr. W. H. Roberts, of Alabama.[1]—Dr. Roberts employed a small silver syringe, whose canula was an inch long and terminated in a trocar-shaped steel point, near which were two small orifices for the exit of the fluid from the syringe, which would hold about fifty drops. After purging the patient freely, and administering an anodyne, the operation was performed as directed by Dr. Pancoast, oil of cloves being, however, the liquid employed. In six cases reported by Dr. Roberts as treated by this operation, most of them were subsequently as bad as before.

Radical Cure of Hernia, by Dr. J. C. Nott, of Mobile.—A man, aged fifty, labored under enlargement of the testicle and scrotal hernia. After Dr. Hicklin, the attending surgeon, had removed the testicle, Dr. Nott proceeded to the cure of the hernia.

Operation.—Extending the incision a little above the external ring, the latter was fully cleared of cellular tissue. The hernial sac having been already opened, a considerable portion was removed with the testicle to which it was adherent, and a leaden wire passed through the internal column of the ring, two or three lines from its margin, and about four above the pubis. This being continued down under the neck of the sac, between the latter and the pubis, was brought out through the external column of the ring, at a point opposite to the perforation in the other column, the object being to draw together the two columns of the ring, and at the same time compress the neck of the sac. A single knot being made in the wire, the latter was twisted by a pair of forceps as tightly as so weak a substance would permit, but the opening being large enough to admit three fingers to pass into the abdomen, was only reduced by the operation to about half its breadth. The integuments were now united by suture, &c.

The wound suppurated very profusely, and was about six weeks in closing, owing to peculiar difficulties. Two months after the operation, a hard, insensible lump occupied the seat of the external ring, where the wire had been placed, and four months subsequently

[1] Southern Med. and Surg. Journ., vol. ix. N. S. p. 133.

the patient, though engaged at hard labor, had had no return of his hernia.

Operation of Dr. Jameson, of Baltimore.—Having operated for crural hernia on a lady, who subsequently had a return of the protrusion, and begged to be relieved at all hazard, Dr. Jameson operated as follows: Having, by an incision similar to that required for strangulated femoral hernia, exposed the crural ring, a flap of integuments, two inches long and ten lines wide at its base, was dissected from the adjacent parts, reverted on itself, and introduced into the ring so as to plug it up, the wound being closed by several points of the interrupted suture. This operation cured the patient in this instance, but has not, so far as I know, ever been repeated.

Operation of Gerdy, of Paris.[1]—A curved needle, pierced with an eye near its point and fastened to a handle, several quills for the quilled suture, some strong aqua ammonia, together with ligatures and a camel-hair pencil, being prepared, the operation is thus performed:—

"Whilst the patient is lying down, the surgeon places his left forefinger under the anterior edge of the scrotum, pushes back the skin from below upwards into the ring, and as far as possible into the inguinal canal, leaving the spermatic cord behind. The needle, armed with a double thread, is then directed on the finger to the bottom of this blind pouch, and its end brought out in front, so as to traverse, at the same time, the reflected portion of the skin, the front of the canal and the skin of the abdomen. As soon as the eye, near the point of the needle, is seen outside, one end of the ligature is disengaged and kept outside, whilst the other end is withdrawn with the needle. (Plate XLIV., Fig. 1.) Being then pushed through the same tissues, it is brought out half an inch from its first point of issue (Plate XLIV., Fig. 2), and the second end disengaged in the same way. The pouch, formed of the skin of the scrotum, being now retained by a loop of thread in the canal where it was pushed by the finger, the threads of one side are tied on a quill half an inch long, and the other threads on another tube so as to form the first point of a quilled suture. (Plate XLIV., Fig. 3.) Two other points of suture being made in the same way, one on the inside the other on the outside, at half an inch distance from the

[1] Malgaigne.

first, a camel-hair pencil should be dipped in the ammonia, and the scrotal skin in the pouch cauterized sufficiently to destroy its epidermis. Inflammation attacking this skin, the two surfaces which are in contact, suppurate; and adhere about the eighth day, when the threads are removed and the canal obliterated.

The other plans of treatment are very varied; thus, Velpeau, at one period, revived the old plan of scarifying the sac, but has since abandoned it, and Belmas introduced strips or bags of gelatine into the cavity of the sac, though it proved to be a very imperfect plan of proceeding. Bonnet, of Lyons, and Mayer, have also attempted the constriction of the canal by pins and ligatures (as in cases of varicocele), but have obtained only occasional and temporary success.

The following operation is among the more recent of those proposed, and presents some points which are worthy of notice:—

Operation of Dr. T. Wood, of Cincinnati.[1]—Having prepared a needle with the eye in the middle, and a spear-point at each end so as to enable it to pass readily in any direction without becoming entangled, place the patient on his back in bed with the pelvis elevated, so as to relax the tension of the abdominal parietes. The hernial sac with all its contents being then returned through the ring, pass the little finger of the left hand into the ring so as to carry before it the thin structure of the scrotum. After thus ascertaining the condition of the ring, and being satisfied that there is nothing between the columns but the spermatic cord, carry the latter downwards and inwards, and hold it by the pressure of the finger in the angle of the ring, which is next to the symphysis pubis, and, whilst it is thus retained, thrust the point of the needle through the integuments so as to strike the inner column of the ring about one-eighth of an inch from its margin, and as near the pubes as is possible without endangering the cord either by wounding it with the needle, or by constricting it, when the sides of the ring are approximated by the ligature. The point of the needle being then passed through the tendon in many points, so as to excite more action, and carefully directed upwards, pass it through and across the canal (so as to avoid the cord, and also prevent its becoming entangled in that portion of the scrotum which caps the finger), until it reaches the opposite column of the ring at a similar distance from its margin, when, the side of the needle being

[1] Western Lancet, vol. xii. p. 281.

pressed strongly against the abdominal ring, the finger should be gradually withdrawn until the point of the needle can be made to reach a proper point for puncturing the tendon, when it should be thrust through and made to appear on the external surface of the integuments opposite its point of entrance. The point of the needle being now seized, and drawn carefully through until the ligature has passed through both the punctured columns of the ring, make it retrace its course as soon as its eye escapes from the tendon, so as to carry the end of the ligature through and out of the first opening made in the skin, thus placing the first end of the ligature at the puncture first made, and the last end at the opening made by the exit of the needle; after which the two ends should be tied over a compress placed between them, so as to bring the opposite columns of the ring in contact and cause their union by adhesive inflammation. After the ligature is applied and the columns approximated, the patient should be kept constantly on his back, and the ligature not removed for eight or ten days, the free suppuration usually seen at this time facilitating the escape of the ligature, when gentle traction is made on it.

Remarks.—The three cases operated on by Dr. Wood were, apparently, cured at the time of his report, though he desired a longer period to test the cure. The first case had then been operated on eighteen months, the second eight, and the third three months, but each continued to wear his truss. The discussion in the Medico-Chirurgical Society of Cincinnati, on Dr. Wood's paper, led to the expression of sentiments which all familiar with hernia will probably admit to be reasonable, viz: that his operation, like that of Gerdy, only closes the external ring, and does not act on the internal ring or on the inguinal canal, and that though applicable to direct hernia, it is not equally so in the oblique variety. But even if this operation should accomplish nothing more than a closure of the external ring, it must prove useful in many cases, and therefore appears to me to be worthy of further examination. Its true value can only be established by its trial in numerous instances.

§ 2.—GENERAL OBSERVATIONS ON THE RESULT OF THE MEANS RESORTED TO FOR THE RADICAL CURE OF INGUINAL HERNIA.

A strong desire to ameliorate the condition of those who labor under the evils of hernia, having led surgeons, as has just been shown, to investigate the possibility of effecting a radical cure of this complaint, their conclusions in respect to the results of one plan of treatment (trusses) have, in some instances, been so favorably received as to have led a great number of patients to believe that radical cures of hernia can be accomplished solely by the use of these bandages. The report of a committee of the Philadelphia Medical Society, appointed with a special view to the investigation of the truss of Dr. Chase,[1] has often been quoted as indorsing the opinion that his truss will accomplish a radical cure; but such has never seemed to me to be the true verdict of the committee. Though believing in the advantage of employing Dr. Chase's truss in preference to many others, their report says: "That the success, in cases of umbilical hernia in young children, is almost general . . . that success in other varieties of hernia, affecting subjects (children) of similar ages, is by no means rare under the operation of trusses with soft pads; that, in children over ten years of age, it (*a radical cure*) becomes rather uncommon; that in youths between the age of puberty and twenty years, it (the radical cure) becomes rare, and after the latter period *very rare*." This committee defined a radical cure as follows: "A cure is radical when the tendinous and fascial barriers to the egress of the bowels are brought or restored to their normal or original firmness and power of resistance," to which I would add, and capable of permitting the ordinary actions of life, during three years, without the reappearance of the hernia. Under this definition, there are few cases of adults over twenty years of age that are shown to have been cured in the many works which I have consulted, and I therefore respectfully reiterate the opinion that a radical cure of a hernia (not congenital) in a patient over twenty years of age, has very rarely been accomplished by a truss. Temporary relief has enabled some patients to go without the truss for a few months, but in the majority of instances, I think it will be found that the complaint has or will reappear in about eighteen months.

[1] Report of Committee of Philadelphia Medical Society, Philad. 1837.

Nor is this opinion solely that founded on my individual observation of many of the late Dr. Chase's patients, as well as those treated by myself with his truss. Dr. T. Wood, of Cincinnati, who was a private pupil of Dr. Chase, and specially instructed in his opinions and mode of treatment, and who also saw numbers of patients treated by him, says, in an extended article on the radical cure of hernia:[1] "I have seldom met with a patient who had not a hernia at the end of two years' treatment. I have much more rarely met with one that remained cured at the end of three years, and I have never known one to be radically cured of a hernia at the end of four years' treatment by any means whatever. The conviction is therefore indelibly stamped on my own mind that no truss will effect a radical cure of hernia any more than indigo will cure epilepsy, or the thousand and one corn salves will radically cure those troublesome customers that torture your toes."

In thus expressly advancing the opinion that hernia is not radically cured by a truss in the majority of instances after the age of eighteen years, or after the period when the patient's frame is well developed, I am fully aware that others entertain somewhat less decided sentiments on the subject, and the reader will therefore view the opinion as that based chiefly upon individual experience. It may be that I have been unfortunate in the selection of cases, or that I was wanting in surgical skill, but as others may be similarly situated in this respect, I humbly desire to prevent any young surgeon from accidentally misleading his patients into the belief that the use of a truss will cure them, lest the result cause them to charge him either with ignorance or wilful deceit, and induce them to place him in the same class with the miserable characters who profess to cure all disorders.

Although decided in my own views on this subject, I desire it to be understood that my opinion and that of Dr. Wood also differ from that of the committee appointed by the American Medical Association in 1852, to report on the radical cure of hernia. This committee (composed of Drs. Hayward, J. M. Warren, and Parkman, of Boston) "regard compression, when properly employed, as the most likely means of effecting a radical cure in the greatest number of instances," and some of the French surgeons coincide with them. Many, however, both of the French and English school,

[1] Western Lancet, vol. xii. p. 277, *et supra.*

have dissented from this opinion; and the reader will, therefore, see that the question is by no means settled, and should so regulate his opinion as to protect himself from the suspicion of wilfully misleading his patient, by candidly stating to him the uncertainty of the result. Let the adult fully understand that whilst he wears a truss that is accurately fitted, he is as secure as he can be against the dangers of strangulation; that his hernia will not be so liable to give him trouble as it was before the application of the truss, no matter what he may do; that whilst he wears it there is a *chance* of a cure, but that, in all probability, he will find it essential to his safety to wear a truss for many years, if not for life.

The other means which have been resorted to in the attempts to cure hernia radically, date back to a very early period of the profession—Celsus, Aetius, Guy de Chauliac, and other surgeons, having advised various means of accomplishing it. Few, however, seem to have presented unexceptionable facts, as each period appears to have been dissatisfied with the acts of its predecessors, and to have endeavored to remedy their operations, or suggest others. The application of a ligature around the sac was advised especially by Guy de Chauliac, A.D. 1360, who directed that the sac should first be laid bare, in order to strangulate it with greater certainty at its root. The use of a leaden ligature, and the approximation of the sides of the ring, as advised by Dr. Nott, present a modification of this operation, which may prove to have several advantages over the old-fashioned thread and the strangulation of the neck of the sac, and, as it does not constrict the cord (being placed below it), is worthy of further trial. Of the operation of Mr. Gerdy, I have only to say that my personal observation of some of his cases, several years since, did not induce any confidence in its ultimate success, whilst the plans of Velpeau, Belmas, and others, have not been sustained by general professional experience. The modification of the plastic operations, also, tried many years ago by Dr. Jameson, of Baltimore, has been well thought of, but, though the patient was benefited, I am not aware that the operation has been repeated.

SUMMARY.—Upon the whole, I incline to the opinion that though any of these operations, when followed by the use of the truss for two years, will be more likely to effect a radical cure than the truss alone, yet that the result of the operations by themselves will also be doubtful in the majority of cases. As they have, however, succeeded,

PLATE XLIII.

SURGICAL RELATIONS OF THE PARTS CONCERNED IN HERNIA.

Fig. 1. A view of the relation of the Internal Oblique and Transversalis Muscles to Inguinal Hernia, showing the mode of formation of the Cremaster Muscle. 1. Tendon of external oblique, a portion of the muscle and its tendon having been excised in order to show the parts beneath. 2. The fibres of the internal oblique. 3. A section of the tendon of the external oblique everted upon the thigh, and showing the origin of the internal oblique and transversalis muscles from Poupart's ligament. 4. Common tendon of the last two muscles. 5. Cremaster muscle as seen upon the cord, but not extended upon the testicle, as is usually the case.

After Bernard and Huette.

Fig. 2. A view of the relations of the Transversalis Muscle and Fascia. 1. Transversalis muscle, as shown by the removal of the parts above it. 2. Circumflex ilii artery in its course to anastomose with the ilio-lumbar. This artery lies between the transversalis and internal oblique muscles. 3. The femoral artery exposed by opening its sheath. 4. The femoral vein.

After Bernard and Huette.

Fig. 3. Formation of an Inguinal Hernia at the internal ring, and the relative position of its coverings. 1. Tendon of external oblique everted. 2. Section of fascia transversalis. 3. Intestines seen through the peritoneum. 4. The cord. 5. Mouth of hernial sac.

After Bernard and Huette.

Fig. 4. Relative position of the coverings of an old Scrotal Hernia, as shown by laying open the part. 1. Penis hooked back. 2, 2. Skin pinned back. 3, 3. Fascia superficialis. 4. Dartos muscle. 5. Internal layer of dartos. 6. Tendon of external oblique, and external abdominal ring. 7. The spermatic cord. 8. Tunica vaginalis communis, or fascia propria.

After Bernard and Huette.

Fig. 5. Relative position of constituents of the Cord. 1. Tendon of external oblique. 2. Same slit open. 3. Fibres of internal oblique and transversalis, or the cremaster muscle. 4. Tunica vaginalis communis. 5. Probe passed beneath vessels of cord. 6. Vas deferens.

After Bernard and Huette.

Fig. 6. Relations of the coverings of the Testicle. 1. Tunica albuginea. 2. Tunica vaginalis testis. 3. Cremaster muscle and tunica vaginalis communis of the cord.

After Bernard and Huette.

Fig. 7. Mode in which a Hernial Sac is formed. 1, 1. Point of protrusion. 2, 2. Intestine about to escape. 3, 3. The peritoneum as protruded in front of the intestines.

After Bernard and Huette.

Plate 43.

Fig. 3.

Fig. 1.

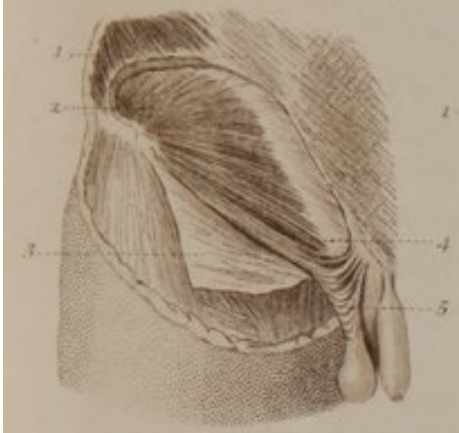


Fig. 2.

Fig. 4.

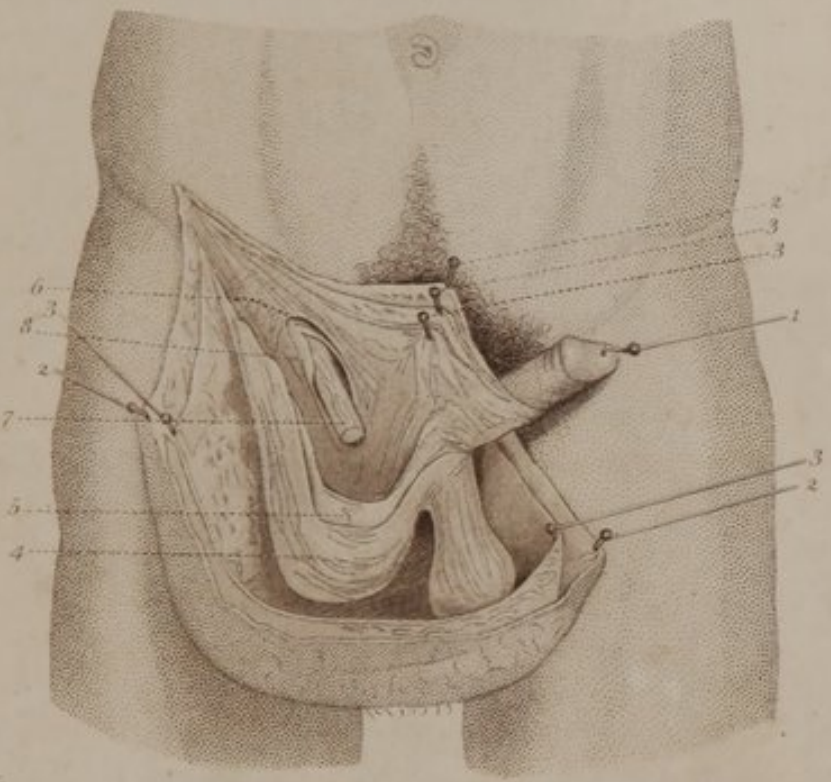
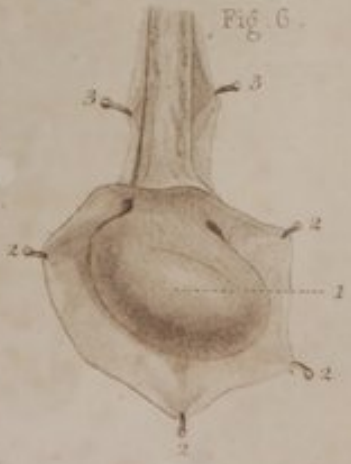


Fig. 5.

Fig. 7.

Fig. 6.



at least for some few months, other surgeons may deem it proper to repeat the trial. If called on to select any one method of operating, I should prefer the plan of Dr. Wood, of Cincinnati, or the use of a leaden ligature below and around the ring and neck of the sac, in a manner somewhat similar to that reported by Dr. Nott, whilst, if a more simple operation was desirable, I should resort to the use of the injection as practised by Drs. Pancoast, Watson, Roberts, &c. Many of those most experienced in the result of these operations are, it will be seen, like myself, far from being satisfied of their ability to effect a radical cure, Dr. Robert expressing the opinion,[1] based on the record of his cases, that, "so far as the danger of the operation is concerned, he has yet to learn that any existed, having seen the intestines come down the day after the operation and returned without bad consequences. He has also seen the oil of cloves thrown into the sac when the omentum was there, and retained without trouble. Yet, since the latter part of 1847, he has had so little confidence in the operation as to have given it up, preferring to rely upon the introduction of a small seton at the external ring. Dr. Wood, also, it will be seen, was not so satisfied with his success, at the date of his report, as to recommend his operation as a certain radical cure; and Dr. Pancoast was unable to testify to the permanency of the cure, owing to his losing sight of his patients.

CHAPTER XVII.

STRANGULATED INGUINAL HERNIA.

Oblique or Indirect Inguinal Hernia, in the male, consists, as before stated, in a protrusion of some of the abdominal contents through parts which have been left in a weakened condition, by the descent of the testicle from the loins to the scrotum. In the female, this form of hernia passes through the openings left for the passage of the round ligament of the uterus in its course to its insertion. When the protrusion occurs directly through the abdominal parietes behind the external abdominal ring, and without following the course of the inguinal canal, it constitutes the form of the com-

[1] Southern Med. and Surg. Journ., vol. ix. p. 136.

plaint which has been designated as "Direct Hernia." As the oblique hernia is the most common, a reference to the changes induced upon the parts by the descent of the testicle will facilitate the comprehension of the anatomical relations of such portions as are directly connected with the operation required for its relief when strangulated.

SECTION I.

SURGICAL RELATIONS OF INGUINAL HERNIA.

The anatomical details of the abdominal parietes belonging to special anatomy, and being generally among the elementary studies of every medical student, I shall not now enter upon a description of the muscles, fascia, &c., which compose the abdominal walls, but limit this account to a few of the points especially connected with the surgical relations of inguinal hernia.

The split or opening in the tendon of the external oblique muscle of the abdomen, or the "External abdominal ring," is found at the point where the tendon, or ligament of Poupart, is attached to the spine and symphysis of the pubis. This opening or ring being somewhat triangular in its shape, has its base resting upon the pubis, whilst its summit is lost in the general fibres of the tendon of the external oblique. It is covered by the skin and fat as well as by the fascia superficialis abdominis of Camper, whilst the space or opening contained between its sides is filled with loose cellular tissue in the normal condition, though the existence of hernia may so thicken it as to justify the name of "intercolumnar fascia." Through this ring the spermatic cord of the male, and the round ligament of the uterus in the female are transmitted, either to the scrotum or pubis, both of them inclining very much to the outer side (outer column) of the ring. In the integuments over this ring we find a small artery and vein (arteria et vena ad cutem abdominis of Haller). Behind the ring is the common insertion of the rectus abdominis and pyramidalis muscles, which tend very much to strengthen the part and prevent, except in ventro-inguinal hernia, the descent of the bowels at this spot. Extending obliquely upwards and outwards from this ring—for the extent of an inch and a half in the normal condition—is the space or flattened passage designated as

the inguinal canal, though, except when distended by a hernia, it cannot properly be spoken of as a canal. Behind, it is bounded by the rectus abdominis muscle and fascia transversalis, to which it chiefly owes its strength; below, by the crural arch; whilst its anterior and inferior boundaries are chiefly due to the imperfect fibres of the internal oblique and transversalis muscles, to the tendon of the external oblique, and to the fascia superficialis and skin. Throughout its length, we find the spermatic cord of the male and the round ligament of the female, and when an oblique hernia descends through it, these structures will generally be found behind, below, and within the hernia. The upper, posterior, or external orifice of this canal is designated as the "Internal abdominal ring," or opening in the fascia transversalis, though such an opening never exists in the normal condition of the parts, as a process of the peritoneum as well as of the fascia transversalis is extended into the canal in its healthy condition; the presence of the internal ring is therefore always due either to dissection, or to the pressure of a hernia from which its edges have become defined. On the inner side of the internal ring, when it exists, or on the inner side of the cord or round ligament, is found the Epigastric Artery, which, running vertically upwards, or nearly parallel with the fibres of the rectus muscle, has the peritoneum behind it, and the fascia transversalis in front of it. Through these structures, the fœtal testicle and oblique inguinal hernia descend in their course from the abdomen to the skin, and in the course of this canal must the taxis be practised, when the effort is made to restore it.

When the testicle of the fœtus leaves the loins in its descent to the scrotum, it pushes before it that portion of the peritoneal sac which lies in front of the intestine; then presses in front of it, and extends a portion of the fascia transversalis; next, a few fibres of the transversalis muscle; then, a few of those of the internal oblique muscle, the two together constituting the cremaster muscle. Passing then through the external abdominal ring, it extends the portion of the cellular tissue which is between the sides of the ring and the fascia superficialis, and, lastly, drops into the pouch of the skin known as the scrotum. When in the scrotum, this gland is, therefore, covered by the skin, fascia superficialis, cremaster muscle, condensed cellular tissue (tunica vaginalis communis), and by the peritoneum (tunica vaginalis testis), and the cord has the epigastric artery between the linea alba and the line of its descent (inguinal canal).

Shortly after taking its position in the scrotum, the tube-like process of the peritoneum, which then extends from the scrotum to the abdomen, is obliterated, though sometimes it remains open (congenital hernia, congenital hydrocele), or is only closed at points (encysted hydrocele, hydrocele of the cord). The process of fascia transversalis (extra peritoneal cellular tissue), which had been protruded in a pouch like the peritoneum, but contracted into a tube-like prolongation on the cord, is then gradually changed, and loses its dense characters, except on the surface next to the peritoneum, where it presents a funnel-shaped depression at and around the cord, whilst the remaining layers contract upon the cord and are diminished in character and distinctness.

A portion of intestine or omentum (hernia) pressing against the peritoneum at the same point of the abdominal parietes, does the same thing as the testicle did, that is, pushes a portion of the peritoneum in advance of it, unless the sac formed by the descent of the testicle had not been cut off from its connections with the general peritoneal cavity, when it passes directly into the same sac as the testicle (congenital hernia).

On reaching the fascia transversalis, it also slightly distends it into a sort of pouch; but, as the pressure is continued, the edges of this pouch at the point of pressure become thickened, especially in old hernia, and take on a defined shape, thus constituting the internal ring, whilst the centre is either absorbed or converted into a reticulated structure (fascia propria), and then the tumor, passing on, takes a position in front of the cord, but also a little towards the median line of the body. Being here beneath the fibres of the transversalis and internal oblique muscles (cremaster), it escapes through the external ring, pushes before it the cellular tissue which usually fills up this ring (intercolumnar fascia), and, pressing it against the superficial fascia, the two become blended in one, and there only remains the additional covering of the skin. In operating upon an inguinal hernia, there are, therefore, usually found the skin, superficial fascia, cremaster muscle, fascia propria and sac, all of which must be divided before the contents of the tumor can be made apparent.

The only bloodvessels about this class of tumors are the small artery and vein, before spoken of as being found directly beneath the superficial fascia, and the epigastric artery and vein, which is directly beneath the peritoneal fascia. The arteria ad cutem abdo-

minis is therefore between the fascia superficialis and the external oblique tendon, whilst the epigastric artery is between the fascia transversalis and the peritoneum. In indirect inguinal hernia, the latter artery is towards the inner side of the contents of the tumor, that is, towards the linea alba, and runs parallel with the external edge of the rectus abdominis muscle, whilst in ventro-inguinal hernia, or that in which the protruded part does not follow the entire course of the spermatic cord, it may be upon its outer side. (Plate XLII., Fig. 3.) But as the pressure of the hernia upon the peritoneum and fascia transversalis elongates the first, and causes a thickened margin to the second, this artery is removed a line or two from the edge or margin of the opening in this fascia, designated as the internal abdominal ring. In the normal condition of the parts, the distance between the internal and external abdominal rings is about an inch and a half, the internal ring being about this distance exterior to the external ring, or about as much nearer to the anterior inferior spinous process of the ilium. But, in hernia, the traction caused by the protruded parts, especially in old hernia, approximates these two rings, so that one is often very nearly in contact, and also behind the other, and the epigastric artery is brought, therefore, more towards the external ring and the linea alba; but unless an extraordinary arrangement exists, it will yet run parallel to the anterior edge of the rectus muscle, and be on the median or internal side of the protrusion.

SECTION II.

OPERATIONS FOR THE RELIEF OF STRANGULATED INGUINAL HERNIA.

The operations required for the relief of this kind of hernia consist in that performed for the restoration of reducible hernia, and that requiring the division of the parts by the knife for the relief of the strangulation.

§ 1.—TAXIS IN STRANGULATED INGUINAL HERNIA.

Taxis, as employed for the purpose of replacing an inguinal hernia within the cavity of the abdomen, consists in manipulating the tumor so as to press the portion which was last protruded, first

through the ring or opening at which it has passed, the remaining part usually following readily the course of the first, when a judicious continuance of the pressure is persevered in.

In making the taxis in cases of strangulated inguinal hernia, it is essential to success that the parts concerned should be in a state of perfect relaxation, and that the patient should offer no resistance to the manipulation of the surgeon; but, as a strangulated hernia soon becomes painful, some little opposition may always be anticipated, unless means are taken to prevent it. The use of anæsthetics in these cases, as in those of children, before referred to, is, therefore, especially demanded, in order to obviate this resistance, as well as to relax the muscles generally. As the position of the patient also materially facilitates the operation of Taxis, he should, before being etherized, or when the latter agency is not employed, be placed upon the back with the knees drawn up and the shoulders well raised and supported by pillows, in order to relax the abdominal parietes. The surgeon being then placed upon the affected side, should seize the tumor with his right hand, and draw it gently downwards, so as slightly to elongate it; then placing his thumb and first two fingers at the upper part of the tumor, so as to compress or squeeze it gently, let him force back a portion of the intestinal contents, if possible, so as to reduce the bulk of the tumor, and, pushing the portion last protruded upwards and backwards, compress the lower part of the swelling with the fingers and thumb of the other hand, in the same manner that he would squeeze a caoutchouc bottle to empty it of air. If, after a short time, the tumor diminishes in size, its base may be approximated to the summit, and the effort made with the fingers of the left hand near the ring to push into the abdomen some small portion of it, or this part may be slightly compressed by these fingers, whilst the others endeavor to replace another portion. Should the effort, however, not succeed, the fingers and thumbs of both hands should be made to force upwards and backwards all portions of the mass, kneading it so as to empty it of its contents; or a part of it may, if possible, be inverted by pressing the forefinger towards the ring, and then retaining it there a few seconds. (Plate XXXIX., Fig. 6.) If, after moderate manipulation in this manner, no diminution of the swelling is perceptible, the taxis should cease, the patient be allowed to rest, or his position be changed to such a direction as might induce the intestines within the abdomen to gravitate in a different direction

from the hernia, and thus facilitate its return. If, however, a very small portion of the tumor can be replaced, the rest will usually follow; and when the protruding portion is intestine, a distinct gurgling sound will be perceived as the last part returns to the belly, in consequence of the liquid or gas which had been confined in the constricted portion again passing into the main channel.

NEW METHOD OF MAKING TAXIS.[1]—After vainly employing the usual means of reduction, as just detailed, Dr. Wise, of India, succeeded in restoring a strangulated hernia by the following plan, it having been suggested by a Mussulman gentleman, who had seen it successfully applied: "Place the patient on a table, and having folded a long sheet several times on itself, carry it around the lower part of his pelvis, twisting it on itself in front, and again at the sides, so as to enable the assistants, who stand on each side, to hold the extremities of the sheet, and pull them gently upwards, or towards the patient's head, whilst a third assistant holds the feet, and the surgeon makes the taxis. As the gut immediately above the strangulated portion is often superficial, and distended with flatus and liquid, it will be drawn upwards from the hernial sac, whilst the return of the protruded portion is favored by the taxis practised by the surgeon."

If, after one or two trials of either or both of these means of making the taxis, no change is effected, then it may become a question whether it is better to resort to herniotomy or to repeat the taxis.

In small hernia, where the constriction is tight, the part painful, and the patient vigorous, the repeated attempts at taxis, or a resort to anything like forcible pressure, is always dangerous, and tends to the development of inflammation in the part. When, therefore, in such cases, no progress is made, notwithstanding a judicious employment of the adjuvants before alluded to, a repetition of the taxis can only tend to increase the patient's danger. But in large and old hernia, unaccompanied by much pain, or where the hernial contents have occasionally been down before, but were reduced with some trouble, the repetition of the trial may succeed, especially if cold applications are made, as before directed, to the tumor in the interval of the attempts. In recent and small

[1] Western Journ. of Med. and Surgery, 3d series, p. 207, from London Journ. of Med.

hernia, great judgment in the use of pressure will be required, and, as a general rule, it will prove best not to employ the taxis too long, say more than twice, provided the manipulation is correctly practised, that is, in the line of the axis of the tumor, or upwards towards the cavity of the abdomen and in the line of the inguinal canal. In other cases, the demand for a prompt resort to the operation is not so urgent, as it has more than once happened that in these hernia, after everything has apparently been tried and a resort to the knife been decided on, a slight and apparently hopeless effort has suddenly caused the tumor to disappear. With young surgeons, there is apt to be too much delay before resorting to the knife, and the force employed in the taxis is often too great. It should, therefore, be remembered that delicacy of manipulation will generally succeed better than force, and that the ultimate success of the operations for the relief of the strangulation has been most marked in those cases where it was not delayed until positive and high inflammatory action was established. Dessault assumed it as a maxim that "success might always be anticipated in a hernia which had not been touched before operating,"[1] and was often successful where strangulation had existed five days, but almost constantly failed when strong efforts had been previously made in the taxis. The resort to cold combined with moderate pressure, such as that produced by placing a pound weight on the tumor, when continued for a half hour, has frequently succeeded even when judicious taxis had failed; and it may be readily accomplished by the application upon the swelling of any substance of this weight. But the dangers of delay should always be borne in mind, even when these means are employed, though they are less likely to excite inflammation than the repeated pressure of the fingers in the taxis. Dr. Joseph Parrish, of Philadelphia, whose experience in hernia was quite large, coincided in the opinion of Mr. Hey, "that he had often had occasion to regret performing the operation *too late*, but never *too early*."[2]

In making taxis for the relief of strangulated hernia, whether before or after the incision of the tissues, it is important that the symptoms of strangulation should disappear when the reduction is accomplished. Should they not do so, and yet the restoration of

[1] Œuvres Chirurgicales, as quoted by Parrish on Hernia, Philad. 1836.

[2] Parrish on Hernia, p. 28.

the hernia within the abdomen be certain, it may become necessary to incise the canal and seek for the constricted tumor in the abdomen, as the condition of the parts concerned in the reduction "*en bloc*" or "*en masse*," as the French describe it, requires prompt relief. In the work of Dr. Parrish, and in an article by Dr. Geo. C. Blackman,[1] of New York, in the works of Cooper, Lawrence, and others, will be found many valuable details in relation to this troublesome and dangerous accident as connected with the treatment of strangulated hernia.

§ 2.—REDUCTION OF STRANGULATED HERNIA IN MASS.

As death has sometimes ensued upon the employment of the taxis, in certain cases of strangulated hernia, in which, though the contents of the tumor were evidently returned into the abdomen, the symptoms of strangulation yet existed until the termination of life, the attention of surgeons was given at an early period to the investigation of the cause, and from the *post-mortem* appearances of these cases, it was discovered that the symptoms were the result of the return of the whole tumor into the abdomen, whilst the stricture existed in the neck of the sac. This condition of things was however so rarely met with, that when it was first reported by Le Dran, Scarpa, Louis, and many of the surgeons of his time, denied the possibility of the occurrence. Closer investigation has, however, shown that such an accident is not so exceedingly rare as was at first supposed. Dupuytren, Breschet, and Jobert, among the French surgeons; Sir Charles Bell, Cooper, Lawrence, and Luke, among the English, and Dr. Joseph Parrish, of Philadelphia, and Cheeseman and Blackman, of N. Y., having, at different periods, noted similar cases, and called professional attention to it.

TREATMENT.—In order to relieve a patient under these distressing circumstances, whether resulting from the taxis, or from an operation in which the sac has not been opened, the first efforts should be directed to obtaining, if possible, the reproduction of the hernial tumor. Sometimes this is said to have been easily done; but in most of the cases reported by those whose attention has been directed to this complication of hernia, it has proved difficult, or even impossible; and nothing has therefore remained but to open the canal

[1] Am. Journ. of Med. Sciences, vol. xii. N. S. p. 386, 1846.

freely, draw out the sac, and divide the stricture which existed at its neck, an operation which has rarely terminated successfully. In order to guard against the reduction "*en masse*," during the operation of herniotomy, the finger should be passed around the inner side of the neck of the sac, before restoring the hernia.

§ 3.—HERNIOTOMY IN STRANGULATED INGUINAL HERNIA.

The operation of dividing the stricture in order to relieve the constriction of hernia, consists in dissecting the different coverings of the tumor, and then nicking the constricting part, so as to enable it to yield to the pressure subsequently made on the contents of the tumor, avoiding a large incision of the ring, lest the patient be subsequently unnecessarily exposed to a further escape of the viscera.

PRELIMINARY MEASURES.—Before commencing the operation, the surgeon should properly prepare such instruments as may be required, as well as the dressing. In most cases, he will find it useful to select one good scalpel, one sharp-pointed bistoury, one director, one pair of dissecting forceps, one Cooper's bistoury (Plate XXXV., Fig. 16), or one probe-pointed bistoury wrapped to within an eighth of an inch of its point, and not sharp; a tenaculum, ligatures, needles, and sponges, together with adhesive strips, a piece of linen spread with cerate, a compress, and a bandage sufficiently wide to form a spica of the groin.[1] Then the hair should be shaved from around the tumor, so as to prevent its interfering with the subsequent dressings, the bladder emptied of its contents, a narrow table, well covered, so arranged that the patient's hips can be brought near to its end, and his feet be supported on chairs, room being left for the operator to stand between the knees. Should the operation be demanded after sunset, as is often the case, several sperm candles should be added to the other general arrangements. Three assistants will prove useful; one to aid the operator in his incisions, one to sponge blood from the wound, and one to attend to the etherization or to the wants of the patient.

ORDINARY OPERATION FOR STRANGULATED INGUINAL HERNIA.—In commencing the operation of herniotomy for strangulated inguinal hernia, the selection of a mode of incising the skin must depend upon the abilities of the operator. If he is dexterous, its division may

[1] See Smith's Minor Surgery.

be effected by holding the scalpel in the third position, or like a pen (Plate II., Fig. 5), and cutting in the axis of the tumor from the upper to the lower portion. But if this is not the case, and especially if the patient is fat and the skin thick, it will be better for him to pick up a fold of it transversely to the axis of the tumor (Plate II., Fig. 4), between the thumb and fingers of his left hand, whilst the assistant raises the opposite end of the fold in a similar manner (Plate XLIV., Fig. 4), and thus keep the integuments elevated from the subjacent parts. Then puncturing this fold in its middle, with a bistoury, incise it by cutting from within outwards, or the reverse, so as to expose the fascia superficialis to the full length of the proposed incision; or if the cut, as thus made, is not long enough, then extend it at its angles by raising the sides of the incision in the same manner. After exposing the fascia, the distinctive characters of each of the subjacent layers may or may not be readily made out, according to the changes that have been created in the part by the complaint. To guard against error, the subsequent layers should, therefore, be picked up with the forceps, so as to form a little fold at the most prominent point of the tumor (Plate XLIV., Fig. 5), and this being nicked by pressing the scalpel against it, whilst the surface of the blade lies flat upon the tumor, an opening may be made and a director passed into it so as to enable the operator safely to slit up the layer both above and below to the extent that may be desired. Next, picking up another layer in the same manner, treat it likewise (Plate XLIV., Fig. 6), and proceed to divide the laminæ until the contents of the tumor can be distinctly felt, or perhaps indistinctly seen beneath the serous layer or sac, the latter being more or less thickened, according to circumstances, although it never presents the shining appearance of peritoneum on its outside, owing to the changes produced by the complaint. In the division of each layer, attention should always be given to its appearance, and especially to the presence of muscular fibres, as these will generally show the position of the cremasteric lamina, and serve as a most important point of reference. On reaching the last layer, or that which is believed to be the sac, pick it up with the forceps and rub it between the thumb and fingers of the left hand, so as to be sure that there is no other portion of structure included; nick it, introduce the director, and slit it up (Plate XLIV., Fig. 6), when the bowel or omentum will be fully displayed, the first presenting a

PLATE XLIV.

A VIEW OF THE OPERATIONS PERFORMED FOR INGUINAL HERNIA.

Fig. 1. The first step in Gerdy's operation for the radical cure of reducible Inguinal Hernia. 1. The needle, with an eye near the point, in the act of transfixing the integuments as inverted by the forefinger. 2. The first loop of the ligature. After Bernard and Huette.

Fig. 2. The second step in the same operation. 1. The needle about to form the second stitch. 2. The first loop as placed. 3. The second loop as drawn from the needle. After Bernard and Huette.

Fig. 3. The last step in this operation. Quills having been placed in the proper position, the ligatures have been tied upon them so as to retain the pouch of skin at the ring. 1, 2. The quilled suture. After Bernard and Huette.

Fig. 4. The first incision in Inguinal Hernia. A fold of the skin having been raised transversely over the tumor, is about to be divided by the scalpel from without inwards. It may be incised from within outwards with safety, if the integuments are very thick, or there is a deposit of fat in the cellular tissue. After Bernard and Huette.

Fig. 5. Mode of dividing the layers. A director having been introduced at the opening made by nicking the tissue, the scalpel or bistoury is passed along it so as to slit up each layer to a sufficient extent. After Bernard and Huette.

Fig. 6. Opening the Hernial Sac. 1. Forceps picking up a fold of the sac, and drawing it from the tumor. 2. The scalpel placed flatwise, and about to nick the portion thus raised. After Bernard and Huette.

Fig. 7. One mode of dividing the stricture. The forefinger-nail being passed beneath the stricture, the probe-pointed bistoury, wrapped to near its point, is passed flatwise upon the finger as a director, and its edge being turned up, the nick is made by bringing the handle (2) towards the hand (1), so as to give it a gentle rocking motion. After Bernard and Huette.

Fig. 8. Relations of the Intestine and Omentum in an Entero-epiplocele. 1. Intestine. 2. Omentum. 3. Director in the act of depressing the tumor so as to pass between the contents and the stricture. After Bernard and Huette.

Fig. 9. Mode of dividing the stricture upon a broad director, when the constriction is too tight to permit the passage of the finger beneath it. 1. The director. 2. The bistoury. After Bernard and Huette.

Plate 44.

Fig. 1.

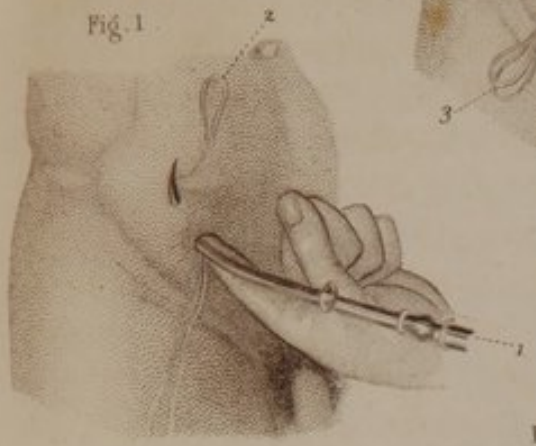


Fig. 2.

Fig. 3.

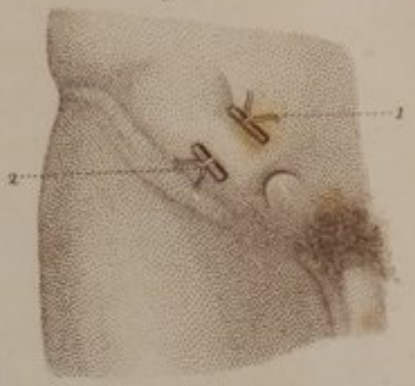


Fig. 4.

Fig. 5.

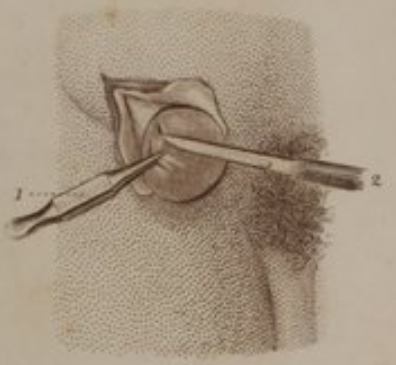
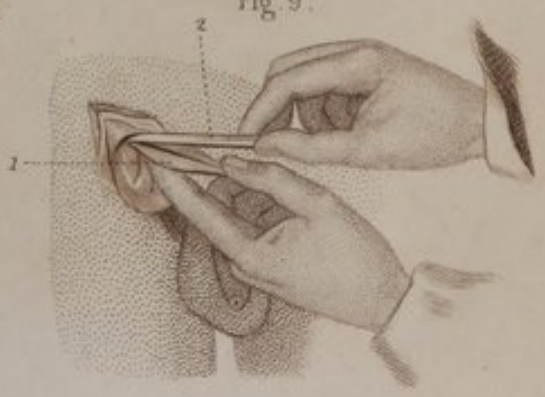


Fig. 6.

Fig. 8.

Fig. 7.

Fig. 9.



sort of doubling or knuckle, and being more or less of a reddish-brown or gray tint, and the latter looking not unlike a mass of fat and cellular tissue, or like the structure usually seen in front of the intestines when *in sitû*, unless it has been very much engorged by the constriction.

Having thus reached the contents of the tumor, it only remains to divide the stricture, the position of which, though varying somewhat, may generally be discovered by passing the forefinger into the wound in the line of the spermatic cord of the male, or of the round ligament of the female.

If the stricture is seated, as is often the case, at the neck of the sac, it may be felt at the external ring, or below it, or at the internal ring, the latter being, especially in old hernia, directly behind the external ring. Then, as it is sometimes difficult to tell whether the hernia has been direct or oblique, and, of course, whether the epigastric artery is on the outer or inner side of the neck of the sac, pass the forefinger as far up as possible, and endeavor to get the finger-nail between the constriction and the bowel, depressing the latter by bearing on it with the back of the finger, whilst an assistant also keeps it as much as possible out of the way, or the director may be substituted for the finger, if the stricture is very tight. With the probe-pointed bistoury, wrapped to within a few lines of its point, or with Cooper's bistoury (Plate XXXV., Fig. 16), and with the cutting edge of it rather dull than sharp, the operator may now free the stricture by passing the blade flatwise along the palmar surface of the forefinger, or along the groove of the director (Plate XLIV. Fig. 9), and carrying the point beneath the stricture, when, having accomplished this, it only remains to turn its edge *directly upwards*, so that it shall be parallel with the external margin of the rectus abdominis muscle. Then, depressing the handle, cause the edge of the blade to press a little against the sharp constricting border of the ring, so as to nick it (Plate XLIV., Fig. 7), or give the blade a gentle rocking motion, so as to repeat the cut, and when there is the least sensation of rending, turn the knife again flatwise, withdraw it, and endeavor to dilate the stricture by means of the finger, or endeavor to replace the intestine or omentum, if its condition is suitable, by making the taxis as before directed. If the nick of the stricture has not been sufficient, a similar manipulation of the bistoury may then be repeated until the opening is sufficiently enlarged to allow

the hernia to pass, though usually the ring will yield to pressure as soon as its thickened edge is notched.

After freeing the stricture, the condition of the contents of the tumor should be attentively examined, before attempting either its restoration or the dressing of the wound, and it is especially important that the operator should see that the stricture is not continued by the neck of the sac, or by a cord of omentum, &c., as is sometimes the case, and an instance of which is related by Dr. Parrish.[1] If there are one or more small and pea-like spots, which present the appearance of positive sphacelation, these points should be picked up in the forceps, and tied by encircling them with a fine ligature, which, after being cut off close to the knot, should be left upon the part, and returned into the abdomen with the intestine, when, by ulcerating through the coats of the latter, they will be discharged per anum, whilst the opening that would otherwise have resulted, will be filled with lymph, as the result of the inflammation thus excited. But if the sphacelus is more extended, say half an inch, then it may be advisable to attach the coats of the bowel to the side of the wound by a suture lest the intestine escape into the cavity of the abdomen, and the separation of the slough give rise to peritonitis. If fastened in the wound, the sloughing of the bowel can only produce an artificial anus, the healing of which will often be accomplished by nature, or may be effected by some of the means hereafter directed. Many experienced surgeons have, however, regarded the use of this suture with distrust, Dessault and others having shown that the inflammation which preceded the gangrene caused sufficient effusion of lymph to retain the bowel at the neck of the sac:[2] the resort to the stitch is, therefore, a rare event.

Should the contents of the tumor be omentum instead of intestine, and the strangulated portion of the former have become sphacelated, then the mortified part should be ligated, and the portion beyond the ligature cut off, the remainder being left as a plug in the opening, after which the dressing may be made as before directed.

Dressing.—If the operation has been promptly done, and the intestine is simply congested, the middle and upper angle of the integuments should be united by a point or two of the interrupted suture, leaving the sac in its place, a morsel of lint being introduced

[1] Parrish on Hernia, p. 147.

[2] *Ibid.*, p. 104.

into the lower angle of the wound to prevent the skin healing, and also to preserve a vent for the subsequent suppuration. The adhesive strips, cerate, compress, and spica bandage being now applied, the patient should be carefully placed in bed, the thigh being flexed on the pelvis by folding a pillow, and placing it beneath the ham.

AFTER-TREATMENT.—When the parts have been returned into the abdomen, and freed from the constriction, it generally happens that the circulation is restored, and the structure resumes its original condition. But, in some instances, inflammation is developed, and general peritonitis follows the operation. Under these circumstances, an active and appropriate medical treatment will be essential to the preservation of the patient. When this is not the case, and there is no reason to apprehend perforation of the bowel, it will merely be necessary to administer a laxative enema, or some mild purgative, as castor-oil, or rhubarb and magnesia, on the second day, the patient being compelled to keep in bed, and use a bed-pan or some other convenience, when it operates, the diet during the first week being strictly restricted to light and farinaceous articles. When three or four days have elapsed after the operation, the condition of the wound may be inspected, and its subsequent treatment regulated by the general principles applicable to the cure of wounds; but when suppuration is established, the diet should be increased to such meats as are easy of digestion, the patient being confined to the supine posture until the part has healed sufficiently to bear the pressure of a light truss over the compress and bandage.

§ 4.—GENERAL REMARKS ON THE OPERATION OF HERNIOTOMY IN STRANGULATED INGUINAL HERNIA.

In the account just furnished of the operation required for the relief of strangulated inguinal hernia, the effort has been made to limit the description to such details as are most frequently demanded. Several complications have, therefore, been intentionally omitted, lest reference to them should tend to embarrass the mind of the young surgeon, and render the operation unnecessarily difficult. A few of them may however be briefly mentioned, as illustrative of the difficulty occasionally met with. Among the most common of the complications for strangulated hernia, are those which are due to the changes that take place in the sac; thus, the sac may be con-

cealed by coagulated blood, especially when the taxis has been employed violently for a long period; or the distinction between the sac and the intestine may be rendered difficult by their close adhesion, or by the presence of gangrene; or the cellular tissue outside of the sac may be heavily charged with fat, so as to add very materially to the thickness of the covering of the hernia. In one case, I estimated the thickness of the tissues through which I cut at half an inch, before I found the sac. At other times the testicle has been found involved in the tumor, or hydatids have been formed in the sac, or the omentum has been forced out and strangulated by a cancerous tumor of the mesentery. Sometimes there have been two sacs; sometimes a very large amount of serum, and a very small portion of intestine, &c. &c. In fact, every possible variety or departure from the normal relations of the parts, or those usually given by anatomists, in their account of the position and appearance of this region in the healthy condition, will be met with in operating. It should, therefore, be remembered that all hernias are liable to peculiarities, arising either from the duration of the complaint, the size of the tumor, the peculiar habit of the patient, or the means employed in the treatment (as violent taxis), or from the existence of other diseases, as hydrocele, or from the hernia being congenital, or from adhesions, or from the formation of bands at the mouth of the sac: but an examination of any of the valuable monographs that have been presented on this complaint, will soon enable any medical man who contemplates the possibility of performing this operation, to obtain a knowledge of these peculiarities. I must now pass them by. Little has also been said of the appearances of the parts under different degrees of strangulation, as these, together with many similar points, would have extended this account beyond its proper limits. Let it, therefore, suffice to say that, in every case where the experience of the operator has not been sufficient to qualify him for contending with such difficulties, he should, if possible, obtain the advantages of a consultation with some older practitioner. To be able to anticipate every peculiarity that may be met with in these cases, requires a combination of fortunate circumstances that none but those who have been widely engaged in surgery, or enjoyed the observation afforded by following the cases in large hospitals, or in the practice of old surgeons, can obtain. But, as a general rule, the well-educated practitioner will not err in the treatment of strangulated hernia, if he opens the various layers

cautiously, divides the stricture only so far as will relieve the obstruction to the circulation of the part, and does not restore the contents of a hernia into the abdomen before he is certain that its circulation is being restored, as may be told by its brighter or more natural color, a livid or ash color usually indicating a tendency to sphacelus. The division of the stricture without opening the sac, has been sanctioned by Mr. Key, Liston, Gay, Teale, Luke, and many of the English school who have reported very favorably of it; thus, Teale reports 32 cases operated on without dividing the sac, of which 27 recovered; and Mr. Gay reports[1] 125 operations in which the sac was not opened, and of these 73 recovered; whilst in 73 in whom it was opened, 13 died. The dangers likely to result from reduction in mass, should however be remembered as militating against the advantages of this mode of operating, and the propriety of it, as an operation to be adopted by an inexperienced surgeon, is deemed by many others a matter of doubt. Thus, Chelius[2] says "that the mode of operating in which the hernial sac is not at all opened, is in general to be rejected, or specially confined to cases in which it is certain the strangulation is seated in the abdominal ring, as in a recently produced, or very large rupture." Sir Astley Cooper, though advising this practice in large ruptures, after dividing the stricture at the neck of the sac, does not recommend it as a general rule. Lawrence prefers opening the sac, and Mr. South[3] does not think any great advantage gained by not opening the sac, as he coincides with Mr. Lawrence in the opinion that the peritonitis originates in the congestion near the seat of stricture, and that its dangers are not enhanced by the incision made into the sac in the restoration of hernia. The greatest objection to it is the risk that is always run of reducing the hernia "in mass," when, if strangulated by the neck of the sac, death will probably ensue. The subcutaneous division of the stricture, as advised by Guerin, is, in my opinion, a dangerous and uncertain operation, as stated by Mr. South, and only to be thought of in ruptures with recent strangulation from the ring. In strangulation by the sac, it is not applicable. It has, however, been accomplished in recent cases of strangulation at the external ring by Dr. Pancoast, of Philadelphia.[4]

[1] Brit. and For. Med. Chirurg. Rev., No. IV. p. 167.

[2] Chelius's Surgery, by South and Norris, vol. ii. p. 303.

[3] *Ibid.*, p. 307.

[4] Trans. Am. Med. Assoc., vol. iii. p. 373, 1850.

§ 5.—STATISTICS.

In order to present some idea of the usual results of this operation, the following cases have been selected from various sources, and arranged so as to readily indicate the result.

STATISTICS OF HERNIOTOMY IN STRANGULATED INGUINAL HERNIA.

			CURED.	DIED.	ARTIF. ANUS.
South[1]	reports	8 cases.	6	2	
Astley Cooper[2]	"	11 "	8	2	1
Geoghegan[3]	"	3 "	2	1	
Lawrence[4]	"	9 "	5	4	
Brand[5]	"	2 "	1	1	
Percival Pott[6]	"	1 "	1	0	
Scarpa[7]	"	7 "	6	1	
Richter[8]	"	1 "	1	0	
		42	30	11	1

From this it appears that, out of forty-two cases of strangulated inguinal hernia, which were operated on, more than two-thirds recovered.

CHAPTER XVIII.

FEMORAL OR CRURAL HERNIA.

FEMORAL or Crural hernia is that form of rupture in which the protrusion occurs at the anterior inferior portion of the abdominal parietes, or at those points where the external iliac vessels pass from the cavity of the pelvis under Poupart's ligament. On reaching this

[1] Chelius, by South, vol. ii. p. 312.
[2] Treatment and Anat. of Inguinal Hernia.
[3] Commentary on Treatment of Ruptures, by Ed. Geoghegan.
[4] Treatise on Ruptures.
[5] Chirurgical Essays.
[6] Treatise on Ruptures.
[7] Treatise on Hernia; also Arnaud.
[8] See Scarpa.

point, a hernia will generally follow the course of the sheath of the femoral vessels and then pass out at the opening of a superficial vein (vena saphena), till, reaching the exterior surface of the aponeurotic expansion which covers the muscles of the thigh (fascia lata femoris), it takes a position a little below the line of the groin. The contents of this tumor, like that described in the preceding chapter, may be either intestine or omentum, the latter being the least common, though, from the position of the cæcum, a portion of the large intestine has occasionally been found in the sac on the right side, and in one case, reported[1] by Dr. Van Buren, of New York, even on the left side, instead of the smaller bowels, as was the case in inguinal hernia. Femoral hernias are most common in females—are usually smaller than inguinal tumors—are always found beneath, and not above, the line of Poupart's ligament—spread sideways as they increase, and have their greatest diameter to correspond with the oblique line of the groin.

SECTION I.

ANATOMICAL RELATIONS OF FEMORAL HERNIA.

The boundaries of the region concerned in femoral hernia, are formed posteriorly by the iliacus internus and psoas magnus muscles, covered by a condensed fascia, which, as it follows the course of the first named muscle, is hence called the iliac fascia. Anteriorly, we find the portion of the tendon of the external oblique muscle of the abdomen (Poupart's ligament), which extends from the anterior superior spinous process of the ilium to the horizontal portion of the pubis, where it is attached by a broad insertion, the exterior edge of this insertion (Gimbernat's ligament), forming the boundary of the opening for the passage of the femoral vessels (femoral or crural ring). The attachment of the anterior parietes of the abdomen to Poupart's ligament, and the continuity of these parts with the fascia of the thigh, constitute the remainder of the structures forming the front of this region. Of these, the extra-peritoneal fascia (fascia transversalis), in its course behind the abdominal muscles, is brought so closely in contact with the fascia covering the iliac muscle, as to adhere to it, the two (iliac and transversalis fascia) sending a pro-

[1] See Bibliographical Index, p. 106.

longation of their structure upon the course of the femoral vessels, and thus forming the commencement of their sheath. As the abdomen is a considerable cavity, and the space occupied by the escape of the femoral vessels a long and narrow one, the relations of these parts has been compared to that of a funnel, of which the abdomen forms the body and the course of the femoral vessels the spout, whilst the extension upon the vessels of the process of the iliac fascia behind and of the fascia transversalis in front, has given to the portions of these tissues which surround the vessels, the name of "infundibular fascia." It will, now, be readily seen that, as Poupart's ligament forms an arch in stretching from the anterior superior spinous process of the ilium to the pubis, there would be a considerable space between it and the bones (Plate XLV., Fig. 1), were it not filled up by the iliacus internus and psoas magnus muscles, and their fascia. These parts, by diminishing the distance between the anterior spinous process and the pubis, leave merely an opening for the vessels (crural ring), which is bounded behind and externally by the iliac muscle and fascia, internally by Gimbernat's ligament, and anteriorly by the fascia transversalis, as well as by the under edge of the tendon of the external oblique (Poupart's ligament). This opening, thus circumscribed, and giving exit to the femoral or crural vessels, is, therefore, correctly designated as the "femoral opening or ring," and is the point through which a communication is established between the thigh and the cavity of the abdomen. In health, the adhesions of the surrounding parts, together with the cellular substance and lymphatic glands, close it entirely; but the action of any of the causes which would force the abdominal contents towards this point, may cause these adhesions to yield, and then the following results may be noted. The abdominal contents being behind the peritoneal sac, must, in their course outwards, press before them first a portion of the peritoneum (hernial sac), then the cellular tissue of the opening, or the extra-peritoneal cellular tissue (fascia propria), in which are found the small vessels and deep lymphatic glands of the part, and when the tumor thus formed escapes from the abdomen into the course and sheath of the femoral vessels, it has no other covering except the integuments. As the psoas and iliacus muscles are on the outer side of the vessels as they pass beneath Poupart's ligament (crural arch), the tumor naturally tends towards the pubis (Gimbernat's ligament), and is, therefore, usually found on the pubic side of the vessels, the femoral vein

being next to it, and the femoral artery outside of the vein. (Plate XLV., Fig. 4.)

If the sheath of the femoral vessels was perfect, the tumor would continue to be covered by it, but in order to admit lymphatic vessels and the superficial veins, this sheath is perforated at numerous points (cribriform fascia), through which the tumor, by gradual distension, is enabled to escape. Here again the hernia would continue to be covered by the fascia lata of the thigh, were it not that the latter is so arranged as to permit the saphena vein to pass beneath it and join the femoral vein, and at this point (saphenous opening), where this vein enters, the tumor escapes (Plate XLV., Fig. 3), and thus getting outside the fascia lata, lies directly beneath the fascia superficialis and skin of the thigh, at a point close to, but below the line of the groin, or Poupart's ligament. (Plate XLV., Fig. 4.)

In the minute anatomical examination of femoral hernia, the peculiar arrangement by which the saphena vein gets through the fascia lata femoris has received considerable attention, and unfortunately been named in every possible point; thus, though all the muscles of the thigh are covered by the fascia lata, the portion of it over the sartorius muscle has been designated as the Sartorial Fascia, whilst that over the pectineus muscle is called the Pectineal Fascia. The sartorius muscle being also above the level of the pectineus, the portion of the fascia lata covering it is compelled to double itself and take the form of a crescent, in order to expand upon the pectineus muscle, and this crescentic margin has, therefore, been named by Mr. Burns "the Falciform Process" of the fascia lata, whilst the extreme point of the horn or crescent has received the appellation of "Hey's ligament." An ordinary observer will often fail to notice these points, but a close dissection, and removal of the loose cellular tissue, with some traction from the knife-handle, will make them and many other little details perfectly apparent to any one who will look for them.

From the looseness of the cellular tissue between the fascia superficialis and the fascia lata femoris near the pubis, this hernia is most apt to rise upwards towards the groin, instead of following the downward course of the saphena vein, and it therefore approaches the outer and lower edge of Poupart's ligament.

The relations of the different parts in this region are usually simple. At the crural ring, counting from the outside of the pelvis

(anterior inferior spinous process), there is first the femoral artery, then the femoral vein, then the hernia, and lastly, Gimbernat's or Hey's ligament, the two being closely attached to each other. At the point where the external iliac artery becomes femoral, or directly beneath Poupart's ligament, we also usually find the epigastric artery, which consequently is at the outer margin of the hernial tumor, or above it.

The Obturator artery arising from the internal iliac, gets out of the pelvis at the thyroid foramen, and, sending a branch to the pectineus and adductor muscles, may, therefore, be at the inner side of the tumor, whilst the internal circumflex, if it should arise from the epigastric, would be in front of it. These arteries have, however, sometimes arisen by a common trunk, and passed anterior to the sac before they divided.[1]

Such an arrangement is, however, very rare, the usual relations of the vessels to the tumor being such as present the femoral vein outside, the epigastric artery also outside, but a little nearer to Poupart's ligament, and the obturator artery inside, or near the edge of Gimbernat's ligament. In twenty-one preparations of crural hernia, Sir Astley Cooper found the obturator artery passing into the pelvis on the *outer* side of the neck of the sac, and therefore entirely out of the risk of injury. "The femoral vein runs on the outer side of the sac, about half an inch from the centre of its orifice. Half an inch beyond the vein and exterior to it is the centre of the External Iliac artery. The Epigastric artery arises from the external iliac, about three-quarters of an inch from the centre of the sac, and, as it passes forwards and upwards, it approaches this point about a quarter of an inch nearer." The spermatic cord, or the round ligament, passes about half an inch anterior to the mouth of the hernial sac, being first situated on the outer side, and afterwards crossing its forepart.[2] The division of any stricture at these parts should, therefore, be made very slightly, but directly upwards, and at the middle of the ring, especially in males, because the position of the structures at the inner and upper side of the ring might, in any other incision, expose the spermatic cord and vessels to the edge of the knife. Women being, however, by far more subject to this form of hernia than men, the division of the stricture upwards, and a very little in-

[1] Cooper on Hernia. [2] *Ibid.*

wards, may be practised without injuring any artery, unless the obturator is very peculiarly placed. But as variations are occasionally found in the arrangement of all the vessels near the seat of stricture, it is the safer plan to proceed cautiously, and feel, if possible, with the finger, the portion to be nicked, or the tissues around it, before making any incision at the ring.

SECTION II.

OPERATIONS FOR THE RELIEF OF STRANGULATED FEMORAL HERNIA.

The operations for the relief of strangulated femoral hernia, like those described in the other forms of hernia, consist in the Taxis, in those attempted for the radical cure, as in the operation of Jameson, quoted in the Radical Cure of Inguinal Hernia, p. 129, and in the division of the stricture, or herniotomy.

§ 1.—TAXIS IN FEMORAL HERNIA.

The general details of the performance of the taxis having been already given in connection with inguinal hernia, it is only necessary at present to refer to the peculiar direction in which these efforts should be made.

The greatest diameter of the tumor in femoral hernia being transverse, in consequence of the development of the subcutaneous cellular tissue of the part, permitting the tumor to expand more readily towards the anterior inferior spinous process of the ilium, than in any other direction, it is generally requisite to resort to a peculiar manipulation and position of the patient in order to favor this operation. Thus, on flexing the thigh on the pelvis, whilst the patient is in the recumbent position, Poupart's ligament, or the front of the crural ring, will be made less tense in consequence of the weight of the viscera not being thrown upon the abdominal parietes; whilst the psoas and iliacus muscle will be less apt to compress it from behind. By adducting the limbs or carrying the affected limb a little towards that of the other side, and by turning the toes of the foot on the hernial side very much inwards, the sartorius, pectineus, and adductor muscles will be relaxed, and the parts about the saphenous opening and Hey's ligament placed in as

favorable a position as possible. Therefore, when the patient is thus placed, and well etherized, it only remains for the surgeon to press the tumor gently downwards and inwards, in the line of the saphena vein, in order to free the hernia from the projecting edge of the falciform process of the fascia lata, or that portion which, after covering the sartorius muscles, is extended towards the pubis in order also to cover the pectineus muscle, and then, with the fingers of the other hand, to push it upwards in the line of the femoral vessels. (Plate XXXIX., Fig. 7.) The tightness of the parts through which femoral hernia passes, and the sharp edge of the constricting part, renders, however, every case of this kind of hernia much more dangerous than that of the inguinal region, and strangulation therefore usually supervenes much more rapidly. Less effort should also be made in the taxis of this form of hernia than in the preceding class, and when the tumor does not readily yield to the judicious application of the means before mentioned, the operation of herniotomy should be promptly resorted to in order to divide the stricture.

§ 2.—TRUSSES IN FEMORAL HERNIA.

The directions for the application of a truss for the retention of a femoral hernia do not differ materially from those already furnished in connection with all classes of hernia, and detailed in the general account of them.[1] Every truss should possess the characters there given, and be applied on the general principles there laid down. As the shape of a pad for femoral hernia differs, however, from that required in the inguinal class, it may prove useful to call attention to the variations noticed between these two kinds of trusses. In the truss for femoral hernia, as the spring has to go round the pelvis in the same position which it occupied in inguinal hernia, whilst the seat of the protrusion is somewhat lower in the groin, and also a little more outwards, it becomes necessary either to bend the point of the spring more downwards and outwards, or to attach the pad to it by means of a different shaped neck. As femoral hernia also protrudes beneath Poupart's ligament, whilst the inguinal variety was found above it, the force which acts upon the femoral

[1] Page 103.

pad must be applied more directly upwards. The femoral pad should, therefore, be so shaped as to fill in the depression in the line of the groin as well as adapted to the inequalities of the thigh between the pectineus and sartorius muscles. With a pad formed as directed for inguinal hernia, but with its long diameter rather vertical or oblique than transverse, and so attached to the spring that it will press more directly upwards than backwards, the thigh strap may be dispensed with and the hernia retained with much less difficulty than in inguinal hernia, as there are in this spot less bony inequalities than are found nearer to the pubis.

The radical cure of femoral hernia by an operation has seldom been attempted, owing to the proximity of the femoral and epigastric vessels, as well as the other peculiarities of the sac, &c., in this region.

§ 3.—HERNIOTOMY IN STRANGULATED FEMORAL HERNIA.

As the tumor in femoral hernia is formed by the sac and its contents escaping at the saphenous opening, and then rising up towards Poupart's ligament, it usually presents itself a little below the line of the groin. In order to expose its contents, various modes of proceeding have been recommended, all based on the general direction of incising the integuments in a line parallel with the great diameter of the tumor. In the external incision, this direction has been slightly modified by different surgeons; thus, Sir Astley Cooper advised that the skin, after being shaved, should be cut directly over the middle of the tumor in a line nearly corresponding with the line of the groin, the incision being extended from the groin to a point a few lines below the lowest part of the tumor, either by picking up a fold of integument and dividing it with the bistoury by transfixing it, or if the tumor was so large as to render the skin tense and difficult to raise, by incising it with the scalpel as in an ordinary dissection. When the tumor is small, or not larger than an egg, a single incision may suffice to open the skin over it, but in larger protrusions, or in those found in corpulent patients, it will be better to make a transverse cut at the base of the first, like a reversed ⊥, so as to dissect off the two flaps laterally. The saphena vein being behind and at the outside of the tumor, is not likely to be involved in this manner of operating.

PLATE XLV.

PARTS CONCERNED IN THE OPERATION OF FEMORAL HERNIA.

Fig. 1. Position of Crural Ring and attachment of Poupart's Ligament. 1. Anterior superior spinous process. 2. Ilio-pectineal ridge. 3. Femoral ring. 4. Septum between femoral vessels and iliac muscles diminishing the size of the crural arch. 5. Poupart's ligament. 6. Anterior inferior spinous process. After Bernard and Huette.

Fig. 2. A view of the relations of the Superficial Fascia to Femoral Hernia. 1. External oblique muscle. 2. Its tendon cleared of the fascia. 3. Fascia lata femoris. 4, 4. Superficial femoral fascia everted. 5. Cribriform structure for transmission of lymphatics. 6, 6. Superficial vessels. After Bernard and Huette.

Fig. 3. A view of the deeper seated parts of the same region. 1. External oblique. 2. Its tendon. 3. Fascia lata. 4. Its cribriform structure raised up. 5. Sheath of vessels. 6. Femoral artery. 7. Femoral vein. 8. Saphena vein. After Bernard and Huette.

Fig. 4. Positions and relations of a Femoral Hernia. 1. Integuments of abdomen. 2. Tendon of external oblique. 3. The muscle. 4. Spermatic cord. 5. Femoral artery. 6. Femoral vein. 7. Intestine protruding at saphenous opening. 8. Hernial sac. 9. Sartorius muscle. 10. Pectineus muscle. After Bernard and Huette.

Fig. 5. Position of a Double Hernial Sac. 1, 1. Ring. 2. Fundus of principal sac. 3, 3. Cavity of peritoneum. 4. Fundus of second sac. After Bernard and Huette.

Fig. 6. Commencement of the formation of an Artificial Anus, showing the relations of the Mesentery to the protruding knuckle. 1. Ring. 2. Intestine. 3. Mesentery. After Bernard and Huette.

Fig. 7. Relative position of the Vessels in Inguinal and Femoral Hernia. 1. Tendon of external oblique. 2. Poupart's ligament. 3. Psoas and iliacus in course to their insertion. 4. Femoral artery. 5. Femoral vein. 6. Spermatic cord. After Bernard and Huette.

Fig. 8. A posterior view of the reflections of the Peritoneum upon the Abdominal Parietes. 1. Bladder. 2. Reflection over round ligament of bladder. 3. Reflection over same on opposite side. 4. Reflection over urachus. 5. Position of indirect inguinal hernia. 6. Oblique inguinal. 7. Ventro-inguinal. 8. Femoral artery. 9. Femoral vein. After Bernard and Huette.

Plate 45.

Fig. 1.

Fig. 2.

Fig. 3.

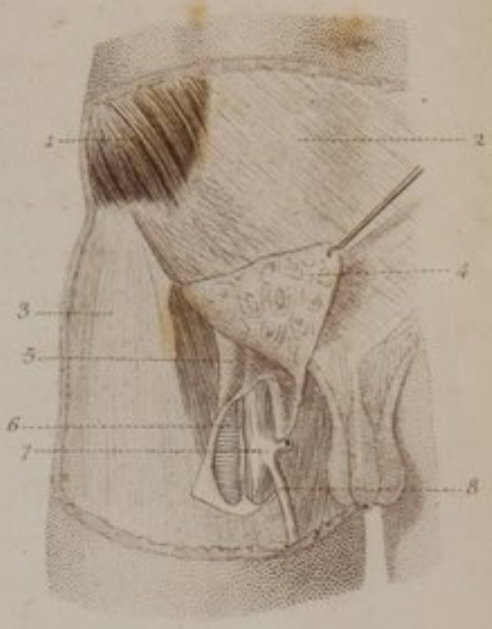


Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

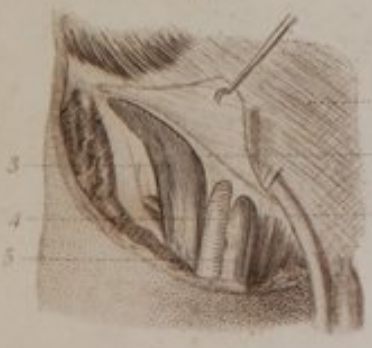


Fig. 8.

Pelletan and Dupuytren preferred a crucial cut for the division of the skin, and Mr. Lawrence one which, beginning an inch above the crural ring, ran obliquely downwards and outwards. After freeing the skin, the superficial fascia may be recognized by its containing several inguinal glands together with more or less fat, and from infiltration, or other causes, is often quite thick. In order to divide it, as well as the fascia propria, or in order to divide safely every structure between the skin and the sac, each layer should be separately elevated by the forceps, and the portion raised incised by placing the blade of the knife flat to the surface of the tumor, so as to nick its coverings. The director being then passed into the opening and beneath the layer, the probe-pointed bistoury should be passed along the groove of the instrument until the parts are laid open to near the same extent as in the first incision. On reaching the sac, which may usually be recognized by the characters spoken of in connection with inguinal hernia, it should be cautiously raised at the more depending portion of the tumor, where the liquid usually found within it naturally gravitates and separates the peritoneum from the intestines; but as the amount of fluid in the sac in femoral hernia is much less than that found in the inguinal variety, more caution is requisite, because the sac being much nearer to the contents of the tumor, the latter are more liable to be wounded. A nick being now made in the portion raised in the forceps, a director should be introduced, and a bistoury carefully passed along it, so as to open the sac freely in a manner similar to that pursued in the division of the other layers. On exposing the contents of the tumor, pass in the forefinger of the left hand and feel for the seat of stricture, which may generally be found as a sharp and defined edge near the interior and inferior portion of the circumference of the ring, or at the points corresponding with Hey's ligament (point of crescentic edge of falciform process of the fascia lata femoris), or at the saphenous opening, or, deeper and higher in the wound at the seat of Gimbernat's ligament. On finding the stricture, pass the point of the probe-pointed bistoury beneath it, in the manner directed for the same step in inguinal hernia; or, if the stricture is so close as to prevent the use of the forefinger, resort to the director found in the pocket-case, or to a spatula; and thus protecting the bowel, get the bistoury flatwise beneath the constricting margin, turn its edge up and nick the stricture very slightly upwards, if it is introduced at the middle of

the ring; or upwards and a little inwards, if the nick is to be made at its inner margin. But the best direction for dividing the stricture has been a point on which the surgeons have often differed. Mr. Lawrence states that Dupuytren and Richerand preferred an incision upwards and outwards; Gimbernat advised the nicking of the edge of the ligament named after him; and Mr. Hey the incisions of the most interior part of the stricture.

In order to comprehend these different opinions on a point which it might be supposed would be certainly settled by daily observation, the varying course of the obturator and epigastric arteries should be recollected, as well as the tendency in all operators to insist upon the observation of certain fixed rules, which are often predicated only on their own modes of demonstrating the anatomical relations of the part. As the stricture may generally be overcome simply by pressure, after its thick sharp edge has been nicked, to speak of the cut that is produced by the edge of the bistoury as a division, is liable to mislead, as the so-called division of the stricture is, in most cases, only a notch in its edge, which is intended to facilitate such subsequent laceration as will permit the restoration of the contents of the tumor. The use of a dull bistoury, and the direction of its edge upwards for merely a line, at several points of the ring, as advised by Velpeau, no matter in what portion of the circumference of the ring the stricture is most marked, will suffice for the relief of the constriction, as may be readily tested on any subject.

The stricture being divided, the condition of the contents of the sac should be inspected and treated as directed for inguinal hernia, after which, the wound should be closed by a suture, adhesive strips, cerate, compress, and bandage, and the patient dieted as before directed.

§ 4.—GENERAL REMARKS ON FEMORAL HERNIA.

Femoral hernia, from its peculiar position, is liable to mislead the surgeon in his diagnosis, and also to confuse him in operating, in consequence of the changes produced by various causes in the surrounding inguinal glands and vessels. Buboes, aneurism, hydatid cysts, foreign bodies, as needles,[1] psoas abscesses, or one

[1] Mott's Velpeau, vol. iii. p. 691, note by Townsend.

or more sacs, or the retention of the hernia in the sheath of the femoral vessels, and its being covered by the fascia lata, are all cases that have been recorded, and may, therefore, reasonably be expected to present themselves again. The frequency of the position of the obturator artery on the front or inner side of the tumor at the seat of stricture, as is the case when it arises from the epigastric artery, is quite marked, it having been found by Mr. Cloquet, after examining two hundred and fifty subjects, one-half of which were females, to be thus situated about once in every three cases.[1]

Owing to these circumstances, the operation on this class of hernia is usually regarded as more dangerous than that performed for the relief of strangulated inguinal hernia; but with the anatomical knowledge that should be possessed by every surgeon, and with proper caution and coolness, the operation cannot be considered as an especially difficult one. With a patient in a state of anæsthesia there need certainly be no haste, even if the operator should deem it right under other circumstances; and if the incisions are slowly and cautiously performed, they will doubtless be safely done. Should a severe hemorrhage result, which cannot be traced directly to a wounded vessel, the introduction of a small linen sac into the crural ring, and the subsequent stuffing of it with lint or cotton, so as to press like a finger on the bleeding point for a few days, as advised by Boyer,[2] may suffice to arrest it.

§ 5.—STATISTICS OF THE OPERATION OF HERNIOTOMY IN STRANGULATED FEMORAL HERNIA.

A reference to the subjoined table will prove that the operation for femoral hernia has certainly succeeded better than most surgical operations, and practice will probably satisfy any medical man that the difficulties of it have been much exaggerated.

[1] Lawrence on Hernia, p. 434.
[2] Velpeau, Méd. Opératoire.

STATISTICS OF THE RESULT OF HERNIOTOMY IN STRANGULATED FEMORAL HERNIA.

	CASES.	CURED.	DIED.
Gimbernat[1]	4	4	0
Lawrence[2]	6	6	0
Scarpa[3]	2	1	1
Monro, Sen.[4]	4	4	0
C. Bell[5]	1	1	0
	17	16	1

All but one of these operations were reported as successful.

CHAPTER XIX.

UMBILICAL HERNIA.

THE term umbilical hernia being generally applied to such protrusions of the abdominal contents as occur immediately in the neighborhood of the navel, as well as to those seen directly in the course of the vessels of the cord, there is a liability to error as regards the seat of this class of tumors, if the surgeon does not recall the difference shown in the structure of the part as seen in the infant and as found in the adult. This difference having been referred to in the general account of the complaint, need only be here briefly hinted at. In the infant, umbilical hernia may protrude either beneath the skin at the margin of the navel or a little further on along the cord, where it is usually surrounded simply by the envelops of the latter. In the adult, these vessels having been removed, and the surrounding parts firmly cicatrized, a hernia can only escape by distending some of the openings in the linea alba directly around this firm cicatrix, the appearances of

[1] New Method of Operating for Femoral Hernia, by Antonio de Gimbernat.
[2] Lawrence on Ruptures.
[3] Treatise on Hernia, by Antonio Scarpa.
[4] Observations on Crural Hernia, by A. Monro, Sen.
[5] Operations for Strangulated Hernia.

which must be familiar to every dissector. These openings being generally on one side of the navel, the point of protrusion is often situated near the superior portion of the circle. As the hernia tends to sink by its own weight, the opening into the abdomen will often be found enlarged and depressed, and thus lead a careless observer to think that the tumor has really escaped at the space left for the vessels of the umbilical cord, or below it.

SECTION I.

SURGICAL ANATOMY.

After the umbilical vessels have entered the abdomen of the fœtus at the opening left for them in the linea alba, the arteries run downwards towards the bladder, whilst the vein courses over to the right side along the free margin of the suspensory ligament, to enter the umbilical fissure of the liver where it terminates in the left sinus of the vena portarum. Like the other bloodvessels in the abdomen, the umbilical arteries and vein are on the outside of the peritoneal sac, and do not perforate this membrane; consequently, any protrusion of a viscus at this point must be covered by a layer of the peritoneum, and have, at least in its early stages, a perfect sac like the other hernia. The variety of opinions on this point, and especially those of the distinguished surgeons who have doubted the existence of a sac, may, therefore, all be explained by the fact that, under distension, the sac may be perforated, as related by Sir Astley Cooper, or gradually thinned or absorbed, as mentioned by Monro and others.[1]

The pressure of large and old hernias in the adult may also lead to a similar diminution in the density of the fascia superficialis abdominis, or even the skin; a case being related by Arnaud, "in which the bowel adhered so closely to the skin as to cause it to be cut in dissecting the parts after death."[2] No bloodvessels are situated near the course of a hernia in this region except it may be abnormal veins, as have been seen by Manec, Maniere, and Velpeau.[3]

As the opening through which umbilical hernias escape is alto-

[1] See Lawrence, p. 453.

[2] Lawrence.

[3] Velpeau, Méd. Opératoire, tome 3me.

gether in the linea alba, there is no umbilical canal, nor is there much liability to the production of a stricture at the neck of the sac.

SECTION II.

OF THE MEANS OF TREATING UMBILICAL HERNIA.

The treatment of umbilical hernias requiring that the contents of the tumor should be pressed into the abdomen as soon as possible after their escape, in order to facilitate the cure, the taxis may in reducible cases be readily accomplished by inducing a perfect state of anæsthesia, and then manipulating the tumor so as to bring it to the level of the ring, after which portion after portion should be restored by the action of the thumb and fingers, as described in the inguinal form of hernia, except that the contents of the tumor should here be pressed directly towards the spine, and then a little upwards, as the mouth of the sac is not in the centre of the tumor but a little above it. Having thus succeeded in entirely restoring the protrusion, it remains to decide whether it will be desirable to attempt only a palliative cure by the application of a truss, or resort to the more severe operation that has occasionally been employed in the attempts at a radical cure.

§ 1.—PALLIATIVE TREATMENT OF UMBILICAL HERNIA.

The truss that is employed for the palliative treatment of umbilical hernia, will differ somewhat according to the age of the patient. In infants, soon after birth, or within the first eighteen months, the application of a compress formed by firmly wrapping a cent or dollar in linen so as to form a pad, and confining it to the part by the ordinary flannel bellyband, or by adhesive strips, is all that is requisite; but in the adult the application of the ordinary umbilical pad and truss of the shops will answer, the structure of the pad being of less consequence in this form of hernia than in the preceding varieties. If the hernia is large, it will prove useful to add the ordinary laced bandage of the abdomen to the use of the truss, in order to support the abdominal parietes more thoroughly, and prevent the lateral separation of the linea alba. This separation is sometimes so great, that in one female subject that I

dissected, the linea alba was open from near the pubes to half-way between the ensiform cartilage and umbilicus, the umbilical ring being nearly three inches in diameter, and the intestines supported only by the skin and superficial fascia, the latter being very much thickened.

§ 2.—RADICAL CURE OF UMBILICAL HERNIA.

The radical cure of umbilical hernia has been often accomplished in the young subject, both by an operation and also by the use of the compress or truss. It should generally be attempted in every case of this form of hernia in children, because in adults the attempt is of very doubtful utility.

DESSAULT'S OPERATION FOR THE RADICAL CURE OF UMBILICAL HERNIA.—The child being laid on its back, with the thighs somewhat bent and the head inclined forwards, return the protruded viscera, and press upon the opening with one hand whilst you raise the sac with the other, so as to ascertain that no part remains unreduced; then, passing a waxed ligature several times around the base of the tumor, including both the integuments and sac as held in the fingers, secure each turn with a double knot drawn tight enough to occasion an inconsiderable degree of pain, and cover the tumor with lint, over which compresses are to be applied and secured by a bandage and shoulder-straps. In a day or two after the first ligature is applied, the shrinking of the parts will require the application of a second ligature, which should be tied considerably tighter, and even a third may become necessary after a few days. In eight or ten days the tumor (skin and sac) will slough off, and leave a small ulcer, which speedily heals; after which a truss or compress should be worn for several months. The probability of the cure diminishes with the age of the child, and in a girl nine years old it failed entirely, in Dessault's hands. In a case operated on by Dr. Jos. Parrish, of Philadelphia, the patient was cured,[1] though the slough of the integuments did not separate until the seventeenth day.

OPERATION OF DR. PHYSICK, OF PHILADELPHIA.—In large umbilical hernia, Dr. Physick proposed to effect a radical cure by

[1] Parrish on Hernia, p. 190.

opening the integuments by a crucial incision as far as the neck of the sac, and then opening the upper part of the sac so as to see its contents, reducing them, if possible, without dilating the ring; but when this could not be done, to divide the stricture outside of the sac. After reducing the contents, he suggested that a ligature should be drawn around the neck of the sac, with a view of closing its cavity.

REMARKS.—This operation, though proposed by Dr. Physick, was never performed by him, though Dr. Wistar is reported to have thus operated with success. In a case subsequently operated on by Dr. William Gibson, of Philadelphia, death, however, ensued.[1] Sir A. Cooper has succeeded by similar means in two cases;[2] but subsequently he, together with Scarpa, Benedict, Richerand, and others, rejected it on account of the pain and inflammation it created, as well as from the fact that pressure alone was generally able to accomplish the cure. In most cases of herniotomy in the adult, the application of a ligature around the neck of the sac should be omitted, and the restoration of the parts without opening the sac avoided, as this exposes the patient to death from internal strangulation, as was referred to in the restoration of hernia in mass.[3]

§ 3.—HERNIOTOMY IN STRANGULATED UMBILICAL HERNIA.

The existence of this complaint being rare, except in the cases of adult females, the description of the operation may be confined to this class of patients.

OPERATION.—The patient being placed in the recumbent position, and the proper preliminary steps taken, pick up a fold of the skin, if it is loose, and, rubbing it between the fingers, so as to be sure that no other tissue is included, incise it with the bistoury from within outwards, as before directed. But if, as is often the case, all the coverings of the tumor are evidently thinned, then the incision should be made in the line of the linea alba by light touches of the scalpel from without inwards, the size of the tumor regulating the selection either of a crucial, ⊤ or ⊥ incision. On opening and dissecting back the skin sufficiently to expose the part to a moderate extent, the remaining tissues, to wit, superficial fascia, fascia propria, and sac, or such of them as can be made out, should be most

[1] Gibson, Institutes of Surg., vol. ii. p. 129. Sixth edition.
[2] Lawrence, p. 489.
[3] See page 140.

cautiously divided, as detailed in the preceding classes of hernias, and any portion of the umbilical ring or opening in the linea alba, nicked to a sufficient extent by means of a director and probe-pointed bistoury, the intestine or omentum being then treated as circumstances may indicate, after which the flaps should be united and dressed as directed in femoral hernia.

Artificial anus, though rare, may occur at the umbilicus as elsewhere, and be cured solely by cicatrization, of which an example has been cited by Dr. R. G. Wharton, of Mississippi,[1] as occurring in a negro child a few days after birth. Amyand, Pelletan, Scarpa, and others,[2] have also seen this condition of the part in the adult, but there is greater difficulty in healing it at this point than elsewhere, owing to the adhesions of the intestine to the abdominal parietes, and the absence of a canal like that seen in the groin.

§ 4.—STATISTICS OF THE RESULT OF HERNIOTOMY IN STRANGULATED UMBILICAL HERNIA.

	CASES.	CURED.	DIED.
Lawrence	3	2	1
Scarpa	1	1	0
Dessault	3	3	0
	7	6	1

From this it appears that, out of seven cases operated on, only one died, and, though representing a small number, this is probably a correct estimate of, or at least an approximation to, the success of the operation in this form of hernia.

§ 5.—SUMMARY OF THE OPERATIONS FOR HERNIOTOMY IN THE THREE FORMS OF STRANGULATED HERNIA.

	CASES.	CURED.	DIED.	ARTIF. ANUS.
Inguinal	49	34	14	1
Femoral	17	16	1	
Umbilical	7	6	1	

On examining the total of the cases thus collected, it is seen that the cures in Inguinal Hernia were only about two-thirds of those

[1] Am. Journ. Med. Sciences, vol. vi. N. S. p. 256.

[2] *Opus citat.*, p. 487.

operated on; whilst in Femoral and Umbilical, all but two were cured. The explanation of this difference must be a matter of conjecture; but the facts, which have been carefully collected during an examination of the sources above mentioned, in the general references throughout the subject of Hernia, are those shown above.

§ 6.—FREQUENCY OF THE FORMS OF HERNIA.[1]

From a statement made by Mr. Lawrence, as based on the records of the London Truss Society for twenty-eight years, it appears that of about 84,000 patients, nearly 68,000 were males and about 16,000 females. Of these, 39,419 were inguinal hernia; 6,210 femoral; 2,775 umbilical; 413 ventral; and 4 obturator.

CHAPTER XX.

ARTIFICIAL ANUS.

ARTIFICIAL anus is the name applied to two distinct conditions of the body; in one of which an opening is formed by nature from the bowels through the skin, in consequence of the mortification resulting from a strangulated hernia; whilst in the other, the opening is made by the surgeon from the skin to the bowel, in order to give exit to such fecal contents as may have been prevented by various causes from escaping at the orifice of the rectum. As the occurrence of the artificial anus which results from strangulation of the intestinal contents of a hernia is the most frequent, and also that most directly connected with the preceding subject, it may properly receive the first consideration.

SECTION I.

ARTIFICIAL ANUS RESULTING FROM MORTIFIED INTESTINE.

PATHOLOGY.—When a portion of the intestine has been so strangulated at the seat of stricture as to lose its vitality and run

[1] Chelius, vol. ii. p. 263, note by J. F. South.

into sphacelation, the dead portion is sometimes so limited that nature can throw it off in the form of a slough, and thus leave the bowel defective in its parietes. In the effort of nature to separate the dead portion, sufficient inflammation is usually excited in the surrounding parts to glue the gut fast to the sides of the ring, through which it has been protruded, or to the abdominal parietes nearest to it; so that after the slough of the bowel has separated, the fecal contents pass directly outwards to the skin, where an ulcer is developed that may present either one moderate sore with a fistulous orifice, or numerous openings of the same character. When the point of a knuckle of intestine, like that found in the hernial sac, is the seat of the slough, the opening through the anterior intestinal parietes gives to the part the appearance of a double-barrelled gun, the septum between the two sections of intestine being composed of that portion of the gut to which the mesentery is attached. (Plate XL., Fig. 6.) But if, instead of a knuckle of intestine, it is the parietes of a straight portion of the gut which is opened, then there will be but a single tube. (Plate XL., Fig. 7.) When the opening in the integuments is large, there is also a tendency in the mucous coat of the gut to prolapse, in consequence of which a tumor formed by the everted mucous membrane is found at the orifice in the skin. The double-barrelled variety of artificial anus requires that the septum which separates the two ends of intestine should be removed, in order to allow the fecal contents to pass from one tube into the other, without escaping from the end of the upper barrel; but the single barrel variety, or that formed by a single piece of intestine, demands merely the closing of the opening in the parietes, in order to fit the gut for the transmission of its ordinary contents. The treatment of these two forms of the complaint is, therefore, quite different, the first demanding the closure of the orifice until nature can heal it, the second requiring the destruction of the septum, spur, or buttress found between the two compartments. Owing to the ulceration of the intestinal parietes extending each way, it occasionally happens that the anterior edge of the septum projects, and materially interrupts the regular course of the contents of the bowels. To relieve such cases, Dessault resorted to pressure, which was applied against the anterior edge of the septum, both in order to force it backwards, and also to compress it, tents and similar means being introduced through the external orifice.

Dr. Physick having noticed that the existence of the septum between the two tubes of a knuckle of that intestine in which the artificial anus existed was the great obstacle to the downward course of the fecal matter, decided to induce sufficient inflammation to glue together the adjoining peritoneal surfaces of the gut, and then, when they were adherent, to cut away the septum, which he did in the following manner:—

Operation of Dr. Physick, of Philadelphia.—Having, in January, 1809, passed a ligature through the septum in the intestine of Jno. Axillius, a patient in the Pennsylvania Hospital, and thus formed a loop, he drew the ligature moderately tight by tying it upon the anterior edge of the septum, allowing the thread to remain one week, so as to keep the two sides of the bowel in close contact. Then cutting away a portion of the septum at the point of union of the sides, so as to create a hole, and, stopping the anterior or external orifice, the feces resumed their natural channel, and the patient recovered.[1]

Operation of Dupuytren.—In 1813, Dupuytren resorted to the operation proposed by a German surgeon, named Schmakhalden, in an inaugural essay which he made public in 1798,[2] to wit, to cut through the intestinal septum by means of a ligature passed through it by a curved needle, when, traction being made upon the ligature, it gradually cut its way out in a longitudinal direction, as is the case in the treatment of fistula in ano. Finding that there was risk of the needle going beyond the protecting adhesions, and opening a portion of the tube communicating with the cavity of the peritoneum, Dupuytren resorted to pressure of the two peritoneal coats of the intestinal knuckle, in order thus to induce inflammatory action. To accomplish this, he invented an enterotome (Plate XXXV., Fig. 18), which acted like a pair of forceps, the blades of the instrument being closed by a screw in the handles, which he employed as follows: After placing the patient in the position for the operation of strangulated hernia, he exposed the two orifices of the intestine, by passing in two fingers or two female catheters, and turning them over each other; the resistance to their approximation indicated the position of the septum. Then taking one branch of the enterotome, he passed it along the sound to the depth of

[1] Dorsey's Surgery, vol. ii. p. 96; also, North Am. Med. and Surg. Journ., vol. ii. p. 269, in a paper by Benj. H. Coates, M. D.

[2] Velpeau, Méd. Opératoire, tome 4me, p. 149.

two inches or more, according to the projection of the septum, and let an assistant hold it whilst the other blade was introduced in the same manner and to the same depth into the other orifice. Then gently turning the screw at the handles, so as to compress the portion of intestine between the blades (Plate XL., Fig. 2), colicky pain supervened, but usually soon passed off, though each turn of the screw seemed liable to produce the same pain. As the length of the parallelism of the tube was increased, solid adhesion of the two sides was induced, and about the eighth day the instrument became movable and fell off, leaving a brown dry eschar in the wound, of the same length as the portion compressed by the instrument. When this separated, the remainder of the septum was felt as a hard and undulated ridge at each side of the opening, through which the passage of the feces was favored by the free use of enemata.[1]

After-Treatment.—After both the operations just described, the opening left in the integuments requires careful treatment, in order to favor its closure; and this may be attempted by the use of such means as will favor the healing of fistulous orifices generally, such as cauterization by the nitrate of silver, or sulphate of copper, or by compression, or by the quilled suture, or by anaplasty. In most cases, a certain amount of pressure upon the abdominal parietes near the seat of the opening will prove useful, and I have more than once seen great benefit derived from the application of a truss over a greased compress placed upon the ulcer, after cauterization by sulphate of copper.

Operation of Dr. J. R. Lotz, of Pennsylvania.[2]—An ingenious modification of the instrument and operation of Dupuytren has been made by Dr. Lotz, of New Berlin, Pennsylvania. His instrument consists of two blades with fenestra, each of which is about an inch long and a quarter of an inch wide, and surrounded by a solid rim about a line thick, the whole length of the instrument being about six inches, and its weight nine drachms.

Operation.—The two blades, being introduced separately, are to be brought together and closed by means of two screws, so as to preserve the parallelism of the blades, after which the plates may be gradually approximated or slackened, according as they induce

[1] Malgaigne, p. 428, Philad. edit.

[2] Am. Journ. Med. Sciences, vol. xviii. p. 367.

pain or nausea. On the third day after the introduction of the plates, the patient having continued comfortable, the portion of bowel compressed between the fenestra may be divided by means of a gum lancet, and an opening at once established in the septum at the point which corresponds with that existing in the blades of the instrument. The compression being now gradually removed, as it had been gradually applied, the instrument may be taken away, when the patient will be found to have a smooth, round hole, of about the dimension of an inch, with the sides of the bowel firmly adherent all round it.

Operation of Dr. J. Mason Warren, of Boston.—A female, aged thirty-four years, having an artificial anus to form after strangulation of a crural hernia of the right side, the feces, in a very liquid state, were constantly running out through two openings in the groin, and three in the posterior part of the thigh; the limb being drawn up nearly to a right angle with the body, and the whole thigh much enlarged and hardened. The skin was also thickened almost to callosity, and excoriated, and the openings were so small as hardly to admit a common director. To relieve this, Dr. Warren operated in the following manner:—

Operation.—After dilating the principal openings by sponge tents, applied very gradually, and continued for a month, the two ends of the intestine were discovered. A gum-elastic bougie being then passed into the upper orifice, and another into the lower, the two were made to penetrate a thick callous mass of integument, and then passed through the abdominal parietes for about an inch, when the septum or spur which separated the two ends of the bowel was encountered and with difficulty entered, being so closely applied to the abdominal parietes as to prevent the least passage of matter from the upper into the lower part of the bowel. As the intestinal ends seemed to lie parallel to each other, the exploring bougies made a very slight angle with each other.

Having now made sure of the position of the lower opening by the introduction of a director, the male branch of Dupuytren's enterotome was carried into the lower intestine, the director withdrawn, and the female branch readily introduced into the upper; but as the two parts of the instrument occupied nearly the whole caliber of the dilated passage leading to the gut, it was necessary to separate and loosen them, and this was found to be impossible,

as the jaws of the female portion would not allow of sufficient motion at the hinge to lock with the other blade.

This instrument was therefore withdrawn, and another, which was about two inches shorter than Dupuytren's, introduced; but this instrument, instead of having one blade received into a groove in the other, was serrated like polypus forceps for the space of three inches. The blades being now introduced and locked without difficulty were, therefore, at once brought together as tightly as the screw would permit. For a few hours the patient complained, but next day was free from pain; the fecal matter passed by the side of the instrument; warm water was injected daily into the wound to prevent any obstruction, and she also had an enema administered, to keep the lower bowel in action.

Three days after its application, the instrument came away, bringing with it a blackish slough two inches and a half long, four lines wide and about three thick, which had the impress of the teeth.

The finger being now passed into the orifice, readily distinguished an opening between the two ends of the intestine, corresponding in size to the slough, the edges of which were greatly thickened and fleshy, and unlike the delicate valvular septum which previously existed.

On the following day there was a discharge per anum; a compress was applied to the orifice of the wound, and the patient ultimately recovered.[1]

§ 1.—STATISTICS OF ARTIFICIAL ANUS.

According to Dupuytren,[2] the following is the result of his experience in artificial anus:—

Of forty-one cases treated by himself and others, thirty-eight were cured, and three died.

Of the thirty-eight cured, twenty-nine were radically cured in from two to six months, and the remaining nine continued to suffer from fistulous orifices, notwithstanding every effort to heal them. The mortality following the use of his enterotome was one in fourteen.[3]

[1] Am. Journ. Med. Sciences, vol. xvi. N.S. p. 116, 1848.

[2] Liston's Surgery, by Gross, p. 446.

[3] *Ibid.* Note by Samuel D. Gross, M D., Louisville.

PLATE XLVI.

A VIEW OF THE OPERATION FOR THE FORMATION OF AN ARTIFICIAL ANUS.

Fig. 1. A front view of the surgical relations of the Colon. 1. Integuments. 2. External oblique muscle. 3. Internal oblique. 4. Transversalis muscle. 5. Lower edge of the liver. 6. Distended cæcum. 7. Transverse colon. 8. Descending colon, with sigmoid flexure seen below. After Bernard and Huette.

Fig. 2. A posterior view of the parts concerned, as shown by removing the dorsal structures. 1. Peritoneum. 2. Kidney. 3. Mesentery. 4. Bowels. 5. Colon. 6. Spine. After Bernard and Huette.

Fig. 3. Littre's Operation for the formation of an Artificial Anus at the right groin. 1, 1. Outline of colon. 2, 2. Extent of inguinal incision in the integuments. 3. An instrument passed beneath the distended colon in order to bring it to the front of the wound. 4. The point of the bowel which is to be perforated. After Bernard and Huette.

Fig. 4. Amussat's Operation, or the formation of an Anus in the left lumbar region. 1, 1. Outline of descending colon. 2, 2. Incision in integuments. 3. Instrument placed beneath the bowel to render it prominent. 4, 4. Ligatures passed through the bowel in order to attach it to the sides of the wound before it is perforated. After Bernard and Huette.

Fig. 5. Shape and appearance of the Anus formed by Littre's Operation. The long diameter of the opening corresponds to the line of the groin, and the bowel is so attached to the edges of the incision in the abdomen as to prevent contraction of the orifice or the escape of the bowel into the abdomen. After Bernard and Huette.

Fig. 6. Appearance of the Artificial Anus formed in Amussat's Operation, showing the position of the sutures and the character of the opening. After Bernard and Huette.

Plate 46.

Fig. 1.

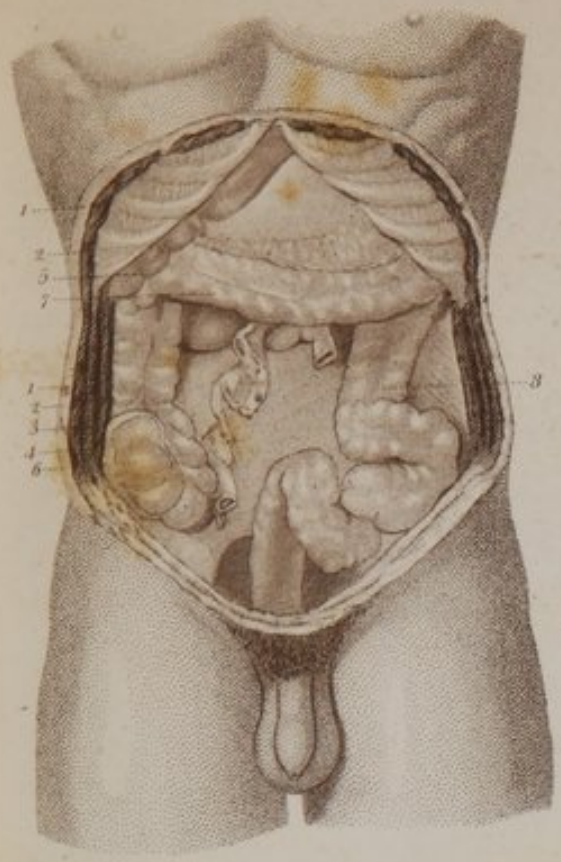


Fig. 2.

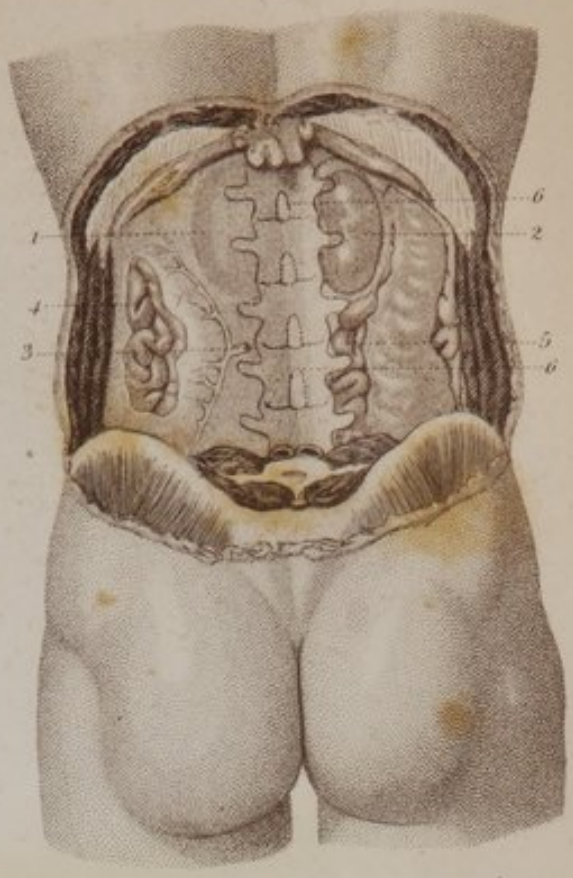
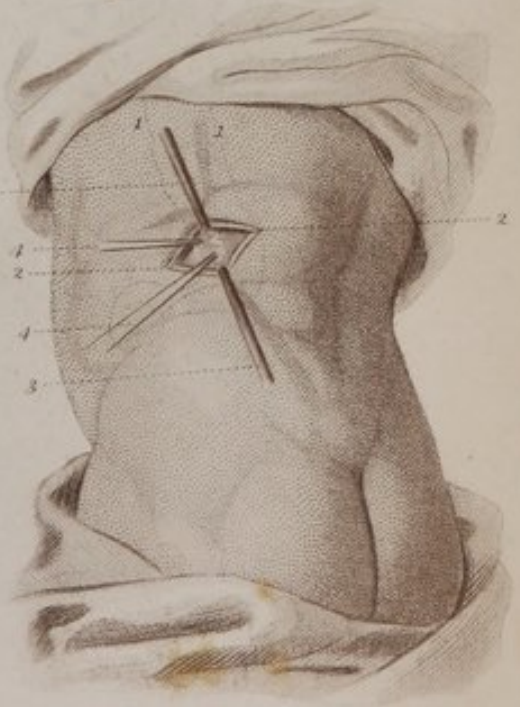


Fig. 5.

Fig. 6.

Fig. 3.

Fig. 4.



Remarks.—As the palliative treatment of artificial anus, when consequent on strangulated hernia, affords only temporary relief, and is the result of the application of a compress or truss to the ulcer at the external orifice, such means do not require much notice; but as the radical cure, by the means above detailed, was an operation which relieved the patient from a most loathsome complaint, it naturally excited considerable attention at the period when it was introduced; and the claims to priority of invention on the part of Dr. Physick and Dupuytren, have, therefore, been strongly contested. In the United States, no one questions the originality of the operation of Dr. Physick, the thesis of Schmakhalden having, in all probability, been limited in its circulation, and not extended to a country, the intercourse of which with Europe was at that time very limited. But, whilst advocating the rights of Dr. Physick, the advantages of each mode of operating need not be overlooked. From an examination of various facts, there is good reason to think that, from the different degrees of obliquity seen in the two tubes in different instances, the selection of any operation must be decided by the peculiarities of the case. As a general rule, I would give the preference to the instrument of Dr. Lotz, of Pennsylvania (which is, as has been shown, a modification of that of Dupuytren), in all cases where the two tubes are not perfectly parallel; but when they are thus situated, the operation of Dr. Physick has the following advantages over that of Dupuytren.

1st. There is no inconvenience caused to the patient, by having an instrument projecting from a tender ulcer during the period of eight days.

2d. There is a better chance of exciting solely adhesive inflammation by the use of the ligature, than there is by compressing the structure, the slough created by the instrument of Dupuytren being liable to extend beyond the width of the blades of the instrument.

3d. The division of the septum by a cutting instrument, as practised by Dr. Physick, is preferable to the irregular orifice produced by the separation of the slough formed between the blades of the enterotome of Dupuytren.

In cases where the obliquity of the bowel does not present anything like an intermediate or double-barrelled septum, neither of the preceding operations for the radical cure would be available, the treatment in this case requiring merely a palliative operation, or such an one as would favor the contraction and cicatrization of the orifice in the intestine as well as in the skin.

SECTION II.

FORMATION OF AN ARTIFICIAL ANUS.

The formation of an artificial anus, in order to give vent to such contents of a bowel as have been prevented from pursuing their natural course, either in consequence of a congenital defect of the natural anus, or by the development of an obstruction in the lower part of the intestinal canal, is purely the result of surgical skill, based upon an accurate anatomical knowledge of the position of the portions of the canal which are best adapted for the safe formation of such a vent as will give exit to fecal matter, with the least possible inconvenience to the patient.

Without alluding to the various causes which may render this operation necessary, or explaining at present the steps of such methods as are demanded by congenital occlusions of the rectum, it is proposed to call the reader's attention to two operations, in both of which the intestine is opened at points more or less closely connected with the regions at which hernia may be developed.

§ 1.—FORMATION OF AN ARTIFICIAL ANUS AT THE GROIN.

As the details of the relative position of the abdominal viscera to the groin, were presented in connection with hernia, there is but little occasion for more than a brief allusion to the part of the intestine usually opened in the formation of an artificial anus.

The colon arising in the right iliac region by the cæcum, passes upwards on the right side, as high as the lower portion of the right hypochondriac region, then transversely through the lower portion of the epigastric region and across the abdomen, to the lower portion of the left lumbar region, when it descends to the left iliac region, where it terminates by the sigmoid flexure. As the groin presents a point to which the attention of the patient may be readily given, it has generally been regarded as furnishing the most favorable point for the formation of an opening, which must subsequently be closed by artificial means, and which must require the patient's personal attention, in order to preserve proper cleanliness. At these points the cæcum or the sigmoid flexure is covered only by

the abdominal parietes. (Plate XLVI., Fig. 1.) Thus we find the skin, superficial fascia, tendon of the external oblique muscle of the abdomen, internal oblique, and transversalis muscles, fascia transversalis, and peritoneum, presenting here the same relative layers that have been referred to in connection with hernia. Through these layers, an incision should therefore be made in such a direction as would present the long diameter of the wound in the line of the groin, the intestine attached to the sides of the wound, and then such a perforation practised on its coats, as will permit the subsequent contraction of the parts, and give sufficient vent to the obstructed contents of the bowels.

This operation dates back to the year 1720, when it was suggested by Littre;[1] since which period it has been performed by many other surgeons; some of whom, either through ignorance or inadvertence of the proposition of Littre, have considered themselves as the originators of the idea.

Operation of Littre.—The patient being placed upon the back, with the thighs extended, and the surgeon placed in a position similar to that demanded for the operation of strangulated hernia, commence the incision on a level with the anterior superior spinous process of the ileum, and carry it inwards and downwards towards the pubis, in the line of the groin, for the extent of two or two and a half inches. After incising the skin and superficial fascia, make a small opening in the tendon of the external oblique, pass in a director, and incise the tendon upon the latter instrument by means of a probe pointed bistoury. After incising in a similar manner the fibres of the internal oblique and transversalis muscles, and tying any branch of the circumflex iliac artery that accident may bring into the line of the incision, next cautiously divide the fascia transversalis, and then with the same caution the peritoneum, incising both upon the director or finger in order to avoid the intestines. If the gut, which is usually distended with feces, now presents itself, it may be distinguished from the small intestines by its reddened color, if congested, or by the yellowish-green appearance which is often noted in this bowel after death, as well as by its peculiar shape. By passing the finger around it, the bowel may now be brought well forward (Plate XLVI., Fig. 3) into the opening, and a ligature being passed through the mesocolon so as to

[1] Velpeau, Méd. Opératoire, tome 4me.

prevent its escape, a puncture may be made into the gut, and then this opening enlarged by an incision parallel with that in the integuments. The contents of the bowel being now evacuated, the mesocolic thread should be securely fastened to the parietes of the abdomen, and the intestine thus left until the third or fourth day, when adhesions having formed between the surface of the colon and the front of the peritoneum, it only remains to prevent the tendency of the wound to contract and close the opening, by the use of a tent.

The subsequent dressing should be such as will protect the skin from excoriation, and guard against the tendency to eversion of the mucous coat of the intestine as well as against the constant escape of the fecal matter. It may be usually accomplished by a compress and bandage, or by a truss, if the parts can tolerate it.

§ 2.—FORMATION OF AN ARTIFICIAL ANUS IN THE LUMBAR REGION.

The descending colon passing from the left hypochondriac region to the left sacro-iliac symphysis, is covered by the muscles of the loins behind, and by the peritoneum in front, the attachment of the latter to the muscles immediately around the crest of the ileum being by a loosely-developed cellular substance. "In its general course, this bowel corresponds to the groove between the quadratus lumborum and transversalis muscles, and, as this is near to the external border of the common mass of the sacro-lumbalis and longissimus dorsi, it may be easily recognized in moderately fat subjects. Sometimes the colon is more internal, and, in great part, concealed by the quadratus lumborum."[1] (Plate XLVI., Fig. 2.)

The layers to be divided in the formation of an artificial anus in the loins, are the skin and subcutaneous fat, the latissimus dorsi muscle behind, the external oblique muscle of the abdomen in front, then the internal oblique and transversalis muscles, then the fascia transversalis, then fat, and lastly the intestine itself; the left colon being devoid of peritoneum in the posterior third of its circumference, especially when distended.

OPERATION OF AMUSSAT.—This operation is a valuable modification of that proposed by Callisen, and is performed as follows:

[1] Malgaigne.

The patient being laid on his belly, and slightly inclined to the right side, a transverse incision should be made in the skin, two fingers' breadth above the crest of the ileum, commencing at the external border of the mass common to the sacro-lumbalis and longissimus dorsi, and following it outwards to the extent of four or five fingers' breadth. After incising the skin and subcutaneous tissue, divide the latissimus dorsi transversely in the posterior third of the incision, the external oblique in the anterior two-thirds, and then the internal oblique and transversalis muscles and fascia, cutting them transversely and then vertically, so as to obtain a crucial incision. On reaching the adipose tissue, which envelops the colon, raise it cautiously and search carefully for the intestine, which may be told by percussion, or by its color, or by feeling the resistance caused by its contents.

After certainly recognizing it, traverse the exposed portion with two needles, so that the bowel may be stitched with two loops of thread about an inch apart, and pierce it in the interval of the loops and divide the intestinal parietes crucially, so as to secure a free evacuation of its contents, aiding this, if necessary, by injections of warm water. Then drawing the intestinal opening well forward by means of three torsion forceps, fasten it to the skin by four points of the interrupted suture. (Plate XLVI., Fig. 4.)

Remarks.—The formation of an artificial anus for the purpose of giving vent to the fecal contents of the bowels, when prevented from escaping by the natural orifice, is an operation which has been practised in adults in consequence of cancerous or other permanent obstructions of the rectum, and in children from malformation of the natural opening of the rectum. At first sight it would appear that this operation must evidently expose the patient to loss of life, and can, at best, prolong it only at the expense of a most loathsome condition. That the bowels may be thus opened is certainly an evidence of the efforts of the surgeon towards relieving the defects of nature, but the results are by no means positive that the operation can secure to the patient even a continuance of a miserable existence.

§ 3.—STATISTICS OF THE OPERATION.

In the United States, the formation of an artificial anus has been attempted, but, as far as I can learn, without much success. In a

case operated on by Dr. Warren, Sen., the patient died.[1] In one operated on by Dr. J. M. Bush, of Kentucky, the patient also died on the fourteenth day;[2] and of eight cases reported by Velpeau,[3] six died and two recovered. But the results furnished by Mr. Hawkins,[4] of England, as obtained from an analysis of 44 cases shows that this operation is not quite so hopeless as might have been supposed. Thus, of 44 cases which he refers to, 22 were counted as recoveries; of these, 1 lived 17 years; 9 about a year; 5 died in 6 months subsequently, and 8 were either alive or lost sight of at the end of 12 months. 21 patients were from 40 to 60 years old, of whom 11 died, and 12 were from 20 to 40 years of age, of whom 6 died. Age does not, therefore exercise any special influence on the operation.

But even with these results, it may be doubted whether it is advisable to induce an adult to submit to this operation, and whether, if left to nature, the chances of life might not be quite as great as those resulting from the operation. The inflammation, extending from the distended bowel to the surrounding parts, might obviate the chances of a general peritonitis, and, if the patient's strength could sustain the sloughing consequent on a rupture of the intestine, nature would doubtless make for herself an external vent. In such hopeless circumstances, the judgment of each one at the moment can alone decide upon the value of an operation. As regards the special advantages of an operation, as practised in the groin, or in the lumbar region, Mr. Hawkins[5] concludes that the decision may be left to the judgment of the surgeon, provided he operates on the left side of the body.

[1] Dr. Warren in MS.

[2] See Bibliography, p. 107.

[3] Méd. Opératoire, tome 4me.

[4] Med.-Chirurg. Transactions, vol. xxxv. as quoted by Dr. Sargent in a note to Miller's Practice.

[5] *Opus citat.*

CHAPTER XXI.

LIGATURE OF THE ILIAC ARTERIES.

THE application of a ligature to the Iliac arteries has been successfully performed at various points, from the origin of the common iliac along the main trunks of both its internal and external branches.

SECTION I.

SURGICAL ANATOMY.

The Primitive Iliac Arteries arise about the lower part of the fourth or fifth lumbar vertebra, and extend to within an inch of the sacro-iliac symphysis, where they divide into the Internal and External Iliacs. In this course, each Primitive Iliac Artery is bounded on the outer side by the psoas magnus muscle, behind by the primitive iliac vein, and, when of full length, is crossed at its lower part by the ureter. The right artery crosses in front of the root of the left iliac vein. (Plate XLVII., Fig. 1.)

The Internal Iliac Artery extends from its origin near the front upper part of the sacro-iliac symphysis to the lower part of the same articulation, being bounded behind by the sacral plexus of nerves, and being about one inch in length before it gives off any branches.

The External Iliac Artery extends from the bifurcation of the primitive iliac to Poupart's ligament along the internal margin of the psoas magnus muscle. In the commencement of its course, it is anterior to the external iliac vein, but gets to its outer margin as it approaches Poupart's ligament. At this point it is about half way between the anterior superior spinous process of the ileum and the symphysis pubis, having the vein on its inside, and the anterior crural nerve half an inch from its outer margin.[1] (Plate XLVII., Fig. 1.)

[1] Horner's Anatomy, vol. ii. eighth edition.

These arteries are behind the Peritoneum, the attachment of which to surrounding parts is generally by loose cellular tissue.

SECTION II.

OPERATIONS UPON THE ILIAC ARTERIES.

The interruption to the circulation of the blood through these arteries, by means of compression, has occasionally been resorted to, and, in some instances, with partial success, the great objection to its employment arising from the proximity of the iliac veins, causing also an interruption in the venous circulation, with all the dangers and inconveniences which usually supervene on such obstructions. The ligature must, therefore, be regarded the best mode of treating the disorders of these bloodvessels, though this operation especially demands operative skill, whilst compression requires rather good surgical judgment than manual dexterity.

§ 1.—LIGATURE OF THE EXTERNAL ILIAC ARTERY.

The ligation of the External Iliac Artery was first performed by Abernethy unsuccessfully in 1796, and again successfully in 1806. His operation was performed as follows:—

OPERATION OF ABERNETHY.—The patient being laid on his back, and a little inclined towards the sound side, so as to relax the abdominal muscles and throw the intestines from the incised side, an incision should be made about four inches long in the adult, commencing an inch and a half from and on the inner side of the anterior superior spinous process of the ileum, and extending obliquely towards the outer column of the external abdominal ring. After dividing the skin and superficial fascia, tie any of the small arterial branches that may require the ligature, open the tendon of the external oblique, introduce a director, and divide it in the course of the external incision. Then carrying the forefinger beneath the fibres of the internal oblique and transversalis muscles, divide them with a probe-pointed bistoury, and, commencing at the iliac margin of the wound, press the peritoneum towards the median line of the body so as to overcome its cellular attach-

ments to the iliac fascia. After exposing the artery about two inches above Poupart's ligament, pass the aneurismal needle under it, from within outwards, or from between the vein and artery towards the ileum. (Plate XLVII., Fig. 3.)

Operation of Dr. John Syng Dorsey, of Philadelphia.[1]—This operation, which was the first of its kind in the United States, was performed in 1811 as follows: An incision three inches and a half long was made, beginning an inch and a half above the anterior superior spinous process and one inch within it, and also four inches and a half distant from the umbilicus, so as to extend obliquely downwards, and terminate about one inch above the aneurismal tumor, which was situated immediately below Poupart's ligament. After dividing the skin, superficial fascia, and external oblique tendon, the internal oblique muscle protruded at the wound, and, together with the inferior edge of the transversalis, was divided nearly up to the highest point of the wound. The cellular adhesions of the peritoneum being then overcome by the forefinger, the artery was readily felt pulsating, and was then separated gently from the adjoining parts without denuding much of it, when the vessel was secured by Physick's needle and forceps. (Plate XLVII., Fig. 3.)

Three knots being made upon the ligature, the ends were left at the external wound; and a strip of adhesive plaster, a pledget of lint, and a compress, completed the dressing. The patient was then put to bed with the thigh moderately flexed on the pelvis, and the limb covered with carded wool and flannel. On the thirteenth day the ligature separated, and on the twentieth he was able to rise in his bed.

Operation of Dr. Wright Post, of New York.—A laborer, aged 41 years, entered the New York Hospital, October, 1813, with an inguinal aneurism of the left side. After general treatment, the operation was performed, January, 1814 (it being the second of its kind in the United States), as follows:—

Operation of Dr. Post.—An incision being made through the integuments with some degree of obliquity, beginning a short distance above the tumor, and extending upwards externally to a middle line between the umbilicus and superior anterior spinous process of the ilium, so as to give it a length of between three and

[1] Dorsey's Surgery, vol. ii. p. 216.

PLATE XLVII.

VIEW OF THE PARTS CONCERNED IN THE OPERATION OF LIGATING THE ILIAC ARTERIES.

Fig. 1. Surgical anatomy of these Arteries. 1. Aorta. 2. Right primitive iliac. 3. Right external iliac. 4. Left primitive iliac vein. 5. Ascending vena cava. 6. Spermatic vessels. 7. Ureter crossing iliac artery. 8. Internal iliac artery. 9. Lymphatics and glands. 10. Anterior crural nerves. 11. Section of abdominal muscles. 12. Anterior superior spinous process. 13. Fascia lata. 14. Psoas muscle. 15. Iliacus internus. 16. Circumflex iliac artery. 17. Epigastric vessels. 18. Sheath of femoral vessels. 19. Saphena vein. 20. Lymphatic vessels of thigh. 21. Spermatic cord. 22. Bladder. After Bernard and Huette.

Fig. 2. Appearance and position of an Aneurismal Tumor of the Femoral Artery, showing the effect upon the superficial vessels, &c. Ligature of the external iliac was required. After Auvert.

Fig. 3. Ligature of the External Iliac Artery. 1. Artery distended, and with the needle beneath it. 2. Incision of skin. 3, 4. Divided edges of muscles and fascia of abdomen. 5. Peritoneum everted. 6. External iliac vein. After Bernard and Huette.

Fig. 4. Operation of ligating the Primitive Iliac Artery, as shown upon the subject. The artery has been raised a little by a ligature towards the orifice of the wound, in order to show it more distinctly. After Nature.

Fig. 5. Ligature of the Internal Iliac Artery, as shown upon the subject, the arteries being filled with wax. After Nature.

Fig. 6. A view of the condition of the Bloodvessels, as found in the patient upon whom Dr. Edward Peace tied the right Primitive Iliac Artery, showing by what means the circulation was carried on. 1. Aorta. 2. Primitive iliac, that on the right side, as well as the right external and internal iliacs, being obliterated. 3. Middle sacral much enlarged. 4. Aneurismal sac. 5. Epigastric artery much enlarged. 6. Enlarged iliolumbar. 7. Circumflex iliac. 8. Obturator artery. 9, 9. Lumbar arteries much enlarged. After Nature.

Fig. 7. A view of the left Iliac Vessels of the same patient. 1. Aorta. 2, 2. Primitive iliacs. 3. Middle sacral, as seen in the previous drawing. 4. Left internal iliac, with all its branches much increased and anastomosing freely with right side. 5. Left external iliac. 6. Left epigastric displaced in the preparation. 7. Poupart's ligament. 8. Left femoral. After Nature.

Plate 47.

Fig. 1.

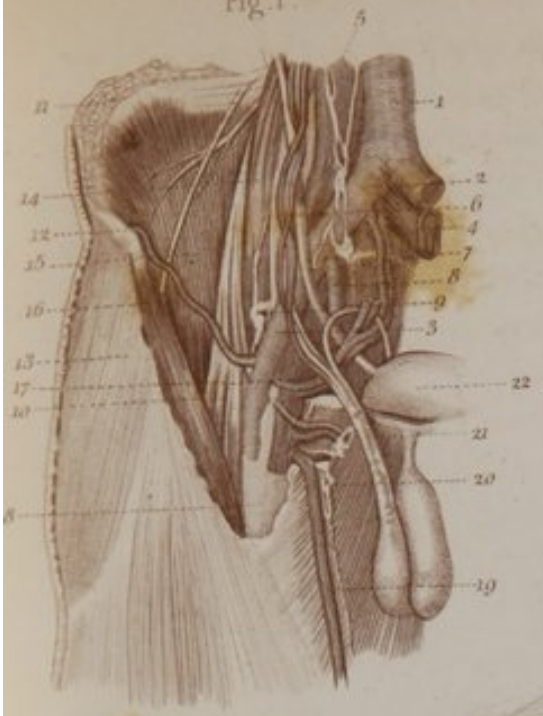


Fig. 3.

Fig. 2.

Fig. 6.

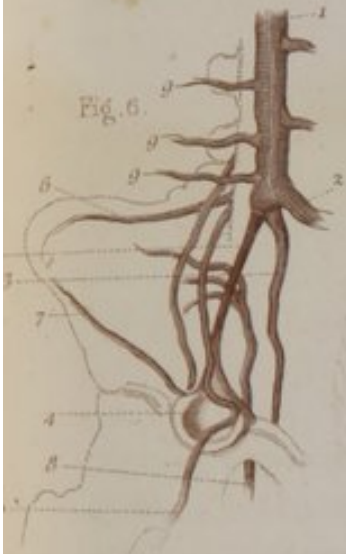


Fig. 7.

Fig. 4.

Fig. 5.

four inches, the abdominal muscles were cut through, until the peritoneum, at the lower part of the wound, was fully exposed. An endeavor was then made to detach this membrane from the crural arch, so as to get at the artery without opening the cavity of the peritoneum, but failed, as the strength and thickness of the membrane, at this point, were much greater than usual, and its adhesion to Poupart's ligament was so firm that the separation, which is usually so easy, was found in this case to be impracticable, in consequence of the pressure caused by the tumor. It was, therefore, necessary to cut through the peritoneum in order to arrive at the artery, which was done on account of the difficulties before referred to. The omentum protruded, was easily replaced, and the artery felt; but every effort to detach the peritoneum from the sheath of the artery, by means of the finger-nail, failed, and it only remained to pass a ligature under the artery by pushing the needle through the coverings of the vessel.[1] To effect this, the point of the finger was placed on the inside of the artery, and a needle being conveyed along this as a director, it was made to pierce the coverings of the vessel, pass under the artery, and come out on the outside of it, by employing the forceps of Dr. Physick. After tying the ligature with care, so as to avoid including any portion of the intestine, the wound was closed with adhesive strips, lightly dressed, and the patient put to bed, the limb being covered with carded cotton. Pulsation returned in the tumor, but the aneurism did not increase, the ligature upon the artery not having arrested the circulation in the tumor, but only lessened it, though the patient ultimately recovered the use of a limb which had before been useless to him.

Operation of Dr. Valentine Mott, of New York.[2]—The skin and superficial fascia being divided by a curvilinear incision, which, commencing just above the external abdominal ring, extends outwards and parallel with Poupart's ligament to a point a little above the anterior superior spinous process of the ileum, the tendon of the external oblique muscle will be fully exposed; then, this tendon being cautiously divided to the extent of the external incision, separate it from the internal oblique muscle and turn up the flap, and carefully detaching the edge of the internal oblique and transversalis

[1] Am. Med. and Philosoph. Register, vol. ix. p. 443, 1814.

[2] New York Register Med. and Pharm., vol. i. p. 105, 1851.

muscles from Poupart's ligament, turn them up also, when the tubular portion of the fascia transversalis, which invests the cord, will be readily seen. Picking this process up in the forceps, rub it between the fingers and nick it transversely with the point of the knife. Then introducing the finger at the opening, pass it along the cord to the internal abdominal ring, when the pulsation of the artery will be felt behind and below this ring, the cord serving as a guide, and rendering it certain that the finger passes below the peritoneum, or between it and the artery, without any injury to either. Then dilating the wound with broad spatulæ, get a good view of the artery, and separating it from the vein, which is below and on its inner side, to an extent only sufficient for the passage of the needle, pass the former around the artery from within outwards, or so that its point will pass from and not to the vein, when the artery may be ligated about one inch above Poupart's ligament, care being taken not to include any nervous filaments in the ligature.

After-Treatment.—Close the edges of the wound by a suture and adhesive strips, leaving both ends of the ligature hanging out of the lower angle, but do not apply any bandage which can constrict the part; after which the patient should be placed in bed, with the thigh slightly flexed on a pillow, while cotton or some other good non-conductor of heat is placed all round the limb, from the toes to the groin, so as to cherish the heat and vitality of the part.

Operation of Sir Astley Cooper.—This surgeon began his incision near the anterior superior spinous process of the ileum, and continued it to a point a little above the inner edge of the external abdominal ring, giving it a semi-elliptical shape.

After dividing the tendon of the external oblique, he followed the course of the spermatic cord with his finger, entered the internal abdominal ring, and, depressing the peritoneum, isolated the artery as before.

Operation of Bogros.—By an incision two or three inches long, equidistant at each end from the pubis and spinous process of the ileum, and immediately over Poupart's ligament, the skin and superficial fascia were divided, a director passed beneath the tendon of the external oblique, the spermatic cord raised, and its adhesions separated, the finger following the course of the cord to the internal ring, where the epigastric artery may be readily found on the inside of the ring. Tracing with the finger the course of this artery to its origin, it only remained to push aside the adhesions of the cellular tissue, and ligate the vessels.

REMARKS.—By reference to the Bibliographical Index,[1] it will be seen that the operation of ligating the external iliac artery has been frequently performed with success in the United States, the names of Drs. Whitridge, of Charleston, Nathan Smith, of New Hampshire, Jameson, of Baltimore, Stevens and Rodgers, of New York, Warren, of Boston, and Barton and Randolph, of Philadelphia, being associated with the earlier operations, whilst those of many others are connected with the subsequent operations on this vessel.

§ 2.—STATISTICS OF THE APPLICATION OF A LIGATURE TO THE EXTERNAL ILIAC ARTERY.

The results of the operation of ligating the iliac arteries have varied somewhat according to the branch tied, though the external iliac, from being the most superficial, as well as that most directly connected with the femoral and popliteal arteries, has been more frequently ligated than either or both of the others. As the circulation can be readily carried on by other vessels when this branch of the iliac is tied, the subsequent difficulties have been less, and the success attendant on the operation such as establishes the propriety and advantage of ligating this vessel for aneurism, or wounds of the femoral artery.

The following cases have been collected from the works of the surgeons whose names are mentioned.

LIGATURE OF THE EXTERNAL ILIAC ARTERY.

	CASES.	CURED.	DIED.
Abernethy[2]	4	2	2
Freer[3]	3	3	0
John C. Warren[4]	4	3	1
Mott[5]	7	4	3
Other American surgeons[6] . . .	22	17	5
	40	29	11

[1] See Bibliography, p. 108.
[2] Observations on Aneurisms, by J. Abernethy.
[3] " " George Freer.
[4] MS.
[5] Transactions Am. Med. Assoc., vol. iv. p. 269.
[6] Bibliographical Index, p. 108.

From this summary, it appears that of forty cases operated on, twenty-nine have been cured and eleven died, or more than two-thirds of the cases operated on have been cured.

Of one hundred and eighteen cases reported by Dr. Norris, eighty-three were cured and thirty-three died, three who recovered undergoing amputation, which also shows that more than two-thirds were cured.

SECTION III.

LIGATURE OF THE PRIMITIVE ILIAC ARTERY.

The ligature of the primitive iliac artery, is one which dates back only to the year 1812, when it was first performed for the arrest of traumatic hemorrhage, by Dr. Wm. Gibson, of Philadelphia (then residing in Baltimore), but without success. The first successful ligation of this artery for aneurism was accomplished by Dr. Mott, of New York, in 1827.

§ 1.—SURGICAL ANATOMY.

The Primitive Iliac Artery being the terminating branches of the abdominal aorta, are about an inch long, where they divide into the external and internal iliacs. Most commonly, the primitive iliac arises about the fourth lumbar vertebra, though sometimes it comes off as low as the inferior edge of the fifth. These arteries rest upon the parts about the alæ of the sacrum, or side of the sacro-vertebral angle, having the psoas magnus muscle upon the outer side, and being crossed at their lowest portion by the ureter. On the right side the primitive iliac vein is outside, and then behind the artery, but on the left the vein lies upon the inside of the vessel, though it does not reach this point until it has passed under the root of the right iliac artery. The peritoneum covers the vessels, and they are easily approached simply by overcoming with the finger the loose attachments of this membrane to the part.

[1] Am. Journ. Med. Sciences, vol. xiii. p. 20.

§ 2.—OPERATION OF LIGATING THE PRIMITIVE ILIAC.

The approach to this artery may be accomplished by a slight extension of such incisions as have been recommended for the ligature of the external iliac. In the operation of Dr. Mott, in 1827, which was the first successful operation ever performed, as well as the first done for the relief of aneurism, the following plan was pursued:—

Operation of Dr. Mott.[1]—The aneurismal tumor, though of only ten days' standing, occupied the whole extent of the external iliac, extending from within Poupart's ligament to some distance above the origin of the internal iliac artery, was of large size, and protruded the belly considerably at the iliac region.

By an incision parallel with and about half an inch above Poupart's ligament, and extending from the external abdominal ring to one or two inches above the crest of the ilium, the skin and muscles were cautiously divided, and turned up as in the operation upon the external iliac artery, when the peritoneum was cautiously detached with the fingers, as in the preceding operation, without being injured. The artery being then examined, the aneurismal dilatation was found to cease at about half the distance between the bifurcation of the aorta and the origin of the internal iliac branches. The ligature was, therefore, passed around the vessel from the outside (so as to avoid the iliac vein), by means of the Philadelphia needle, great care being taken not to injure the ureter or the iliac vein (Plate XXXV., Fig. 2), when, after tying the knot, the wound was held open in order to satisfy those present of the exact situation of the ligature, which was seen to be just below the bifurcation of the aorta, and on the side of the sacro-vertebral promontory. The wound being lightly dressed, the patient was put to bed, and the means previously mentioned employed to preserve the heat of the limb until the circulation was restored, the patient being ultimately cured.

In the case operated on by Dr. Gibson, in 1812, the artery was tied by means of a ligature passed around it, by means of an eyed probe, the original wound being enlarged to the extent of seven inches. This patient died on the fifteenth day of hemorrhage, and on dissection it was found that two ligatures had been placed on the common iliac artery of the left side, about half an inch below the

[1] Philad. Journ. Med. and Phys. Sciences, vol. xiv. p. 176. 1827.

bifurcation of the aorta. The upper ligature was found detached, but no union had occurred in the vessel.[1]

Operation of Dr. Ed. Peace, of Philadelphia.[2]—A man, aged thirty-six years, was admitted into the Pennsylvania Hospital in August, 1842, with an inguinal aneurism of the right side, created by a strain in lifting stone, to relieve which it was decided to ligate the common iliac artery.

Operation.—An incision seven inches long was made through the integuments, commencing at a point on a level with the umbilicus, two inches within and three inches above the anterior superior spinous process of the ilium, approaching to within an inch of Poupart's ligament, and terminating one-half inch above the external ring. This divided the arteria ad cutem abdominis, which was twisted by the artery forceps. The superficial fascia being next divided, the tendon of the external oblique was nicked and incised upon a director, the whole length of the first incision as far inwards as the spermatic cord. Considerable difficulty was now experienced in raising the lower edge of the tendon of the internal oblique and transversalis, owing to the induration of tissue from the pressure of the tumor, but this was finally accomplished by means of the knife-handle, and, the parts being then carefully divided, the peritoneum was reached. When this was cautiously detached from the tumor, the latter was found to involve a large portion of the external iliac artery, but by raising the peritoneum a sound part of the artery was found, about half an inch above the bifurcation of the common iliac.

The artery being now separated from the vein by the finger-nail, a silk ligature was passed around it by Gibson's needle (Plate XXXV., Fig. 12), but notwithstanding the precautions taken to evacuate the bowels, and the length of the incision, it was difficult to see the point of the needle under the artery, on account of the protrusion of the bowels, and the projection of the tumor. Finally, by means of broad-curved spatulæ (Plate XLVII., Fig. 4), the parts were seen, and the ligature being tied with a double knot, both ends were allowed to hang out of the wound, which was then closed by adhesive strips, three points of the interrupted suture, lint, &c. The patient was then placed in bed with his shoulders slightly raised,

[1] Med. Recorder, vol. iii. p. 185.

[2] Am. Journ. Med. Sciences, vol. v. N. S. p. 269. 1843.

his body flexed and inclined to the affected side, and the limb flexed upon a pillow under the knee. In fifteen days the ligature came away, and the patient recovered perfectly.

This patient dying subsequently, Dr. Peace succeeded, after much trouble, in injecting the bloodvessels, and in making a dissection of the part. Although, from the opposition of the patient's friends, the preparation was imperfectly made, it yet shows the means by which the circulation was carried on. From this preparation I have been enabled, through the politeness of the operator, to have the two sketches made as represented in Plate XLVII., Figs. 6, 7, and from inspection of the collateral branches of the artery as seen after the operation, as well as from the minuteness with which the operation has been detailed by the operator, much valuable information may be gained by those who may hereafter desire to repeat it.

REMARKS.—A knowledge of the great amount of the circulation which would be cut off from the lower extremity, by the application of a ligature to this vessel, at first led surgeons to believe that it would be impossible to preserve the vitality of the limb after this operation. The credit of demonstrating the contrary is, therefore, due to the surgeons of the United States, who, in the cases operated on by Drs. Mott and Gibson, conclusively showed that nature was able to remedy even this serious obliteration of the natural channel of the blood to the lower extremities.

§ 3.—STATISTICS OF LIGATURE OF PRIMITIVE ILIAC.

Since the primary operations upon the Primitive Iliac Artery, thirteen others have been reported, as follows: Crampton, in 1828; Liston, in 1829; Guthrie, in 1833, and Syme, 1838, in England; by Salomon, of St. Petersburg, in 1837; Deguise, of Paris, in 1840; by Bushe, of N. Y., in 1832, Post, of N. Y.,in 1840; and Perogroff, of Russia; by Peace, of Philadelphia, in 1842; by Hey, of England, in 1843; by Stanly, of London, in1846; two by Dr. Garviso, of South America; and one recently by Dr. Wedderburn, of New Orleans.[1]

Of the seventeen cases before specified, eight were cured and nine died; showing, as it is thought, the justifiable character of the operation under circumstances similar to those which have before required it.

[1] See Bibliography, p. 107; also Norris, Am. Journ. Med. Sci., vol. xiii. N. S. p. 24, 1847.

§ 4.—LIGATURE OF THE INTERNAL ILIAC ARTERY.

The ligature of the Internal Iliac Artery has been occasionally performed for the relief of aneurismal tumors in its gluteal or ischiatic branches. As there is an ample supply of vessels through which the circulation may be conducted, the application of a ligature to this artery would not in all probability, be attended by serious consequences, were it not from the risk of peritonitis necessarily created by the operation.

The plans proposed for the application of this ligature have varied considerably from those suggested in connection with the external iliac, chiefly because the latter vessel has been most frequently tied in its lower part. As the external and internal arteries come off at the same point, it is evident that a slight prolongation of the ordinary operation upon the external branch of the artery would enable the operator also to tie the internal. But as the plans employed have differed materially from those pursued in ligating the former vessel, the ligation of this vessel has, therefore, taken the position of a distinct operation. The operation was first performed by Dr. Stevens, of Santa Cruz, then by Dr. Atkinson, of England, and then by Dr. White, of New York, as hereafter shown.

Operation of Stevens, of Santa Cruz.—In the case of a negress who labored under an aneurismal tumor of the left buttock, of the size of a child's head, Dr. Stevens proceeded as follows:—

Operation.—By an incision, five inches in length, made in the course, but a little to the outer side of the epigastric artery, the abdominal parietes were divided, the attachment of the peritoneum, from the spine of the ilium to the left sacro-iliac symphysis, overcome by pressing upon it with the finger, and the origin of the artery being felt by the fore-finger, the internal iliac was tied by passing a ligature around it, about half an inch below its origin. This patient was cured in three weeks; and, ten years afterwards, when she died, the preparation was sent to London, but the aneurism was found to have been in the ischiatic instead of the gluteal artery, as had been supposed.[1]

Operation of Dr. S. Pomeroy White, of Hudson (now of New York City).—It being decided to tie the internal iliac artery in order to relieve a gluteal or ischiatic aneurism, Dr. White operated as follows, without any knowledge of the operation of Atkin-

[1] Velpeau, Méd. Opératoire.

son, although aware that Stevens had previously succeeded in his operation :—

Accordingly, he made a semicircular incision, seven inches long, and with its convexity towards the ileum, commencing two inches to the left of the umbilicus and ending at the external ring, so as to divide the skin, cellular substance, and fascia superficialis. Then, the tendon of the external oblique muscle being exposed, it was carefully divided, as were also the external oblique and transversalis muscles, as well as the transversalis fascia. The peritoneum being now detached by the fingers from the iliacus internus and psoas magnus muscles, it was pressed with its contents towards the right hypochondriac region, when the external iliac artery being felt and traced by the finger towards the sacro-iliac symphysis, the internal iliac was distinctly recognized, and, being exposed with the handle of a scalpel, was ligated by carrying the thread around it with the Philadelphia needle, the knot being firmly tied by Dr. Hosack's knot-tier, and the wound subsequently closed with sutures and adhesive strips. The patient soon afterwards recovered.

Remarks.—This operation was among the earliest of those practised upon this artery, and was certainly indicative of considerable coolness and skill on the part of Dr. White, who was at that time a young surgeon. Considerable difficulty was experienced by him in consequence of the constant protrusion of the peritoneum, from the abdominal compression caused by the struggles of the patient. The modern discovery of anæsthetics has, however, obviated this, and the ligation of this vessel, like many other operations upon the abdomen, may now be performed without any such annoyances, as the patient will remain perfectly tranquil, and the bowels have little or no tendency to protrude when the anæsthesia is complete.

Operation of Dr. H. J. Bigelow, of Boston.—A middle-aged woman being stabbed by her husband in the right buttock, the injury led to the formation of an aneurism of the gluteal artery, to relieve which the internal iliac was tied as follows :—

Operation.—By an incision above, but parallel to Poupart's ligament (Plate XLVII. Fig. 5), the skin, muscles, and fascia were divided, the peritoneum separated from its attachments to the iliac fossa, and the artery readily attained and tied, instantly relieving the aneurismal symptoms ; but the patient died of peritonitis on the eighth day. The autopsy exhibited the ligature as placed around the internal iliac, just above its branches, with a satisfactory clot

extending from this point to the bifurcation at the common iliac artery.

Operation of Dr. Gilman Kimball, of Lowell.—A patient, with a pulsating tumor on the back of the thigh, so high up as to cause inconvenience when sitting, having exhibited all the symptoms of gluteal aneurism, the internal iliac artery was tied in the following manner: The patient being placed in a convenient position in bed, and rendered insensible by chloroform, an incision six inches long was made immediately above and nearly parallel with Poupart's ligament, beginning at a point just external to the spermatic cord as it passes through the external ring, and running outwards for three inches, and then, turning more upwards, so as to terminate at a line about midway between the anterior superior spinous process of the ileum and the umbilicus. The abdominal muscles and fascia being then carefully divided, and the peritoneum pushed off from its inferior attachments, the external iliac artery was brought into view, when the peritoneum was still further raised from its pelvic connections by running the forefinger along the inner edge of the psoas muscle, till it reached the promontory of the sacrum. The internal iliac artery being now readily traced in its descent from its origin, the forefinger was kept upon it whilst the ligature was carried around it by means of Scarpa's needle, and the vessel tied by an assistant about an inch from its origin. No accident or embarrassment occurring during the operation, and no vessel being cut that required the ligature, the wound was closed by two or three sutures and adhesive straps, and covered with lint kept wet with water, as in the water-dressing. Secondary hemorrhage supervening on the fourteenth day, the patient died on the sixteenth. At the autopsy, the portion of the artery between the ligature and the bifurcation being slit open, was found entirely empty and without signs of inflammation on its inner surface, or of a coagulum, whilst the part immediately around the seat of the ligature had begun to give way, disclosing a very small aperture, but one sufficiently large to account for the fatal hemorrhage. As there were no efforts at the formation of coagulum above the ligature, the question was raised, whether these results were not connected with the large amount of chloroform inhaled during the operation.

Remarks.—The internal iliac artery was first tied successfully

[1] Amer. Journ. Med. Sciences, vol. xvii. p. 29. 1849.

in the United States by Dr. S. Pomeroy White, then of Hudson, but now of New York; and subsequently by Dr. Mott, also successfully, although the peritoneum was opened during the operation; the operations of Drs. Bigelow and Kimball of Massachusetts, were unsuccessful. The great dangers of the operation are to be found in the tendency to peritonitis, and in the injury to the vein in the immediate neighborhood of the artery.

STATISTICS.—Of ten cases of ligation of this artery as reported by Dr. Norris,[1] in his table on the ligature of the iliacs, and also referred to in the Bibliography, to wit, one by Stevens, of St. Cruz; one by Atkinson, of England; one each by S. Pomeroy White, Mott, and J. K. Rodgers, of New York; one each by Thomas, White and Arendt, of England; and one each by Bigelow and Kimball, of Massachusetts, four were cured and six died, all the operations being performed for aneurism.

CHAPTER XXII.

OPERATIONS PRACTISED ON THE BACK.

THE posterior surface of the trunk of the body presents no points of structure which require more than a passing allusion, the great number and mass of the muscles, together with the arrangement of the vertebræ, being matters of general anatomical knowledge. The operations, also, which are performed upon this region do not demand any especial caution, unless it may be in the complaints due to the disorders of the spinal canal. In order, however, to continue the unity of description which has been sought for in the arrangement of this work, some of the more important cases requiring operative aid will be detailed, as illustrating the operations required in the complaints of this region.

[1] Amer. Journ. Med. Sciences, vol. xiii. p. 23, 1847.

PLATE XLVIII.

EXTERNAL CHARACTERS OF TUMORS OF THE NECK AND BACK.

Fig. 1. Congenital Tumor of the Veins about the Neck. This child was twelve months old; the tumor filled the whole neck; projected beyond the chin, and felt like a coil of vessels folded in every direction on each other, or like a bundle of round worms. After Warren.

Fig. 2. A view of the appearance and position of a Large Hygroma of the Back of the Neck. This tumor was noticed in a child some months after birth, and was supposed to be due to an injury of the part, caused by the application of the forceps. It was relieved by puncture.

After Auvert.

Fig. 3. Appearance presented in Julia Richards, a negress, who had a large Sarcomatous Tumor upon the back, which was removed by Dr. Dorsey, of Philadelphia, in 1815. The tumor had existed eighteen years, grown gradually, and never been painful, but its size compelled her to walk as if carrying a large and heavy sack upon her back. The surface of the tumor was tolerably regular, but very large and numerous veins were seen in various parts of it. The narrowest part of the tumor was thicker than the patient's waist, and its base was very extensive. After being emptied of blood its weight was twenty-five pounds. The dimensions of the tumor are stated in the text, After Dorsey.

Fig. 4. A view of the position and external characters of Spina Bifida in the Loins. This tumor was of very considerable size, the drawing representing it as only one-fourth of its natural size. It was seated in the lumbar region, nearly on a line with the crest of the ilium, and was accompanied by a deficiency in the spinous processes of several of the adjoining vertebræ. After Froriep.

Plate 48.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

SECTION I.

SUPERFICIAL TUMORS OF THE BACK.

The integuments and muscles of the back are liable to very much the same class of tumors as are found in similar tissues elsewhere, and require for their removal precisely the same means, to wit, such an incision of the skin and subsequent dissection as will create as little disturbance as possible of surrounding parts. As illustrative of the operation required by the wens of this region, the following case is cited:—

REMOVAL OF A LARGE STEATOMATOUS TUMOR BY DR. JOHN SYNG DORSEY, OF PHILADELPHIA.—The patient, a negress, aged about 45 years, was admitted into the Pennsylvania Hospital, in 1815, with a tumor upon the back, the dimensions of which were as follows:—

Circumference at the narrowest point			2	feet	10 inches.
"	"	thickest part	3	"	9 "
"	"	horizontally	3	"	1½ "

The weight of the tumor, after removal, was twenty-five pounds. (Plate XLVIII., Fig. 3.)

OPERATION.—After administering an opiate, the patient, at the suggestion of Dr. Physick, was placed upon her face on the table for fifteen minutes, whilst assistants elevated the tumor so as to empty it as completely as possible of blood. Then external incisions, calculated to preserve sufficient skin to cover the surface, being made, the skin was dissected off from the tumor and turned back, and the tumor freed from its attachments by large and rapid incisions, although it adhered somewhat to the spinous processes of the vertebræ, and to the muscles and tendons near the spine. After cleansing the parts thoroughly, the skin was closed by adhesive straps and a bandage, and the wound healed to a considerable extent by the first intention.[1]

REMARKS.—Steatomatous, encysted, and hygromatous tumors are also sometimes found upon the back of the neck, as well as upon the shoulders, and may be treated by very much the same method. Some caution, however, is requisite in forming a diagnosis in these cases, lest they be confounded with Spina Bifida, the development

[1] Med. Record, vol. i. p. 400. 1819.

of which is occasionally seen in the median line of this region, whilst the tumors before referred to are most frequently seen on either side.

In Plate XLVIII. Fig. 2, may be seen an example of one of these tumors (Hygroma), which caused doubts in the mind of Auvert, as to its true character.

In wounds and fractures of the vertebral column, the surgeon may also be required to deliberate upon the propriety of such mechanical interference as may afford the hope of relief, though generally the chances of success will be quite as good when the case is left to nature as when any attempt at an operation is made by the surgeon. In cases of depressed fracture of the spinous processes, the soft tissues have been incised, and an attempt made to draw out the fractured portion;[1] but there is so little reason to anticipate any permanent benefit from such operations, that it must suffice merely to mention the fact of their having been performed. Wounds of the spinal marrow by the introduction of foreign bodies have also done well when left to nature, an instance in which a chisel divided the spinal marrow, and yet the patient recovered, having been reported[2] by Dr. Eli Hurd, of Niagara County, New York.

SECTION II.

TUMORS OF THE SPINAL CANAL, OR SPINA BIFIDA.

Spina Bifida, or Hydrorachis (ὑδωρ, water, and ραχις, the spine), is a disease characterized by the presence of a soft, fluctuating, and often transparent tumor, formed in consequence of the membranes of the spinal marrow being distended by liquid, and caused to protrude beneath the integuments or directly upon the back (Plate XLVIII. Fig. 4), in consequence of a congenital deficiency of some of the spinous processes of the vertebræ, whence the name of spina bifida, or bifid spine. From the observation of Chaussier, it appears that of one hundred and thirty-two children born during a period of five years, twenty-two suffered from spina bifida; and Billard has seen this complaint seven times in one year among the children in the Foundling Hospital of Paris.[3] Without entering upon an

[1] See cases of Drs. Alban G. Smith and Rogers. Bibliog. Index, p. 111.
[2] See Bibliography, p. 111.
[3] Dict. de Méd., tom. xvi. p. 49.

account of the pathology of the complaint, my present limits will compel me merely to say that it is, in many points, analogous to that of hydrocephalus, and often, though not always, conjoined with this disease, whilst it is also sometimes due to the formation of mere cysts in the part. Various means of treatment have been resorted to, among the most successful of which may be mentioned pressure and acupuncturation.

§ 1.—OPERATIONS FOR THE CURE OF SPINA BIFIDA.

The various methods of treating this complaint, as practised in Europe, seemed to have obtained but a very limited success; and the following results obtained by surgeons in the United States are, therefore, more deserving of attention, especially as they have occurred under circumstances where there could be no doubt in regard to the nature of the changes induced by the disease, or in the correctness of the diagnosis.

Operations of Dr. Amasa Trowbridge, of New York.[1]—A child, aged twenty-one months, was presented for advice in June, 1827, laboring under Spina Bifida. The tumor was seated over the lower cervical vertebræ; was as large as an egg; entirely covered with cellular substance, and fluctuating.

Operation.—A small silver wire being placed in a loop around the base of the tumor, the ends were passed through a short canula and drawn moderately tight, so as to produce slight inflammation on the surface at the base. Forty-eight hours having elapsed without any bad symptoms, the wire was then drawn tight enough to destroy all circulation in the tumor; twelve hours after which, the child became restless and feverish. In another forty-eight hours the tumor was dark-colored; suppuration had commenced around the wire, and the latter disappeared in the divided integuments, when, the tumor being excised above the loop, the wire came off and left an inflamed portion three-quarters of an inch in diameter, with an aperture, through which there was discharged turbid lymph or serum, with a slight arterial hemorrhage, which required the use of lint. A preternatural opening into the spinal canal being now discernible, situated between the two lower cervical vertebræ, the dressing of lint was left on for forty-eight hours, and then changed,

[1] Boston Med. and Surg. Journ., vol. i. p. 753. 1829.

as the fluid continued to discharge; but in twelve days more the wound had healed, and the child was subsequently as healthy as other children.

In a second case, aged two years and six months, the tumor was situated over the three lower cervical vertebræ, was represented as having been very large at birth, and now measured seven inches in circumference at its outer portion, something less at its base, and was about four inches in height. It was covered with integuments and natural skin, and fluctuation was quite distinct.

Being operated on in the manner just detailed, the ligature was allowed to remain four days after its first application, and drawn tighter three days after this, the child suffering from symptoms of phlegmonous inflammation. Nine days after the application of the ligature, the sphacelated tumor was excised; a wineglassful of turbid and bloody serum spouted out through the opening, and bleeding from an artery followed, which required the ligature. Under a similar treatment to that first detailed, the fluid was discharged from the aperture for eight days, after which the opening gradually diminished, and in four weeks from the operation the whole wound had cicatrized. A spinous process was found wanting in the vertebral column, and there was an opening through the vertebræ which admitted the point of the little finger.

In a third case, aged four years and three months, the tumor, which was situated over the sacrum, and three of the lower lumbar vertebræ, measured thirteen inches in circumference at the base, and seven in its projection from the back.[1]

Operation.—Incisions being made through the integuments, which were about an inch thick, from the upper portion of the base quite to the lower part over the sacrum, sufficient flap was left to cover the wound in a manner similar to that pursued in excising the female breast. On dividing the integuments, a cavity was found which contained several cysts filled with fluid, and attached to the spinous processes of the third lumbar vertebra. The spinous processes above and below were wanting. There being no communication with the spinal canal, the cysts were dissected out and the child recovered perfectly.[2]

Remarks.—Dr. Trowbridge reports having seen about thirty cases of spina bifida in all points of the vertebral column, and has

[1] Boston Med. and Surg. Journ., vol. i. p. 754. [2] *Opus citat.*, p. 755.

tried puncture, compression, ligature, incision, &c., and often failed, but "prefers the ligature, as above directed, in all cases where the base of the tumor admits of its application."[1] By not tightening the ligature too much at first, only moderate inflammation is induced and the sympathetic disturbance is diminished.

Operation of Dr. Charles D. Skinner, of North Carolina.[2]—The patient, aged seventeen months, presented a tumor on the spine more than three and a half inches long, two and a half wide, and one and a half deep, extending from a level with the iliac crest to near the verge of the anus, the contents of which, by firm pressure could be mostly compressed into the spinal canal. At first, a puncture with a very fine needle drew off a few drops of liquid; two days subsequently, a larger needle drew off a drachm; at another period half an ounce, then an ounce, and then an ounce and a half, after which pressure was applied around the base of the tumor. After about seventy punctures had been made without any serious accident, and the tumor had become reduced to one-fourth of its original size, an indiscretion of diet induced diarrhœa, under which the patient sank.

Operation of Dr. Alexander H. Stevens, of New York.[3]—A child eight months old, presented a tumor nearly similar in position and size to that just described. Being punctured with an iris knife, about four ounces of clear serum issued from the opening, without causing inconvenience. Three days subsequently the operation was repeated, but not more than an ounce escaped. The next day it was again punctured in three places, and about four ounces escaped without bad symptoms, and continued to ooze for nearly twenty-four hours after the operation, the child showing some febrile symptoms, which were thought to be partly due to teething. Evaporating lotion was then kept applied to the tumor, and the sac was not again punctured. These febrile symptoms soon disappeared, and the child, when seen several months afterwards, showed nothing of the disorder except a small lump of indurated and corrugated integument. In this case the fluid was always evacuated very slowly, that is, at the rate of about three drops in a second, about one-third being left in the sac, and slight pressure

[1] Boston Med. and Surg. Journ. vol. i. p. 757.

[2] Am. Journ. Med. Sciences, vol. xix. p. 109. 1836.

[3] *Ibid.*, vol. vi. p. 527. 1843.

being made after each operation; and much of the success of the treatment is ascribed by Dr. Stevens to this mode of proceeding.

Operation by Dr. D. Brainard; Injection of Iodine.[1]—An idiotic girl, aged thirteen years, had a tumor at the top of the sacrum nine inches in circumference, and about three in height, with thin walls; had been paralytic in her lower limbs, but recovered a partial use of them a short time previous to the operation. All her discharges were passed without attention to cleanliness. Under these hopeless circumstances the operation was performed.

Operation.—A small puncture being made with a lancet on the sound skin about half an inch from the base of the tumor, a trocar and canula the size of a common knitting-needle were carried into the sac. Through the canula a solution of iodide of potash grs. j, iodine grs. ss, and water ℥j, was thrown into the sac, and the instrument withdrawn. A severe pain followed, but soon subsided; compresses and a bandage were applied to prevent the escape of the fluid, and the child was laid in bed. Redness, heat, and tension of the tumor with tenderness, and some fever supervened, but in the course of a week these symptoms subsided, and the tumor became soft, yielding, and diminished in size. Compression was then applied with as much force as could be borne. Fifteen days after the operation, the tumor was half its original size, when a second injection, half the strength of the first, was thrown in, and caused but little heat and pain, compression being continued. Nineteen days subsequently the fluid was so far absorbed, as to render it easy to press the tumor nearly to the level of the surrounding skin, when a spring truss was applied to the part, and under this the child improved.

Remarks.—The success attending the treatment of the cases just recited, is certainly sufficient to justify the surgeon in resorting to similar means when similar circumstances demand it. The suggestion of an injection of iodine into the cavity of the tumor, as made by Velpeau, and practised by Dr. Brainard, is due to the analogy supposed to exist between spina bifida and hydrocele, and the result it was hoped would authorize a repetition of this operation; but as this resemblance is not perfect, great care should be employed, lest death ensue from an inflammation of the spinal canal. In a paper subsequently published[2] by Dr. Brainard, he states that

[1] Amer. Journ. Med. Sciences, vol. xvi. N. S., p. 262. 1848.

[2] North-West Med. and Surg. Journal, vol. iii. p. 107.

the number of injections used in this case was fifteen, and that the time required for the cure was ten months, the patient being in good health two years subsequently. In encysted spina bifida, or that in which the communication between the sac and the cavity of the spinal canal is obliterated, this injection may again succeed, and prove to be an excellent plan of treatment. But in spina bifida complicated with hydrocephalus, or in that where the medullary canal is pervious, inflammation of the pia mater, or of the spinal marrow itself, should be anticipated, and then the propriety of exposing the patient to such a risk carefully weighed. In the case of an infant a few days old, treated by Dr. Brainard in 1849,[1] by the same injection, death supervened in about seven weeks; and in another three months old, treated by him in 1850,[2] death followed in about four weeks. In another child, four days old, laboring under spina bifida and hydrocephalus, both the cavities of the spine and cranium were injected at different periods, and the injections repeated several times. In this case there was good reason to hope for success, as the child exhibited great tenacity of life, but in the seventh month of the treatment this child also died in convulsions. Dr. Brainard, however, regards spina bifida as a curable disease, by a similar treatment; although success, as he says, must not always be anticipated. A careful perusal of his paper compels me, however, to dissent from this opinion; and I should certainly regard the operations of Drs. Trowbridge, Skinner, and Stevens, as safer and better adapted to the cure of the majority of the cases that may be presented for treatment.

[1] North-West Med. and Surg. Journal, vol. iii. p. 109.

PART IV.

OPERATIONS ON THE GENITO-URINARY ORGANS AND RECTUM.

CHAPTER I.

OPERATIONS ON THE MALE GENITO-URINARY ORGANS.

THE genito-urinary organs in man being intended for the performance of two distinct functions, to wit: the conveyance of sperm into the female, and the evacuation of the urine, occasionally demand the aid of the surgeon, either in order to remedy congenital defects, or to relieve the evils resulting from disease. Of the operations performed upon them, some are intended for the relief of deformities, and are limited solely to the body of the penis; whilst others, being intended to favor urination, are confined to the urethra. Some are limited to the testicles, and others to the removal of foreign bodies from the bladder; the latter having a special importance, will be referred to in a distinct chapter.

From the varied character of the structures concerned in these operations, it is apparent that anything like a detailed account of each part would necessarily lead into the domain of special anatomy; but, as it may facilitate the reader's comprehension of the steps of operations subsequently to be described, I shall present a brief account of their general relations to each other.

SECTION I.

SURGICAL ANATOMY OF THE MALE ORGANS.

The genito-urinary organs of man consist in the testicles and vesiculæ seminales, and in the penis, urethra, and bladder, the penis being common both to procreation and urination.

§ 1.—THE PENIS.

The penis is attached to the front of the bones of the pelvis, at and below the symphysis pubis; is formed of skin, loose cellular tissue, corpora cavernosa, corpus spongiosum, and the urethra, and varies in size according to the vascular condition of the corpora cavernosa.

The skin of the penis is loosely attached to the body of the organ by a cellular tissue which permits great freedom of motion. At the glans penis, or anterior extremity of the organ, it is thrown into a duplicature or fold (prepuce), the inner layer of which is blended or lost in the mucous membrane covering the glans penis. In consequence of this the prepuce consists of two laminæ, the inner of which is inserted at the base of the corona glandis. Between these two layers, is a loose cellular tissue, liable to a serous or lymph-like infiltration, which sometimes materially interferes with the mobility of the part. Ordinarily, the prepuce may be retracted, or drawn forward so as to expose or cover the entire glans, though congenital defects or diseased action may so limit this movement as to prevent the exposure of the glans to any extent. The corpora cavernosa and corpus spongiosum are not sufficiently connected with the operations usually practised on this part to require further reference at present.

§ 2.—THE URETHRA.

Although the urethra is actually a portion of the structure of the penis, the direct connection existing between it and the bladder, has led anatomists to describe it as if it were an appendage of the bladder. The importance of the canal, and the danger ensuing upon its obstruction, owing to its being the only channel for the escape of the contents of the bladder, has, however, led surgeons to a specific study of it, and to the establishment of certain regional divisions, the limits of which are useful, though purely optional.

The extent of the penis being very varied, a considerable diversity of opinion exists in reference to the average length of the urethra, or the true distance from its orifice to the neck of the bladder.

According to Blandin,[1] its length varies from eight to nine inches, as measured in a median section of a flaccid penis whilst laid upon the abdomen, and, of course, a little elongated.

Malgaigne,[2] on measuring it also in the flaccid condition, but hanging down upon the scrotum, found it to be, on an average, six, or six inches and two-fifths long. In old men, hypertrophy of the prostate augments it two-thirds of an inch, or even more.

Dr. Pancoast, of Philadelphia,[3] has found that, in the negro or mulatto, the average length is about seven inches, measuring from the end of the urethra to the neck of the bladder in the flaccid penis, and about one inch more when elongated by moderately stretching the organ; but as the genital organs of the negro are generally more developed than those of the white, it may be safely inferred that six, or six and a half inches, in white men, measuring from the orifice of the urethra, should suffice to place the point of an instrument within the neck of the bladder.

The regional division of the urethra into fossa navicularis, bulbous, prostatic, and membranous portions having reference to certain points of the genital organs through which the canal passes, does not require detailed reference in connection with operative surgery, but belongs more especially to the descriptions of special anatomy. It must, therefore, suffice to say that, according to Malgaigne,[4] the prostatic portion of the urethra is from seven to eleven lines in length, and the membranous from six to nine lines, the bulbo-cavernous portion being the only part which is influenced by stretching the penis.

Mr. Henry Thompson, of London, in a recent work,[5] after many trials, gives the following accurate data. The greatest length of the urethra is 9 inches, and the least 7¾. The length of the spongy portion 6½ inches, of the membranus ¾ of an inch, and of the prostatic portion 1¼ inches, the average length of sixteen urethræ being 8¼ to 8⅜ inches—in the dead subject; but in the living he regards the statement of Mr. Briggs as correct, to wit, that the average length of the living urethra is 7½ to 7¾ inches.

[1] Anat. Topographique, p. 384.
[2] Op. Surg., Philadelphia edit., p. 467.
[3] Pancoast, Wistar's Anat., vol. ii. p. 170.
[4] Op. Surg., Philadelphia edit., page 469.
[5] Pathology of Stricture, Jacksonian Prize, 1852.

Ordinary Operation.—In the mode of operating resorted to under ordinary circumstances, the patient is so placed that he cannot move from the surgeon, when the latter, after carefully introducing a director between the prepuce and the glans, as far back as the corona glandis, passes a sharp-pointed bistoury along it, punctures the skin from within outwards at the end of the director, and then slits open the membrane from behind forwards in the median line, upon the dorsum of the organ (Plate XLIX., Fig. 2). The glans being thus exposed, it only remains to unite the fold of skin and mucous membrane together by three stitches of the interrupted suture, and treat the wound as a simple sore.

Operation of J. Cloquet.—In consequence of the wings, or lateral lumps, left by the preceding method, Cloquet suggested the following operation, which has since been frequently performed by Liston and others, and often spoken of as Liston's operation:—

Introduce a director between the glans penis and prepuce, on the inferior side of the organ, and place it parallel with and alongside the frænum, taking care that it is not by any mischance carried into the urethra. Then passing a sharp-pointed bistoury along it to the corona glandis, transfix the prepuce, and slit it up from behind forwards on the side of the frænum, when the glans will be fully exposed (Plate XLIX., Fig. 4). After this, a point or two of the interrupted suture, made so as to unite the skin and mucous membrane on the free side of the flap, completes the operation.

Operation of Cullerier.—As the constriction of the preputial orifice is often dependent on a contracted condition of the lining membrane of the prepuce, this surgeon operated by incising only the mucous membrane, commencing at its free edge and cutting backwards to a sufficient extent to permit the free expansion of the skin. A somewhat similar plan has been recommended by Dr. E. Peace, of Philadelphia, and found to be efficient.

Remarks.—Although the operations for the relief of phymosis are simple, the future usefulness of the organ and the absence of evident deformity will depend somewhat upon the plan selected. Where the defect is a congenital one, the selection of the method is entirely in the power of the surgeon, and, under these circumstances, the advantages of the different plans should be well considered, especially if the patient is an adult. In the operation of circumcision, as usually practised, the cicatrization of the wound is apt to leave such a constriction of the mucous membrane as pre-

vents the free exposure of the gland, and has occasionally led to the production of a new phymosis. To obviate this, it will, therefore, be found advantageous, where circumcision is practised, to pursue the Jewish plan of operating, and, after excising the skin, to tear up the mucous membrane longitudinally on the dorsal surface of the penis, or, as suggested[1] by Maisonneuve, of Paris, after circumcising the skin alone, simply to incise the membrane on the dorsum of the penis to the extent of a centimetre, and cut off the angles of these flaps, uniting them afterwards with the skin, as by this means the constriction of the cicatrix is prevented, in consequence of the more prompt union of the surface, and the separation of each side from the other after the angles of the wound have been removed.

Frequent opportunities of testing the advantages of the plan of Cloquet having satisfied me of its value, I do not hesitate to recommend it as that best adapted to the adult, because it fully exposes the glans, and leaves little or no lateral deformity, as is frequently the case in the dorsal incision. Should the existence of chancres near the frænum, or other circumstances, prevent its performance, and compel the adoption of the dorsal cut, I should prefer excising the two flaps and uniting the mucous membrane and skin at the line of the corona, so as to leave the glans permanently uncovered.

§ 2.—PARAPHYMOSIS.

PATHOLOGY.—The word Paraphymosis (παρα, back, and φιμοσις, a bridle) is employed to designate that state of the penis in which the prepuce is drawn back and contracts behind the corona glandis, so that it cannot be again brought forward. In many instances, this condition is owing to a difference between the two layers of the prepuce, the skin being the narrowest, though it may be caused by the constricted margin of the prepuce being so distended by the shape of the head of the penis, that it readily slips over to the corona, but cannot subsequently be drawn forwards in consequence of the congestion and enlargement of the glans which ensue upon its constriction.

When a paraphymosis is allowed to continue, the prepuce may

[1] Gazette des Hôpitaux, No. 13, 1853.

slough, or adhesions form, so as to render the thickened folds behind the glans a great deformity. To obviate this, two means of treatment may be resorted to; one (compression) having for its object the diminution of the bulk of the head of the penis, and the immediate anteversion of the retracted prepuce; the other (incision), the division of the constricting ring or margin of the prepuce, or, if necessary, its dissection from the attachments formed behind the corona.

I. COMPRESSION.

After bathing the part in cold water, or keeping cold cloths constantly on it, compression, which is the simplest of these operations, may be attempted as follows:—

Operation.—Place a piece of soft linen upon the retracted prepuce, seize it just behind the glans between the first and second finger of each hand, so as to draw it forwards, and at the same time apply the thumbs against the extremity of the glans, so as to knead and force it backwards, when, after a gentle perseverance, success will be obtained, in most instances, especially if the attempt is made within two or three hours after the occurrence of the retraction, otherwise it will be more difficult (Plate XLIX., Fig. 9). Where there is much œdema of the prepuce, and the mucous membrane is highly tumefied, it may be necessary, and I have often found it advantageous, to puncture the membrane at numerous points, so as to give exit to the serum and allow of the more ready movement of one layer of the prepuce upon the other, after which compression should be made as before directed.

II. INCISION.

When the constricting prepuce is so tight, or the adhesions so close that it cannot be made to yield to the force applied through the fingers, it may become necessary to resort to the knife.

Operation of Incision.—Let one assistant retract the skin of the penis as much as possible towards the pubis with one hand, and draw the prepuce forwards with the other so as to display, if possible, the seat of stricture, after which the surgeon may nick it

with a bistoury, either by cutting from behind forwards, or introducing a director, and dividing the stricture upon it; or, what is more easily done, make a vertical cut through the prepuce from above downwards and from the mucous membrane to the skin, until the constriction is freely removed. The latter operation, by enlarging the prepuce, prevents a reproduction of the disease.

§ 3.—DIVISION OF THE FRÆNUM.

When from congenital defect the frænum extends as far forwards as the extremity of the urethra, it may depress the point of the glans, and cause inconvenience in sexual intercourse; or the irritation and laceration of the part, or mental anxiety in regard to the defect, may lead the patient to insist upon its section. Under these circumstances, the operation for its relief may be performed as follows:—

OPERATION.—After arranging the patient so that his motions can be controlled, retract the prepuce, and let an assistant hold it back and support the penis, whilst the surgeon, drawing the frænum from the glans with his left hand, transfixes it with a bistoury held in the right (Plate XLIX., Fig. 1), so as to cut from behind forwards and shave it off. A piece of linen to prevent adhesion is all that is subsequently requisite, or the surface may be lightly cauterized.

§ 4.—AMPUTATION OF THE PENIS.

Amputation of the penis may be demanded by wounds, gangrene, &c., as in the operation practised upon the extremities, though cancer is the most frequent cause of its performance. When demanded, the anatomical relations of the organ should be borne in mind, especially the loose attachment of the skin, and the tendency of the penis to shrivel up and contract upon itself, after being stretched. The latter circumstance is often a source of trouble where means are not taken to obviate it, the surgeon being worried by the unexpected difficulty found in arresting the bleeding, or annoyed by the excess of skin over the stump, in consequence of his elongating the organ during his incisions. When the amputation is to be performed low down, or near the pubis, especial care should be

taken to avoid drawing the skin too much forwards, lest that over the pubis or scrotum be removed unintentionally.

Operation.—Having prepared a small catlin, together with ligatures, tenaculum, and forceps, the hair should be shaved from around the part, and the glans and free end of the organ wrapped in a bandage so as to give the operator a good hold upon the member. Then, whilst the patient is in a convenient position, the surgeon, without drawing upon the portion held in his left hand, should pass the catlin rapidly round so as to divide the skin (Plate XLIX., Fig. 10); then cut through the upper part of the corpora cavernosa, ligate the arteries, and, resuming the knife, finish the operation by dividing the remainder of the organ at one sweep.

Dressing.—After arresting the hemorrhage, a catheter may be passed into the urethra, and the stump dressed like any other stump, the catheter serving to keep the patient dry, and steady the organ during the dressing. As, however, the urine will do no harm to the wound, and irritability of the bladder may render the use of the catheter objectionable, a resort to it must be decided upon at the moment by the judgment of the operator.

Remarks.—The performance of amputation of the penis at the pubis does not differ materially from the plan just detailed for the operation upon the body of the organ. An elliptical incision will, however, be preferable to the circular one above mentioned, care being taken to avoid encroaching too much upon the skin of the scrotum. When the penis is removed near the pubis, the patient is also more apt to be annoyed by the urine passing upon his thighs and perineum, unless he places himself in a sitting position. Under all circumstances, the mental depression after the operation is often sufficient to prevent proper digestion and assimilation, and, the return of a malignant disorder being thus hastened, it may be doubted whether, in the case of cancer, anything is gained by the operation. In one patient, under my own care, though life lasted for nearly two years after the removal of the organ in consequence of cancer, his existence was one of extreme unhappiness, the man being constantly distressed by mental anxiety and bodily pain, and the disease showing itself in the stump in a few weeks after the amputation.

PLATE L.

INSTRUMENTS FOR OPERATIONS ON THE URETHRA.

Fig. 1. A Male Silver Catheter. The eye is better than the perforations usually made, as such an opening will not clog with mucus. Schiveley's pattern.

Fig. 2. Curve of the catheter adapted to old men with enlarged prostate. After Dorsey.

Fig. 3. Small silver sound for the purpose of dilating or detecting a stricture of the urethra. Schiveley's pattern.

Fig. 4. Largest size sound for same purpose. " "

Fig. 5. Smallest size of the instrument. " "

Fig. 6. Flexible lead bougie for dilating strictures; it may be retained in the bladder many hours without creating irritation. Schiveley's pattern.

Fig. 7. French Bougie with a "porte empreinte" for taking a cast of a stricture. 1. The "porte empreinte." From the instrument.

Fig. 8. Amussat's instrument as applied to dilate a stricture; being introduced closed, the loop is expanded by the screw. Schiveley's pattern.

Fig. 9. Chew's stylet for dividing stricture. It is to be introduced into a silver catheter, like Fig. 14. Schiveley's pattern.

Fig. 10. French pointed gum-elastic bougie for dilating stricture. From the instrument.

Fig. 11. Physick's stylet for incising stricture in the spongy portion of the urethra. 1. Slide to mode the blade. Schiveley's pattern.

Fig. 12. Steel bougie silvered, and of double curve, to dilate strictures; there are two ends, of different sizes, embraced in each instrument. Schiveley's pattern.

Fig. 13. Lallemand's porte-caustic for cauterizing the urethra. 1. Cup for the caustic. Schiveley's pattern.

Fig. 14. A curved catheter and stylet for dividing strictures near the neck of the bladder. Schiveley's pattern.

Fig. 15. Extra end of another curve. " "

Fig. 16. Physick's Bougie Catheter for entering the bladder in cases of stricture. After Dorsey.

Figs. 17, 18. Shape of the piece of wax-cloth before it is rolled into the bougie, and attached to the catheter. After Dorsey.

Fig. 19. The complete instrument. " "

Fig. 3.

Fig. 1.

Fig. 4.

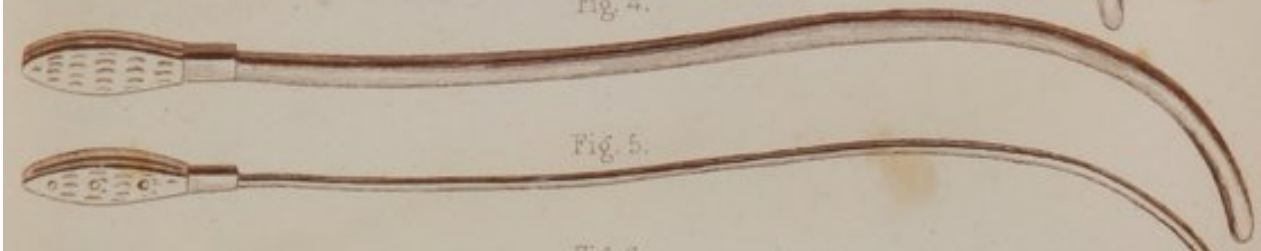


Fig. 5.

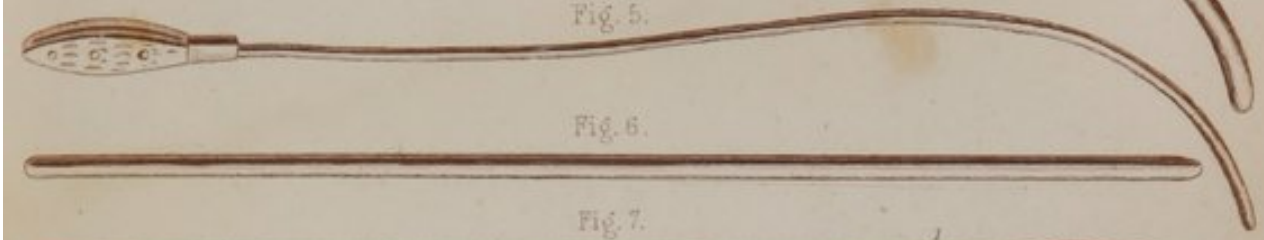


Fig. 6.

Fig. 7.

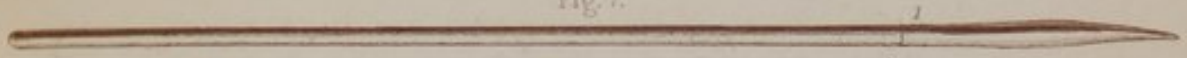


Fig. 8.

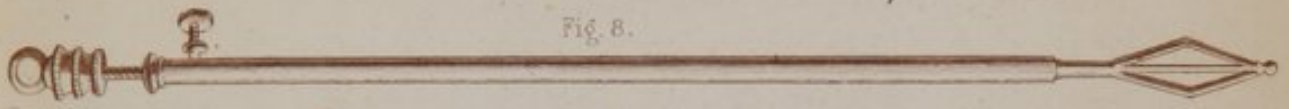


Fig. 9.

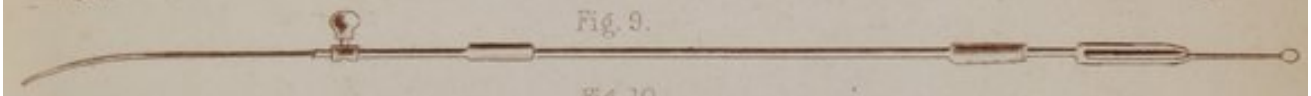


Fig. 10.

Fig. 11.

Fig. 12.

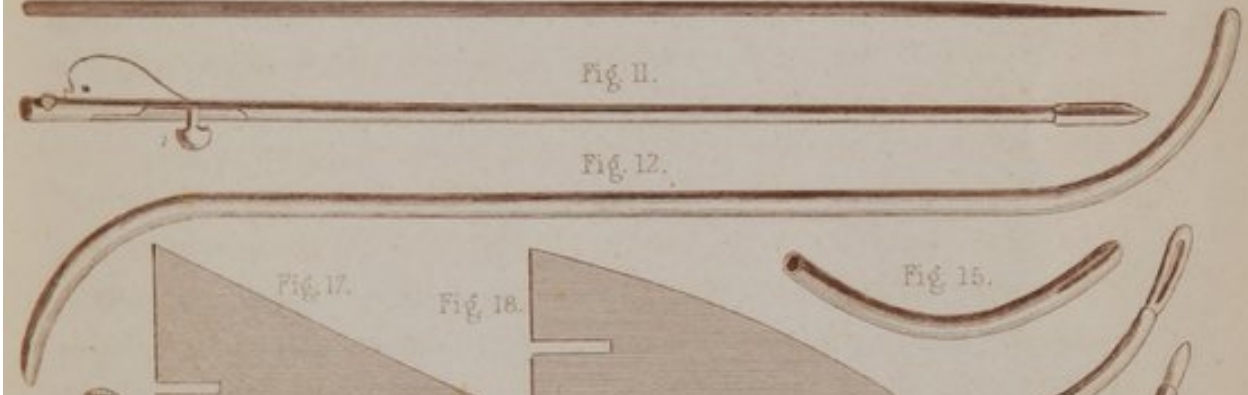


Fig. 17.

Fig. 18.

Fig. 15.

Fig. 13.

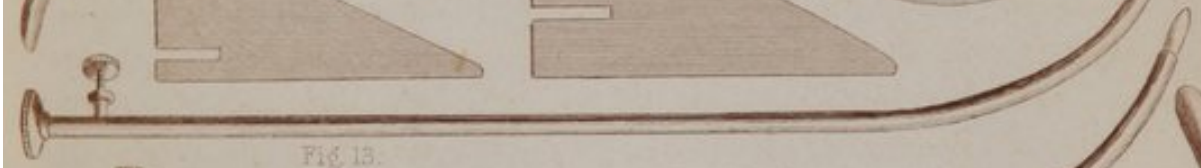


Fig. 14

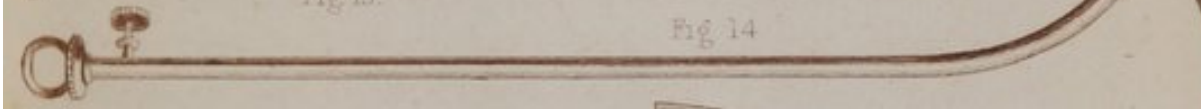


Fig. 16.

Fig. 19.

Fig. 2.

SECTION III.

OPERATIONS ON THE URETHRA.

The necessity of passing through the urethra in order to accomplish the treatment of some of the complaints of the bladder, has caused many operations to be placed under this head that do not strictly belong to this region; such, therefore, as involve disorders of adjacent parts may be advantageously referred to a subsequent section. At present, catheterism, stricture, and congenital malformations of the canal will alone be considered.

§ 1.—CATHETERISM.

The removal of urine through the hollow tube called a catheter constitutes the operation of Catheterism, and is one which in the normal condition of the canal, and in skilful hands, is easily performed. Various details may, however, be given, in order to facilitate the progress of those who are inexperienced.

I. CATHETERS.

The selection of the catheter (either of silver or caoutchouc) is so purely a matter of personal opinion, that nothing need be said in reference to the material, except to discountenance the use of gutta percha, which is dangerous from its brittleness. When the surgeon, especially in the country, is so placed as to find it desirable to evacuate a patient's bladder whilst unable to obtain the regular instrument, the following practice, suggested and occasionally advised by the late Dr. Physick, may prove worthy of being noted. In a case of great emergency, this distinguished surgeon resorted to a common article of dress, and formed a catheter by regularly extending the elastic spiral wire often found in the suspenders of gentlemen, covering it with a piece of muslin which had been dipped in melted beeswax, and then cutting eyes near the point.[1]

[1] Dorsey's Surgery, vol. ii. p. 167.

Another excellent contrivance, suggested by a surgeon in the United States whose name has escaped my recollection, is to hammer out a piece of sheet-lead, and, rolling it round a large knitting-needle, afterwards make eyes in it as required.

A method of treatment that has proved effectual in cases of retention of urine from spasm, and which may be employed even when the surgeon cannot obtain a catheter, is the injection of warm sweet oil, as suggested by the late Dr. Hewson, of Philadelphia. The point of an injection syringe being introduced into the urethra, and the canal held closely around it by an assistant, gentle and steady pressure upon the piston will force the warm oil to the neck of the bladder, where its pressure will often suffice to induce relaxation of the spasm.

II. ORDINARY OPERATION OF CATHETERISM.

Whilst the patient is lying down with the shoulders elevated, the knees flexed, and breathing freely, so as to insure relaxation of the abdominal muscles and prevent straining, the surgeon should place himself upon the left side, oil the instrument, and seize the corona glandis between the ring and second fingers of the left hand in a state of supination (Plate LI., Fig. 1), or between the forefinger and thumb. Then seizing the handle or end of the catheter with the right hand, so that the back of the fingers may be below or next to the abdomen and the thumb on top, introduce the point of the instrument into the urethral orifice, holding the penis perpendicularly to the pubis, and the body of the instrument parallel with the median line of the abdomen, with its concavity presenting to the pubis. After passing the point a short distance into the canal, gradually elevate the right hand, and keeping the point of the instrument in contact with the superior side of the urethra, press the catheter towards the bladder, bringing its handle or free end from the horizontal to the perpendicular position, so as to cause the point to pass through the bulb of the urethra. Then, gradually depressing the handle so as to bring the shaft parallel with the thighs of the patient, cause the point to mount over the triangular ligament, when the gush of urine may be checked by the thumb placed over the orifice of the instrument until a vessel is held to receive it. In this movement, the end of the instrument should be made to describe

the arc of such a circle as will enable the point to pass readily behind the pubis, as is shown in Plate LI., Fig. 4. After evacuating the bladder, keep the end of the catheter closed with the thumb until the instrument is removed from the patient and held over a vessel, when, on freeing it, the urine which has filled the instrument will escape without soiling the patient.

The "Tour de Maître," or "Master-stroke," consists in passing the catheter through the spongy and bulbous portion of the urethra, with its mouth presenting to the patient's feet and with the convexity of the instrument towards the pubis. Then, on reaching the perineum, turn the catheter rapidly around so that its concavity will be towards the pubis, and, rapidly depressing the handle of the instrument, slip its point quickly into the bladder. This ad captandum movement does not possess a single advantage over the plan just described, and savors somewhat of charlatanism. All rapid movements in the introduction of instruments into the urethra should be discouraged, as they unnecessarily expose the patient to danger from the laceration of the canal, or from the creation of a false passage. Some surgeons, when passing the catheter, prefer that the patient should stand up, with his back against a wall, whilst they seat themselves in front of him, but the recumbent posture of the patient has always been the most convenient to me. In the introduction of the catheter in irritable patients, even when not laboring under any organic change in the course of the urethra, the mere passage of the instrument with all possible gentleness, will sometimes be followed by severe constitutional disturbance, such as rigors and fever, or by symptoms of local irritation, as a muco-purulent discharge or epididymitis. These symptoms being usually evidence of neuralgic irritation transmitted to the spinal system of nerves, may be best alleviated by warm hip-baths—by anodyne enemata, such as laudanum and starch—by a full dose of Dover's powder, and by rest in a warm bed, with the testicles supported by a suspensory bandage—or by leeches to the perineum, and the application of warm clothes, though most frequently rest and an anodyne will suffice without the employment of the other measures. When difficulty has been experienced in the introduction of a catheter, it may be retained in the bladder for two or three days, by attaching tapes to a ring or bandage around the penis, a plug being placed in the instrument so as to prevent the constant escape of the urine.

Remarks.—Under ordinary circumstances, or when the urethra

is in its normal condition, the introduction of the catheter cannot prove a difficult operation to any one who is familiar with the anatomy of the urethra. As a certain amount of dexterity is, however, only to be gained by practice, the student should endeavor to introduce an instrument into the bladder whenever he has the opportunity in the dissecting-room. In a healthy subject, practice will soon give the hand its cunning, whilst the difficulties occasionally met with in the patient, may be prepared for by a little study of the diseases of the urethra as found in the monographs on this subject, or by a reference to the brief mention of them to be found in the following section.

III. OBSTACLES TO CATHETERISM.

Although, as just stated, the introduction of an instrument into the bladder is, under ordinary circumstances, a very easy operation to one perfectly familiar with the anatomical relations of the part, it may be rendered one of great difficulty in consequence of certain peculiarities which will now be mentioned.

If the instrument is a fine one, its point is liable to enter and be held by an enlarged lacuna. To obviate this difficulty, withdraw the catheter a little and elongate the urethra by stretching the penis; or, the point of the instrument may pass readily as far as the membranous portion of the urethra, and hitch there in consequence of its being made to bear too much on the inferior side of the urethra, from the too sudden elevation of the handle, or it may be carried so as to strike against the lower edge of the triangular ligament. In these cases, when difficulty is experienced, the young surgeon should be especially cautious as to the amount of force that he employs to overcome it, as it is very easy to drive an instrument through the membranous portion of the urethra, and thus carry it between the bladder and rectum; or, make a false passage and create a perineal fistula in consequence of the point of the instrument being thrust into the perineum, or even, as I saw in one instance in the hands of an ignorant practitioner, brought out at the *tuber ischii*. Again, especially in old men, there may be such a condition of the third lobe of the prostate as will prevent the entrance of the instrument into the bladder, in consequence of the enlargement of the gland, as may be partially diagnosed by feeling the prostate through the rectum.

To overcome the difficulty created by an enlarged lobe of the prostate, it is absolutely necessary that the *point* of the catheter should be made to curve upwards a little more behind the pubis than is usually required, and various means of accomplishing it have therefore been suggested. The simplest of these is to introduce the left forefinger into the anus and press up the point of the instrument, whilst its free end is gently depressed to the level of the thighs; or where the flexible catheter with a wire stylet is employed, to resort to the expedient by which Mr. Hey, of England, accomplished the same object, that is, gently withdraw the wire a little, and push the catheter onwards, a practice which has often proved successful. The proper shape of a metallic catheter for an enlarged prostate, may be obtained by introducing the point of its curve or the end of wire, if an elastic instrument, into the tube of a key for the extent of a quarter of an inch, and then gently bending up the point.

As a flexible wax bougie, by adapting itself to the condition of the part, will often pass more readily than a catheter, Dr. Physick was accustomed to attach a bougie point to the ordinary catheter in the following manner:—

PHYSICK'S BOUGIE CATHETER.[1]—Cut off the point of a flexible French (gum-elastic) catheter, so as to leave the canal open throughout the instrument; then rolling up a piece of waxed linen so as to form a conical pointed bougie, make a slit half an inch long in its lower end, so that the rolled part may be inserted into the catheter. The other portion of the linen being now wrapped around the outside of the instrument, and fastened with a strong thread (Plate L., Fig. 16), the latter should be stitched through the end of the bougie and brought out of the open end of the catheter, so as to secure the extraction of the point, if accidentally broken off. This bougie catheter is readily made, and will often serve the purpose of evacuating the bladder better than any other instrument.

With patience and gentleness combined with practice, most of the difficulties attendant on the passage of a catheter through a diseased urethra may be overcome; those consequent on irritability of the canal, or a spasmodic contraction of the perineal muscles, yielding usually to gentle and continued pressure, and those due to stricture of the canal requiring the means spoken of under this

[1] Dorsey's Surgery, vol. ii. p. 170.

head. In cases of spasmodic stricture, or in any case requiring the use of a catheter in cold weather, it will prove useful to warm the instrument and grease it thoroughly with lard in preference to oil before using it.

Should these means, judiciously employed, fail to empty the bladder, its contents may require to be evacuated by cutting instruments, in the manner hereafter detailed under the head of "Puncturing the Bladder."

Occasionally it happens that a catheter, even when well placed in the bladder, will not evacuate its contents, in consequence of the over-distension of the viscus. As this effect is due to temporary paralysis of its muscular coat, it may be necessary for the surgeon to make gentle pressure over the pubis in order to aid in the evacuation of the urine.

In some instances, it happens that a surgeon is called upon to pass the catheter in a patient who has previously been injudiciously treated, and whose bladder is paralyzed from over-distension by the use of diuretics, or whose urethra has been torn by the forcible attempts at the introduction of an instrument so as to create a false passage. In treating such cases, great care is necessary in order to obviate the tendency of the catheter to enter the false route instead of passing along the true one. With an accurate knowledge of the urethra and a light touch, any deviation of the point of the instrument may, however, be readily told and obviated by withdrawing it a little, elongating the urethra, and then passing the catheter onwards, whilst its point is kept closely applied to the upper or lateral portions of the canal, the false route being nearly always found on the inferior surface of the urethra in consequence of the practitioner bearing the point of the catheter too much towards the perineum, after it has passed the bulb. Two-thirds of the false passages will also be found at or near the bulb, or in the membranous portion, or in advance of the triangular ligament, in consequence also of the too rapid elevation of the instrument from the level of the abdomen.

§ 2.—STRICTURES OF THE URETHRA.

PATHOLOGY.—Strictures of the urethra have been divided into those dependent on spasm of the part and those due to such morbid

changes in the parietes of the canal as result in a progressive diminution of its caliber, until at last it offers a marked obstacle to the escape of the urine from the bladder. The latter class of strictures, being the result of marked changes in the part, are usually designated as permanent strictures, and may be due to any cause capable of inducing inflammatory action in or around the mucous coat of the canal. Whether this action results in a simple bridle or thread-like deposit, or in one of greater breadth and extent, there is usually noted more or less thickening of the mucous membrane, as well as solidification or induration of the adjoining tissues. In front of a stricture there may be but little departure from the normal condition of the lining membrane of the urethra up to the edge of the obstruction; but behind it the canal is often considerably dilated, either in its entire circumference or on one side, whilst the adjoining lacunæ and entire mucous coat indicate the effects of these changes, by their various departures from the natural state. It has also been asserted that softening and dilatation are often present at one or more points adjacent to the stricture of the urethra as well as in that of the œsophagus.[1]

The most frequent seat of the permanent stricture is behind the bulb or at the commencement of the membranous portion, though it is also found at other points, and especially in the middle of the corpus spongiosum, where the urethra is liable to be bent in the attacks of chordee which accompany gonorrhœa.

Diagnosis.—The existence of stricture, though often indicated by marked symptoms, can only be accurately told by such an exploring operation as brings an instrument directly in contact with the obstruction. To do this correctly it is essential that the operator should have a correct knowledge of the natural relations of the part; that the bougie, sound, or catheter first employed, be sufficiently large to distend the canal and thus enable its point to escape the orifice of any enlarged lacuna, and that the ordinary difficulties referred to in catheterism be borne in mind, especially the liability to error caused by depressing the handle of the instrument too soon, or before its point has reached the triangular ligament of the urethra. After establishing the existence of a stricture it is also essential that its position, extent, character, and permeability be accurately learned before deciding on the plan of treatment.

[1] See p. 488, Part III. vol. i.

Various means have been suggested in order to demonstrate accurately the existence, situation, and condition of a stricture, among which the use of soft bougies, or those formed of waxed linen, have been the most prominent. When one of these instruments—of the full size—is oiled, carried down to and pressed firmly against a dense stricture for a few minutes, it softens by the heat of the body, and takes such an impression as will show accurately the position of the obstruction. But as the less dense strictures are incapable of marking their own position upon such an instrument, the following plan, which is a slight deviation from that suggested by Ducamp, will prove serviceable.

To take a Cast of a Stricture.—Take a piece of silk ribbon about two inches wide and three inches long, and cut it obliquely across (Plate L., Fig. 17); then pull out all the transverse threads to within three-fourths of an inch of the length of the piece; next melt equal parts of beeswax, shoemakers' wax, and resin in a cup; fasten the sound part of the ribbon to a wax bougie, by a stitch, or by thread wound around it, and dipping it into the melted mixture, saturate the longitudinal threads of the ribbon with the wax; dip this into cold water, and then mould it, by pressure with the thumb and fingers, into a conical shape (Plate L., Fig. 7). On carrying a bougie thus armed down to a stricture and pressing it gently against it, a perfect cast of the part may be taken, provided the bougie and waxed end are large enough to fill up the canal.

Treatment.—Having thus learned the character and position of the disease, attempts may now be made to overcome it, either by dilatation, incision, or the use of caustic, the selection of either plan being decided by the character of the obstruction, or the peculiar circumstances of the case. Dilatation is especially applicable to recent, and not very contracted strictures, or to patients who can be kept under treatment a considerable length of time, or have sufficient intelligence and judgment to enable them to continue the introduction of an instrument after they have left their surgeon. Incision should seldom be employed except in old, dense, and almost impermeable strictures, where the patient can be subsequently watched; and caustic proves most useful in similar cases where, from the position of the stricture, its puncture would be attended by great uncertainty, as in the membranous portion of the canal, or in those patients in whom the alterative effect of the caustic may lead to a modification of the surrounding tissues and the possibility

of continued dilatation. The value of these different means of treating stricture have been variously estimated, some surgeons preferring one plan, some another, and some a combination of all. I shall therefore describe them separately, and state the estimate of their value subsequently.

I. DILATATION.

Dilatation of a stricture consists in expanding it by the introduction of such an instrument as is capable of entering within the limits of the contraction, and can only result from the application of a force which shall act from within. It is evident, therefore, that this mode of treating the complaint is only applicable to such strictures as are sufficiently patulous to permit the entrance of the dilating instrument, and sufficiently flexible to permit of the distension of the parietes of the canal. Dilatation is therefore usually accomplished by first passing a large metallic sound, or flexible bougie down to the stricture, in order to show its distance from the fossa navicularis; then passing one sufficiently fine to penetrate it, and then another, each of them being allowed to remain a few minutes at a time, unless they cause great irritation, or constitutional disturbance, when they should be withdrawn, and not replaced until next day. If they do not excite too much irritation, each sound may be followed by one of greater bulk, until at last the stricture is sufficiently distended to permit the free passage of the urine. In some instances, surgeons have advised the employment of special dilators; thus, Mr. Arnott, of England, employs an instrument which he terms a "fluid dilator." Perrève, of Paris, recommends a two-bladed steel dilator, the blades of which are introduced closed, and then made to expand by a screw at the free end. A similar one has been also advised by a Mr. Holt, of England, and Mr. Wakely[1] uses a series of hollow tubes, each of which is passed over the one first introduced, so as gradually to increase its thickness. Dr. Parrish, of Philadelphia, recommended[2] a tapering silver bougie, and Dr. Gross, of Kentucky, prefers[3] a common silver catheter, with a slightly conical point.

Bougies, made of the bark of the Ulmus Fulva, have also been suggested within the last few years by Dr. Waters, of Maryland, and

[1] London Lancet, vol. i. 1851.
[2] Surgical Observations, p. 295.
[3] Diseases of Urinary Organs, p. 635.

by Dr. McDowell, of Missouri, as especially advantageous in dilating strictures; but personal experience has shown me that they are brittle, dangerous, and have no advantage over the bougie of gum-elastic. Those of gutta percha are also objectionable, and have been broken off in the canal.

Operation of Dilatation.—In order to treat a stricture by dilatation, the surgeon should first give his attention to the preparation of the general health of the patient, and especially to the condition of his digestive organs, so that there may be no irritation subsequently excited by the passage of phosphatic, or otherwise disordered urine. Then, if the patient is irritable, let the surgeon also quiet the system by gentle anodynes and the use of the hip-bath, with rest, or let him employ anæsthetics during the operation. Having thus attended to the constitutional treatment, let him select such an instrument as he deems best (my own preference being for the solid metallic bougies, with a broad handle like a sound, and a smooth and slightly tapering point, Plate L., Figs. 4, 5), and after warming and greasing it, carry it down to, and, if possible, within, the stricture; retaining it there for a few minutes; or, if this cannot be accomplished, carry it to the face of the stricture, and allow it to remain there as long as the patient can bear it without inconvenience, whether it be five minutes or two hours, though usually few persons will be able to sustain the pressure of the instrument either within or against a stricture more than half an hour at a time, and some, only half a minute. If the patient, on the contrary, is "case-hardened," most of these precautions may be omitted, and the instrument be passed to the stricture, held there a few minutes, removed, and then the patient permitted to attend to his ordinary avocations, if not of too laborious a kind. Many patients walk to the surgeon, have a bougie passed, and travel about all day without inconvenience; whilst others will have rigors and the constitutional disturbance referred to in connection with catheterism, from the simple introduction of the most highly finished instrument. Sudden and forced dilatation of a stricture has been advised by some of the European surgeons, and occasionally proved useful, but it is a dangerous plan of treatment, even in skilful hands, and no others should attempt it, as it has very often resulted in a "false passage." Very often the single introduction of a bougie through a stricture will be followed by benefit, but generally the operation must be repeated for many months, until the absorbents have been

sufficiently stimulated to remove the disease. The further observations on the treatment of dilatation will be reserved for the end of this section.

II. INTERNAL INCISIONS IN STRICTURE.

The internal division of stricture is especially applicable to such cases as are too dense to admit of dilatation, or so tight or so situated as to render it difficult or impossible to enter them. In these cases, it has been suggested to cut through the induration by means of a lancet applied so as to act through the urethra itself. Such an incision is especially demanded in cases where it is required to evacuate the bladder promptly, or in those where the resistance forbids the hope of any advantage from dilatation.

INSTRUMENTS.—Among the various instruments resorted to by surgeons for the purpose of dividing a stricture, I shall select as especially good the lancet, or stylet catheter of Dr. Physick, of Philadelphia, and that of Dr. Chew, of New Orleans.

PHYSICK'S STYLET CATHETER FOR DIVIDING STRICTURES.—This instrument consists of a silver catheter, curved so as to pass readily as far as the stricture, in which is concealed a lancet that may be protruded at pleasure. (Plate L., Figs. 11, 14.)

OPERATION.—The catheter being passed down to the stricture, is pressed against the obstruction, the lancet protruded to the extent of two or three lines, so as to cut into the thickened part, the blade retracted, and the catheter again pushed forwards in the opening thus made, until at last it can pass beyond the obstruction, and restore the permeability of the channel. A common catheter being afterwards introduced, should be allowed to remain a few days, until the incisions have healed; when, by repeated introductions of a dilating bougie, the subsequent contraction of the part may be prevented.

CHEW'S INSTRUMENT FOR INCISING AND DILATING A STRICTURE.—A useful modification of the stylet of Physick may be found in the instrument of Dr. Chew, of New Orleans (Plate L., Fig. 9). This instrument consists of a silver catheter, open at the point, and split so as to permit a double-edged knife to be projected from it. The point of the knife is blunt, and pierced for the passage of a probe-pointed wire. The knife and probe being closely withdrawn within the point of the catheter, the latter is passed down to the stricture, the probe, gradually protruded, passes within it, and the knife,

guided in the proper course by the probe, is pushed on gradually, until it divides the stricture; when, being retracted, the catheter is pushed on into the bladder, and the parts subsequently dilated by the constant use of bougies.

Remarks.—The advantages of the treatment of stricture by internal incision, like that by dilatation, being also a point on which there is a diversity of sentiment, the estimate of its value will be deferred till after the consideration of the other means of treatment. Should the operation create severe constitutional disturbance, it must be counteracted by the employment of the means advised in the use of the catheter.

III. EXTERNAL INCISIONS IN STRICTURE.

In some cases of stricture where it has been found impossible to pass an instrument, and especially in patients who had stricture in advance of the bulb, the older surgeons made a buttonhole incision from without inwards, as follows:—

Operation.—A director or sound being passed down to the stricture, was there held by an assistant whilst the surgeon made an incision through the inferior portion of the parietes of the urethra, upon the point of the sound. Then directing the patient to endeavor to urinate, the surgeon passed a probe in at the bottom of the wound, and searched for the portion of the urethra behind the stricture, or cut backwards until he found it; after which a catheter was carried into the bladder through the penis, and the opening in the urethra closed upon the catheter by sutures.

Remarks.—This operation having been occasionally demanded, its performance has been followed by results of a satisfactory kind, in a class of cases which appeared otherwise to be hopeless, and under slight modifications has been recently brought again into notice by Mr. Syme, of Edinburgh, and excited warm discussion as to its dangers and advantages. The modification of Mr. Syme, and his advocacy of its merits, having given this operation the authority derivable from the name of him who so warmly urged its value, the modified operation is frequently spoken of as Syme's operation. A similar method was, however, practised in the United States, and ably advocated by Dr. Jameson, of Baltimore, in 1828, but was generally received with little favor, owing to the difficulties attendant on its performance, even in able hands.

SYME'S OPERATION.[1]—Introduce a grooved director through the stricture, which may generally be dilated to receive this instrument. Then placing the patient upon his back at the edge of the bed, and with his knees held up, make an incision about an inch and a half long in the middle line of the perineum (in advance of the bulb of the urethra), so as to admit the knife to the groove in the director, and slit up the thickened texture to the extent of an inch or two, if necessary. Then passing a No. 8 catheter into the bladder, retain it there for at least two, but not more than three days. After the withdrawal of the catheter, the urine will now and then escape through the wound, but it soon diminishes to a few drops and gradually resumes its proper course. A full-sized bougie must, however, be subsequently passed every three or four weeks in order to maintain the cure.

A curious train of symptoms, consisting of severe rigors, bilious vomiting, suppression of urine, and delirium, have sometimes supervened on the withdrawal of the catheter; but Mr. Syme thinks them of slight importance, as it only requires, in his opinion, time and patience to remove them.

Professor Miller, of Edinburgh, who attended a patient with Mr. Syme, thinks them, on the contrary, very serious, having found these operations to be followed by a perineal abscess which required to be opened; by a pelvic abscess which opened into the rectum, and by a painful as well as protracted and critical recovery.

REMARKS.—The treatment of strictures of the urethra by external incisions is a question which has lately been warmly discussed, especially in connection with the method of operating, which, as just stated, is named after Mr. Syme, though the principle is quite an ancient one, having been recommended, and practised in 1650, and revived in 1811 by Chevalier, again by Arnott in 1822, and again by Sir B. Brodie, as well as by Dr. Jameson, of Baltimore, in 1828.[2] Many objections have been raised to this operation, and supported to some extent by cases which indicate its dangers, such as the risk of hemorrhage, of perineal infiltration, and of abscesses. The opinion of most surgeons in the United States coincides, I think, therefore, with that expressed by Mr. Solly, of London, in relation to this operation, to wit, that where it is possible to introduce a

[1] Am. Journ. of Med. Sciences, vol. xxvi. N. S. p. 227.

[2] Am. Journ. Med. Sciences, vol. xxvi. N. S. p. 234, from Association Med. Journ., April 29th, 1853.

grooved director, it is also possible to pass a bougie and relieve the patient by dilatation. As Mr. Syme only claims the applicability of his operation to cases where the stricture is in advance of the bulb, many will be found to which it is not suited. In patients who have stricture of the membranous portion of the urethra, or who have the canal almost entirely obliterated at the seat of stricture, or who have the winding corkscrew stricture sometimes seen, or have perineal fistula, this operation cannot be readily employed. But when the stricture is in advance of the bulb, when the submucous and spongy structures around the canal are converted into a hard fibrous mass, or when the constriction seems to be composed of a fibro-elastic tissue like India-rubber, which, though readily dilatable, yet soon contracts, the external incision may be, in the opinion of Mr. Coulson, advantageously resorted to. It should, however, be recollected that in Mr. Syme's operation, death has ensued from purulent infection, as well as from hemorrhage, and that it has almost followed the subsequent perineal and pelvic abscesses. If, with these results before him, the surgeon yet deems the other means of treatment objectionable, he should bear in mind the importance of preventing the urine from escaping within the perineal fascia, and infiltrating the surrounding parts. As in any incision dilatation is requisite in order to maintain the cure after the operation of Mr. Syme, I would generally prefer to use the stylet catheter of Physick before mentioned, rather than make an external wound. But if an external incision is essential, and a director can be passed through the stricture, it is of course much safer to operate in the manner directed by Mr. Syme, that is, by cutting on the point of a sound, previously introduced into the canal, and, if possible, into the stricture itself.

IV. CAUSTIC IN STRICTURES.

The removal of stricture by the application of caustic is a mode of treatment that has much to recommend it, as it destroys the extreme sensibility of the canal and stimulates the absorbents to a change of structure. It may be accomplished by various instruments, according to the character, position, and extent of the stricture, the principal object being to retain the caustic in contact with the constricted part sufficiently long to produce an eschar. When caustic potash is employed, twenty seconds will usually be sufficient,

after which its further action should be arrested by injecting sweet oil; but, when the nitrate of silver is used, from one to two minutes may be required, the time varying according to the density of the stricture and the inflammatory tendency of the patient.

The instruments employed to introduce these caustics have been very varied, but need not be specially referred to, the selection of any one being influenced mainly by the taste of the operator. I shall, therefore, merely mention the mode of applying it recommended by Ambrose Paré and Hunter,[1] as it is one which personal experience has taught me is sufficient for the ordinary varieties of stricture at any point where an instrument can be applied.

Operation.—Select a metallic canula or catheter, open at both ends, of sufficient size to distend the urethra to its utmost extent, and pass it down to the obstruction; then arm securely a smaller canula with a morsel of caustic, so that it may project about two lines beyond the canula. Pass the smaller within the larger canula, carry it down to the stricture, retain it in contact with the obstruction for the time above directed, and, withdrawing it, inject oil or salt and water into the urethra through the larger canula, before the latter is withdrawn. After the caustic has been applied in this manner, at intervals of from three to eight days, according to the inflammation which may have been induced, forcible catheterism, if judiciously performed, will generally perforate the obstruction; after which, lateral cauterization, occasionally practised by means of Lallemand's, or some similar instrument, will diminish the risk of subsequent contraction.

General Remarks on these Operations.—The treatment of strictures of the urethra by any of the means just detailed is an operation requiring much judgment on the part of the operator, lest the force (either in dilatation, internal incision, or the introduction of the armed bougie) applied to a stricture through the instrument, lead to a perforation of the walls of the urethra and the production of a false passage. But when the surgeon is guided by a correct knowledge of the structure concerned, as well as of the changes produced in the canal by disease, any of the plans just mentioned may be safely employed; the selection of one rather than another being mainly the result of the peculiarities of the case, or the effect of individual experience and tact.

In estimating the value of any method of treatment, it should,

[1] Mott's Velpeau, vol. iii. p. 1060.

however, be recollected that a permanent stricture is a diminution of the urethra due to inflammatory thickening; that this thickening, or obstruction, often presents us with a species of inodular tissue, or organized lymph similar to it; and that, like ordinary cicatrices in the skin, the parts about it do not lose their contractile tendency for months. If, then, even in a moderately tight stricture, dilatation is resorted to, and forced catheterism practised, a passage may be created and gradually enlarged under mechanical force, and yet so little change effected in the vital action of the part that, on the cessation of the dilating means, the stricture will be liable to return, as is daily seen in cases where the occasional use of the bougie is not pursued by the patient after leaving the hands of the surgeon. When, therefore, patients who whilst having small and tight strictures, were barely able to urinate, are yet, whilst treated by dilatation, enabled to void a full stream, and to receive readily a full-sized instrument, are about to leave their surgeon, they should not be allowed to return home under the idea that they are certainly cured, but should be made aware of the risk they will incur if they neglect the introduction of the bougie, as it is not uncommon to find them, in twelve months, more or less afflicted by a reappearance of many of their old symptoms. Dilatation, therefore, though very prompt and useful in many cases, is a plan of treatment liable to induce false security, as it merely palliates, but does not radically remove the complaint unless persevered in for a long period.

When incisions are made through a stricture (either by internal scarification, as practised with the stylet of Physick, or by the buttonhole incision of the older surgeons, or by that which has lately been so highly lauded by Mr. Syme, of Edinburgh), there is also little change effected in the action of the part that can induce a hope of the permanent removal of the obstruction. As a means of insuring the prompt evacuation of the bladder, incisions are highly serviceable, and that resulting from the use of the stylet of Physick may do away with the necessity of tapping the bladder through the rectum, but alone these operations will do little towards curing a stricture, as the creation of internal or external incisions necessarily gives rise to new cicatrices, and these cicatrices ultimately increase the tendency to contraction. Although useful as a means of forming a communication with the bladder, I would yet caution the inexperienced operator against the omission of dilatation for a long

period, after the passage is apparently perfectly permeable by a cutting instrument.

The application of caustic is, I think, the best means of removing the diseased structure, and has many points worthy of deliberate and unprejudiced consideration. When a superficial eschar is formed, either by the rapid action of the potassa fusa, or by the slower effects of nitrate of silver, a certain amount of action is induced in the surrounding parts, which increases the activity of the absorbents, and hastens a permanent cure. But even when the application of the caustic is not made with a view of creating an eschar, its effects will yet prove useful by modifying the action in the canal, stimulating the absorbents, allaying irritation, modifying vascular action, and inducing a return of healthy action. Enlargements of all kinds, even of bones, have often yielded to a similar stimulus, whilst the ulceration resulting from the separation of the eschar always tends to union by granulation rather than by actual contact, as is the case in incisions. The application of caustic requires, however, much care, as its action may extend to the sound parts, unless carefully watched; and on this account its employment is objected to by many operators. By fully distending the sides of the urethra in the manner before mentioned, and applying the article as above directed, it is, however, difficult for the caustic to touch any other part than that which is directly in front of it, whilst the introduction of oil after the use of caustic potash, or of salt and water after that of the nitrate of silver, will effect such a change as will neutralize either article. In the treatment of old and dense strictures, I should, therefore, prefer the treatment by cauterization; in those which are small and recent, the employment of dilatation by means of those metallic bougies which, by having a broad handle, prevent any deviation of the point of the instrument, the solid bougies of all kinds being preferable to the flexible ones as dilating instruments; but in impervious strictures, or in a bad case of retention of urine, I would resort to Chew's stylet, if it were possible to pass it with reasonable caution; and if not, I should cut into the bladder from the perineum, relying chiefly upon the anatomical knowledge of the structures concerned. Such an operation is, I well know, a very difficult one, and one in which no surgeon, who was not an experienced anatomist, would be likely to succeed; but, with correct anatomical and practical knowledge, it has been done, and could of course be repeated by others.

PLATE LI.

OPERATIONS PRACTISED ON THE URETHRA.

Fig. 1. Catheterism. The penis is held in the left hand between the thumb and forefinger, so as slightly to elongate the urethra, and prevent the presence of folds of the mucous membrane, whilst the second and third fingers push back the prepuce. The point of the catheter is about to enter the orifice of the urethra. After Bourgery and Jacob.

Fig. 2. A section of the pelvis and abdominal parietes, to show the relations of the parts and position of Lallemand's porte caustic, whilst passing through the prostate, in the operation of cauterization. After Bourgery and Jacob.

Fig. 3. A similar section, showing the position of a catheter when being introduced into the bladder. The vertical line represents the plane of the symphysis pubis. The first position of the catheter, when its point has reached the membranous portion of the urethra, makes an arc of from 60° to 80° as at 1. Depressing it yet more, about, 25° or 30°, as at 2, elevates the point beneath the pubis, and carries it into the neck of the bladder. The circle 1, 2, 3 shows the line of motion of the mouth of the instrument; if the mouth is depressed more than the angle marked at 3, the instrument will drag on the suspensory ligament, and may injure the third lobe of the prostate, and the bladder. After Bourgery and Jacob.

Fig. 4. Puncture of the bladder through the urethra by means of the stylet catheter of Physick. 1. Course above the prostate in consequence of the too early depression of the mouth of the instrument. 2. Puncture through the prostate near the natural line of the urethra. 3. Course below it. After Bourgery and Jacob.

Fig. 5. A buttonhole opening made in order to remove a stricture in the urethra. 1. A director passed down the urethra to the front of the stricture. 2. Another director introduced through the perineal puncture. 3. The bistoury enlarging the perineal incision. After Bourgery and Jacob.

Plate 51.

Fig 1.

Fig 2.

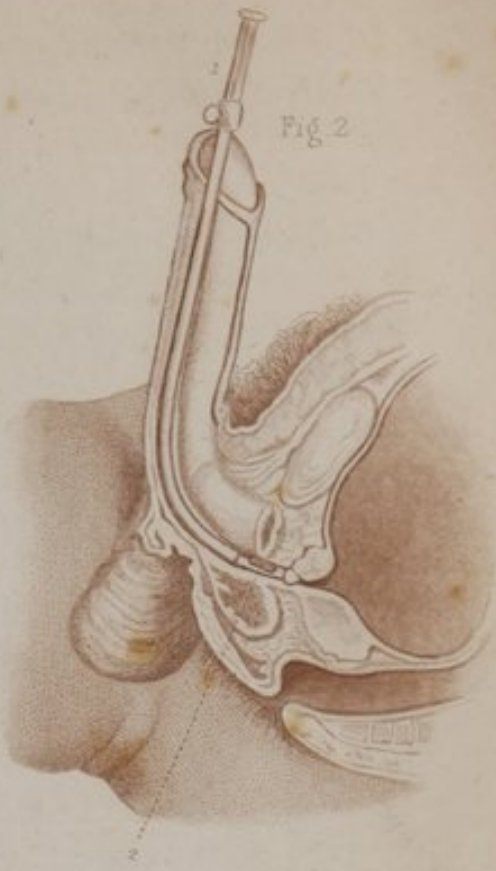
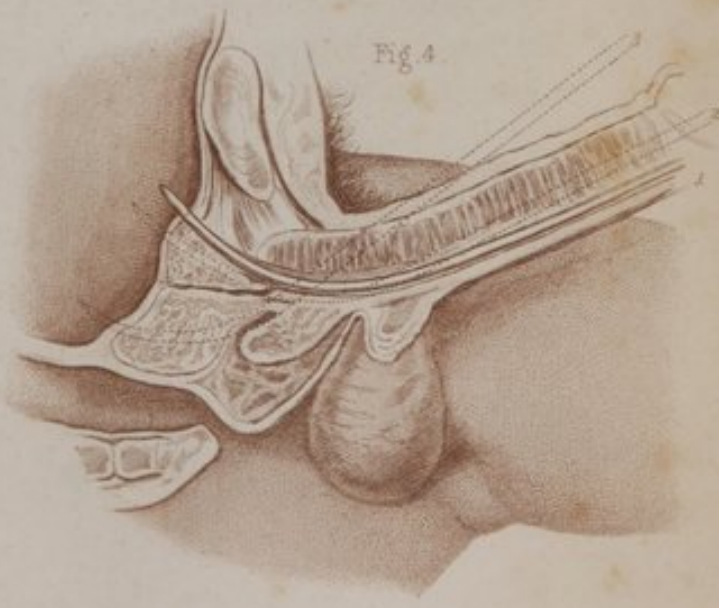


Fig 5.

Fig 3.

Fig 4.



§ 3.—SUMMARY OF THE TREATMENT OF STRICTURES IN THE URETHRA.

The treatment of stricture of the urethra, to be well conducted, must be the result of a minute study of the anatomy of the parts; of the etiology and pathology of the complaint, as well as of an accurate diagnosis, lest the obstruction be supposed to be due to a different condition of the canal from that which actually exists. The subject of stricture of the urethra is, therefore, one which has engaged special attention, and been most ably treated in monographs of considerable extent. A full account of the complaint must not, therefore, be sought in works which, like this, are of a general character. The most that can be anticipated in an operative treatise is the details of treatment and an estimate of their value, and even these, in some cases, must be necessarily curtailed. The reader is, therefore, referred to the valuable work of Dr. Gross, of Louisville,[1] for the result of much valuable experience, and for such facts as would extend this account beyond its proper limits, though they would doubtless aid the young surgeon in the decision of the difficult question "of which plan of treatment is best adapted to strictures." In attempting to furnish as much information as is compatible with the plan of the work, I can, therefore, only append to this account a summary of the opinions of some of the more recent writers on the subject, although aware that even this summary will merely exhibit more clearly the diversity of sentiment entertained by experienced authors in regard to the whole subject of stricture of the urethra.

Dr. Gross, of Louisville, whose able work on these diseases has been before referred to, states[2] that the practice which he has generally found most successful is that by dilatation, aided or not as the case may be by cauterization, and that he seldom omits the latter operation when the contraction is firm and within a reasonable distance of the fossa navicularis, having often succeeded in entering the bladder with the largest size catheter in a few seconds after cauterization, in cases where all other modes of treatment had been unavailingly employed for years. He always, however, pays great

[1] Practical Treatise on the Diseases and Injuries of the Urinary Bladder, Prostate Gland, and Urethra, by S. D. Gross, M. D., Philadelphia, 1851.

[2] History of Kentucky Surgery, p. 115, 1852.

attention to the condition of the patient's bowels, and to his diet, no matter what plan is pursued.

When the stricture is exceedingly narrow and callous, and situated on the membranous portion of the urethra, little treatment short of division of the perineum will, he thinks, afford permanent relief; and for this purpose he prefers Syme's operation, regarding the urethrotome as an uncertain and dangerous instrument.

Dilatation, as being attended by the least inconvenience to the patient, has been the treatment usually preferred by a majority of practitioners, though a large number of experienced surgeons regard it with distrust, and look upon "a cure by dilatation" as a very temporary one, the disease often returning soon after the cessation of the treatment. Amongst the latter is Mr. Henry Thompson, of London, who, in a work[1] on strictures of the urethra, which attained the Jacksonian prize for the year 1852 from the College of Surgeons, remarks in relation to dilatation as a means of treatment: "That although there are few cases in which with care and perseverance an instrument cannot be passed through the stricture, and prove the most safe, efficient, and generally applicable of all the means of treatment, there are yet some in which its effects are so temporary that its claim to be regarded as a cure must be disputed. The contraction often reappears, and that so rapidly, that, in order to maintain a canal sufficiently patent for the performance of its functions, an instrument must be passed every other day or oftener, and the patient be thus submitted to perpetual treatment."

The same surgeon, speaking of the use of caustics, also expresses the opinion that the nitrate of silver is useful in a very limited number of cases; that neither it nor the caustic potash should be used as an escharotic; but that the potassa, when applied in very minute quantities, "possesses a certain power to loosen and dissolve the tough fibrous tissues of some strictures."[2]

In summing up the treatment of strictures, Mr. Thompson, therefore, concludes:[3] "That dilatation has been found successful in the great majority of cases, but that it is certainly inefficient for the cure of some old and extensive strictures, as well as for some which are accompanied by a highly irritable condition of the urethra; that cauterization is a useful adjuvant to dilatation, especially where

[1] The Pathology and Treatment of Strictures of the Urethra, by Henry Thompson: London, p. 205, 1854.

[2] *Op citat.*, 220.

[3] *Ibid.*, p. 284.

much irritability exists, though wholly inapplicable to the removal of old and extensive contractions, and that the internal division of strictures (incision) is particularly suited to these last-named cases when situated in the anterior or middle part of the urethra.

Mr. Guthrie[1] gives as the result of his experience, that "a hard and elastic, or intractable stricture, is never permanently cured by dilatation, or by the application of caustic, although it may be relieved by the regular periodical use of a dilating instrument, and that the strictures generally deemed most difficult to cure, may be best removed by cutting through them," though he also expresses the opinion that the division of an old, hardened, or elastic stricture through the perineum will not usually be followed by a permanent cure unless dilatation is subsequently continued, and he therefore prefers the internal incision, or the division of a stricture by a stylet, especially in old and fat patients, as it creates less constitutional disturbance.

Many other writers might be quoted who object to all incisions, but as their statements would only add to the confusion consequent on the diversity of opinion that they would exhibit, I shall omit them.

I have, therefore, only to repeat my individual preference for the following plans: First, to try dilatation, and continue it in permeable strictures; second, to render strictures which are very dense, or nearly impermeable, more easy of dilatation by the application of either caustic potash or the nitrate of silver, applied as directed; and third, to attempt to cut through all impermeable strictures by the stylet, if they are seated anterior to the membranous portion of the canal, or resort to the perineal section when seated further back or in the membranous structure.

§ 4.—PUNCTURE OF THE BLADDER.

When, in cases of stricture, it is found impossible to evacuate the contents of the bladder through the urethra, or by the urethral section, or the surgeon is unwilling to expose his patient to the risks of a perineal operation, the contents of the bladder may be evacuated either by puncturing it through the perineum or rectum, or through the abdominal parietes above the pubis.

[1] Lancet, June 1851.

I. PUNCTURE THROUGH THE PERINEUM.

Place the patient in the position of lithotomy, and let an assistant hold up the scrotum and press upon the bladder above the pubis. Then, whilst standing in front of the perineum, place the left forefinger on the left side of the raphe, half an inch in front of the anus, and between the bulb and the ramus of the ischium, so as to render the perineum tense, and, with a straight trocar and canula, at least seven inches long, puncture the integuments. Then, passing the left forefinger into the rectum, so as to preserve the bowel untouched, push the trocar towards the bladder, so that its point may reach the base of this viscus near its neck or behind the prostate gland, by passing through the skin, fascia, fat, and anterior edge of the levator ani muscle. When the want of resistance, and the greater mobility of the point of the trocar indicate that the instrument has entered the bladder, withdraw the finger from the rectum and the trocar from its canula, when, after evacuating the urine, the canula may be corked and fastened in position by tapes, which should be attached to a double T or split perineal bandage.[1] In very urgent cases, the bladder may be evacuated by puncturing it through the perineum with a lancet, as was once done by Sir A. Cooper, and also by Dr. Jones, of Philadelphia.[2]

II. PUNCTURE THROUGH THE RECTUM.

As the bladder, when distended, encroaches very much upon the rectum, forming there a tumor which may be felt from the gut, and as there is no structure of consequence on the median line of the bladder immediately behind its neck, the urine may be evacuated through the rectum in the following manner:—

Operation.—Place the patient in the position for lithotomy, and pass the left forefinger, well oiled, into the rectum, and it will readily reach the prostate gland, immediately above and behind which it will feel the distended bladder lying nearly in contact with the rectum, a little cellular tissue alone intervening *in the median line.* Then with the curved trocar and canula, sold by the cutlers

[1] See Smith's Minor Surgery, 3d edit. p. 117.

[2] Dorsey's Surgery, vol. ii. p. 173.

for this purpose, the puncture may be made as follows: Withdraw the trocar within the end of the canula, and passing it along the forefinger first introduced into the rectum, bring its end to the protruding portion of the bladder, and then, thrusting the trocar forwards, puncture the anterior coats of the rectum, the intervening cellular tissue, and the posterior coats of the bladder. On withdrawing the trocar, hold a vessel to receive the urine, and after evacuating it, plug up the canula and fasten it in its position by means of tapes attached to a T bandage, as before described.

AFTER-TREATMENT.—The patient being kept in the horizontal position, the canula should be accurately retained at each stool, and if required to be worn longer than three days, changed by slipping a small catheter through it into the bladder, and this catheter changed by slipping another, or the canula again over it. When the urethra can subsequently be rendered pervious, a catheter should be kept in the bladder through the urethra in order to favor the healing of the rectal fistula, which is apt to supervene.

III. PUNCTURE ABOVE THE PUBIS.

The patient being placed on his back, and the hair shaved off, make an incision an inch and a half long, through the skin, fascia, linea alba, and between the recti muscles so as to expose the fascia behind the muscles, and immediately over the distended viscus, the peritoneum in these cases being reflected from the bladder to the abdominal parietes in such a manner as to prevent its being involved in the operation. Then puncture the bladder with the curved trocar and canula used for the puncture through the rectum, or have one made with a curvature of a segment of a circle seven inches in diameter, so as to adapt it more readily to the curve behind the pubes. After evacuating the urine, fasten the canula by tapes to a T bandage, and pass an elastic catheter through the canula so as to prevent its end irritating the coats of the bladder. If the instrument is worn several days, it should be withdrawn whilst the catheter remains in order to cleanse it, and then replaced by slipping it over the catheter as a director.

REMARKS.—As all these operations are liable to be followed by death or serious inconvenience, they should never be resorted to until every means has been tried to overcome the obstruction in the urethra. The advantages possessed by one of them over the

others is shown by the following table of Mons. Mondiere, given in the *Revue Médicale*, April, 1841, and quoted by Dr. Gross:[1]—

	CASES.	CURED.	FISTULA.	INFILTRATION.	DEATH.
Perineal . .	9	6	1	0	1
Recto-vesical .	28	19	3	3	2
Supra-pubic .	55	49	0	0	6
	92	74	4	3	9

The recto-vesical operation is thus shown to be the least fatal, but the most frequently followed by fistula and infiltration, whilst the perineal and supra-pubic operations have each been followed by one death in nine operations. The proportion of deaths after all the operations is however remarkably small in this table, and much less than has generally been supposed to be the case.

IV. PUNCTURE OF THE BLADDER IN THE FEMALE.

Should this operation be ever requisite, the puncture should be made by introducing the trocar from the vagina and healing the fistula subsequently left by touching it with the nitrate of silver.

§ 5.—FISTULA IN PERINEO.

PATHOLOGY.—When the existence of a deep-seated stricture has led to a dilatation and rupture of the urethra behind it, the following effects may be noted: The urine, when expelled from the bladder, escapes into the surrounding cellular tissue, and either creates such violent inflammation as results in gangrene, or in more favorable cases leads to the formation of an abscess, which, breaking outwardly, leaves an ulcerated opening, through which most or all of the urinary secretion is subsequently voided. This opening constitutes a perineal fistula, and continues because the flow of urine prevents such adhesive action as would heal it. Sometimes the fistula communicates directly with the urethra, though most frequently the hardening, contraction, and adhesions of the surrounding parts give it a more winding course, and render it

[1] Diseases of Urinary Organs, p. 315, from Am. Journ. Med. Sciences, vol. iii. N.S. p. 495.

difficult to trace it with a probe. When a perineal fistula has existed for a few weeks, the urethra in front of the stricture is often disposed to contract and close up, so that a channel, which was previously quite pervious, not unfrequently becomes directly the reverse, rendering it impossible to enter the bladder by the usual route, and requiring high operative skill in order to restore its permeability.

Operation for Perineal Fistula.—When a perineal fistula is so situated as to permit the introduction of a director into the bladder, and of a probe into the urethra in front of the stricture (Plate LI., Fig. 5), the formation of a buttonhole opening, as before referred to, will frequently prove sufficient to restore the continuity of the canal, especially if the subsequent use of the catheter is persevered in until the fistula has healed. But when there is a considerable distance between the bladder and the permeable portion of the urethra, the indurated perineum will sometimes defy all attempts to trace the course of the fistulous canal into the bladder, and the surgeon will be compelled to open the perineum, as in the operation of lithotomy, and divide all the portion which intervenes between the neck of the bladder and the spongy portion of the urethra. As this operation is one in which anatomical knowledge is of the utmost importance, the incisions being regulated entirely by the judgment of the operator, it is usually regarded as one of the most difficult in surgery, and as far surpassing that of lithotomy. In many instances, surgeons have preferred trying other means, and, when these failed, have left the result to nature; but, as a cure can be accomplished, it is the duty of every one to acquire such experience as is essential to its success. In three instances, I have assisted in its performance, and, though satisfied of its difficulty, have been also pleased with the result, all the patients being cured both of the fistula and stricture. As characteristic of this operation, I cite the following method, as described by the late Dr. Wm. E. Horner, of Philadelphia,[1] and based upon his own dissections of the parts concerned.

Operation of Dr. Horner, of Philadelphia.

Anatomy.—By repeated observation, Dr. Horner has found that, from the top of the symphysis pubis to the anterior end of the membranous part of the urethra, the distance is two and three-quarter

[1] Dr. Horner in MS.

inches; to the posterior end of the bulb of the urethra, three and three-quarter inches; and to the urethral opening in the triangular ligament three inches.

Operation.—With these measurements firmly fixed on the mind, the surgeon, when desirous of overcoming the obstruction, should cut without any director, and in the line of the incision for lateral lithotomy, for the membranous part of the urethra, just in front of the triangular ligament. This point being found, and the urethra punctured, a probe should be introduced into the bladder, and a small semi-cylindrical canula of tin passed in upon it to the same point, and then another larger canula on this, and then others, one after the other, the preceding one in each case being withdrawn upon the introduction of its successor, until the stricture is fully dilated. As the stricture is generally at the junction of the membranous with the spongy portion of the urethra, the surgeon should now pass a sound through the urethra from the glans penis to the stricture, and slit the membranous part of the urethra from behind forwards to the tip of the sound, making this incision along the median line. The stricture being thus relieved, let him next pass a flexible catheter along the whole line of the urethra into the bladder, the tin canula previously introduced being retained in order to give a certain direction to the catheter, when the latter should be secured as usual[1] for a few days, after which a leaden catheter may be put in its place, as it is much less irritating to the urethra. No catheter, however, should be withdrawn from the bladder for the first few days after the operation, without having previously slipped into it, from the perineum, a tin canula of sufficient size to act as a conductor to the next catheter.

Remarks.—During the last twenty-five or thirty years, Dr. Horner operated frequently for perineal fistula on the plan just stated, with scarcely one failure, and he, therefore, recommended it strongly. When the patient is cured by this, or any other perineal, or even internal incision, it is essential that the urethra should be dilated, at proper intervals, with a large sound, in order to prevent the recurrence of the stricture, or the contraction of the cicatrix, formed at the point where the urethra was opened.

[1] See Smith's Minor Surgery, third edit. p. 401.

§ 6.—HYPOSPADIAS AND EPISPADIAS.

An imperfect condition of the urethra is occasionally found as the result of a congenital defect, in which the canal terminates or opens by a slit upon some point between the scrotum and head of the penis. When the opening is upon the inferior portion of the penis, it takes the name of Hypospadias, but when situated on the dorsum it is called Epispadias.

Hypospadias, being the more common of the two, may be taken as the type of this deficiency.

Hypospadias may be found at any point, but it is especially seen at the fossa navicularis, near the middle of the penis, near its root, or between the penis and the scrotum.

Operation.—When the opening is near the glans, and the anterior portion of the canal is impervious, puncture the point of the glans with a bistoury, and push in a small trocar and canula until the perfect urethra is reached, taking care not to push the point of the instrument either towards the dorsum or under surface of the organ. After creating the canal, keep a catheter constantly in it until the parts have healed. The contraction consequent on cicatrization is, however, apt to cause a considerable diminution in the size of the new urethra.

When the opening is seated near the middle of the penis, and the urethra is patulous to near the fossa navicularis, the trocar may be introduced into the orifice and carried forwards to the point of the glans.

Sometimes the defect has consisted in a mere fissure, around which the corpus spongiosum was deficient. Although this is almost a hopeless case, the surgeon may deem it advisable to attempt a plastic operation, freshen the sides of the fissure, and unite the skin of the part over a catheter.

Remarks.—The rarity of hypospadias in such a position and to such an extent as presents much chance of success renders it difficult to assign any value to the modes of operating that have been described, few of them having accomplished perfect cures. In a little patient of eighteen months, who had an opening near the middle of the penis, but in whom the urethra was otherwise perfect, I have, however, succeeded in closing the fissure by freshening the edges and uniting them by the harelip suture; and Dr. Mettauer, of

Virginia, has also reported[1] a case of rare deformity of the penis, which was relieved by an operation. As his account also contains an excellent description of some of the usual forms of this defect, the reader will derive much valuable information by referring to it.

SECTION IV.

OPERATIONS ON THE SPERMATIC CORD.

The operations practised upon the spermatic cord are such as have for their object the arrest of the circulation in the bloodvessels of the testis, the ligature of the spermatic artery in cases of sarcocele, and the arrest of the venous circulation for the cure of varicocele.

§ 1.—LIGATURE OF THE SPERMATIC ARTERY.

ORDINARY OPERATION.—By an incision in the line of the cord, the skin, superficial fascia, cremaster muscle, and tunica vaginalis communis were divided; the artery, which could be felt pulsating, separated from the other vessels and ligated, and then the wound partially closed (Plate LII., Fig. 1).

REMARKS.—This operation does not always cut off the circulation from the testicle so perfectly as to insure its atrophy; and when performed for the relief of sarcomatous, or other degenerations, may require to be followed by castration.

§ 2.—LIGATURE OF THE SPERMATIC VEINS.

Enlargement of the spermatic veins of the cord, as well as those of the scrotum, sometimes leads to atrophy of the testicle, though more frequently it only creates pain, irritation of the skin, and such difficulty in walking as is characteristic of varicocele. To relieve this, it is sometimes sufficient to support the parts by a suspensory bandage, though various operations have been suggested in

[1] Am. Journ. Med. Sciences, vol. i. N. S. p. 43, 1842.

order to effect a more permanent cure, all having for their object the interruption of the circulation through the veins, and the restoration of the natural caliber of the vessels. Among these operations may be noted all that are applicable to varices in the extremities, as will be shown hereafter. At present, it must suffice merely to enumerate such as are most frequently applied to this region.

In all the operations upon the veins of the cord, it is important that the surgeon should first separate the vas deferens and spermatic artery from the bundle of veins. This may be readily done by gently compressing the cord between the thumb and fingers of one hand, and causing the vessels to slip laterally, when the vas deferens will readily pass to the inner side of the cord, and may be told by its cartilaginous consistence, the artery being known by its pulsation. The veins being then rendered distinct by the patient standing up, any of the operative processes which may be selected can then be readily attempted.

Operation of Dr. S. D. Gross, of Louisville.—The patient either sitting in a chair, standing, or lying down, as most convenient, with the scrotum entirely divested of hair, grasp it from behind with the left hand, and make a vertical incision nearly an inch long, over the anterior part of the tumor, down to the enlarged veins. Then carefully isolating these from the vas deferens, artery, and nerves, by a few touches of the point of a scalpel, pass a short, thick, straight needle underneath two or three of the larger trunks, and winding around it a stout thread, either elliptically, or in the form of the figure 8, draw it with great firmness, so as to indent the coats of the vessel, and stop the circulation, after which the wound may be closed by adhesive plaster, or a twisted suture. The patient being now put to bed, and the scrotum supported, he should be kept on light diet. At the end of twenty-four hours, when the blood in the veins is sufficiently coagulated, pass a sharp-pointed and narrow bistoury underneath the veins, with its back to the needle, and divide them. Should symptoms of inflammation arise about the parts, cold lead-water, or the cold water dressing may be demanded. In five or six days, the patient may sit up, and in a few more may be permitted to walk about.

Remarks.—This operation is a revival of the old operation of Celsus, and has always been deemed adequate to the cure of the complaint. Dr. Gross has performed it eight times with success, all his patients recovering without a bad symptom.

PLATE LII.

OPERATIONS PRACTISED ON THE TESTICLE AND CORD.

Fig. 1. Ligature of the Spermatic Artery. 1. The director passed beneath the artery. After Bernard and Huette.

Fig. 2. Velpeau's operation for Varicocele. 1. The pin as passed behind the vessels. 2. The figure of 8 ligature thrown around it. After Bernard and Huette.

Fig. 3. Ricord's operation for Varicocele. 1. The first loop of a double ligature carried between the veins and the skin. After Bernard and Huette.

Fig. 4. View of the Veins and Ligatures before the latter are drawn tight. 1. The enlarged veins. 2. The vas deferens. 3. The posterior ligature. 4. The anterior. After Bernard and Huette.

Fig. 5. A view of the Knot formed by drawing on the ends of each Ligature, after they have been passed through the opposite loop and are about to constrict the veins. After Bernard and Huette.

Fig. 6. Operation of Vidal du Cassis for Varicocele. 1, 1. The enlarged veins. 2, 3. The two silver wires passed in front and behind them, so as to compress the vessels when they are twisted. 4. The vas deferens. After Bernard and Huette.

Fig. 7. A view of the arrangement of the wires. The larger one remaining firm, the smaller twists around and compresses the vessels upon it. After Bernard and Huette.

Fig. 8. The Veins as constricted, shortened, and rolled up by the twisting of the silver wires. After Bernard and Huette.

Fig. 9. Breschet's operation. 1, 1. The compressors. After Bernard and Huette.

Fig. 10. The operation of Castration. 1. The scrotum drawn back to favor the enucleation and dissection of the testicle. After Bernard and Huette.

Fig. 11. A side view of the operation of Tapping a Hydrocele. 1. Position of the left hand as it compresses the sac. 2. The right hand holding the trocar and canula. After Bernard and Huette.

Plate 52

Fig 1.

Fig 2.

Fig 3.

Fig 6.

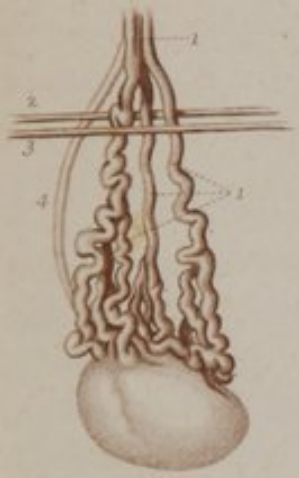


Fig 4.

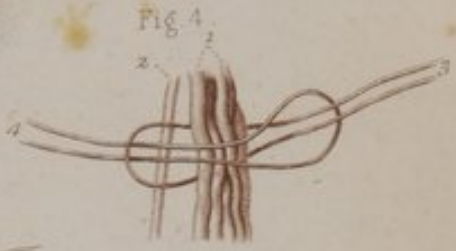


Fig 5.

Fig 8.

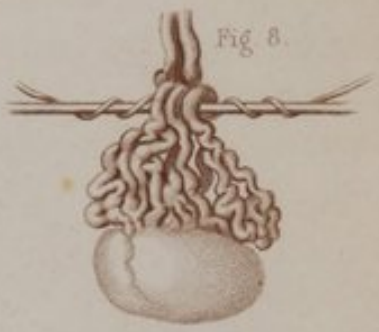


Fig 7.

Fig 9.

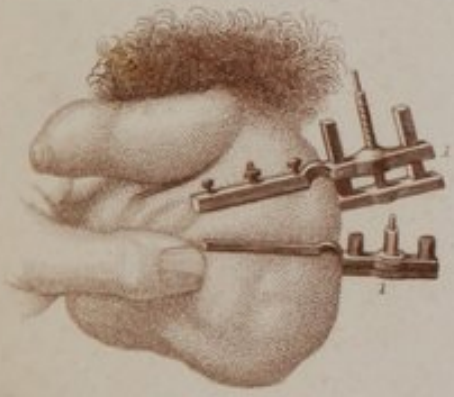


Fig 10.

Fig 11.

Operation of Dr. Jno. Watson, of N. Y.—The varicose veins being soft and swollen in a lump as large as a hen's egg, the pain and uneasiness led the patient to seek relief by an operation, which was performed as follows: The whole of the free integuments that could be embraced without much stretching, being included in the blades of a very long and slender forceps, which passed over the cord, and obliquely down to the lower part of the scrotum on the opposite side, the included part was removed by one sweep of the bistoury, leaving a wound which gaped so much as to expose both testicles, covered only by the tunica vaginalis. The external pudic artery, near the upper angle of the wound, was the only vessel that required the ligature, and five or six stitches of the interrupted suture were necessary to coaptate the integuments over the cord, and so on, below the testes. The patient suffered but little, was dressed with the water dressing, confined to bed for several days, and, before the end of the month, had the wound perfectly healed and the varicocele cured.

Remarks.—This operation, though a modification of Sir Astley Cooper's, acts rather by drawing the cord laterally, than by elevating the testes, as was the object of Cooper's operation. As it compresses the veins in their long diameter, it soon diminishes their caliber.

Operation of Velpeau.—After picking up the enlarged veins between the thumb and fingers, a pin is passed through the skin behind the veins, and surrounded by a figure of 8 suture, so that the scrotum and the veins may be compressed by the ligature upon the pin (Plate LII., Fig. 2). After two or three days have elapsed, and there is evidence of inflammation, this pin may be removed, as in the ordinary harelip suture. But, as the compression of the integuments even for this period seemed to be liable to induce erysipelatous inflammation, Velpeau subsequently modified the operation by passing a double ligature in front of the veins beneath the skin, and, placing the pin behind the vessel, slipped the loop of the ligature over one end of the pin, and tied its two ends around it so as to compress the veins directly upon the pin.[1]

Operation of Ricord.—After isolating the veins, Ricord operates as follows: Two needles being prepared, each threaded with a double ligature, this surgeon passes one of them *behind* the veins, so

[1] Dictionnaire de Méd., tome 30me, p. 559.

that the loop of the ligature projects a little outside of the scrotum (Plate LII., Fig. 3), and removes the needle. Then, passing the point of the second needle from the opposite side of the scrotum, but through the same puncture as that made by the exit of the first needle, he carries the second ligature in front of the veins, and thus forms two loops, one on each side of the scrotum. On passing the free ends of each ligature through the opposite loop, and drawing upon them, the vessels will be constricted by the approximation of the loops beneath the skin (Plate LII., Figs. 4, 5), the tightness of the compression by each ligature being preserved by tying its ends upon a small plate or pledget outside the skin.[1] After the constriction has been thus practised for forty-eight hours, untie the ends of the ligature from over the pledgets, and pushing upon the threads, loosen the loops, or introduce fine pointed forceps, and draw them out, or attach a single and colored thread to the centre of each loop before drawing it into the wound.

Operation of Vidal du Cassis.—This surgeon combines the subcutaneous ligature of the veins with diminution of their length, so as to prevent the subsequent return of the circulation in the following manner: A silver thread being passed with a needle behind the cord, another larger wire is made to pass through the same opening in front of it (Plate LII., Fig. 6), and the veins being thus placed between the two wires, beneath the skin, their extremities are twisted, until by the torsion they are brought closely together and strangulate the veins. By continuing the torsion, the metallic cord in its rotation draws in the parts comprised between the wires, so that the veins are rolled around them until, as the twist is continued, the testicle itself is raised (Plate LII., Fig. 7), its ascent being facilitated by the relaxed condition of the parts.

Finally, the two ends of the metallic cord are knotted on a pledget upon the skin, and, a director being passed beneath the knot, the whole is twisted more and more, from day to day, until the wires cut through the skin and veins.[2] The advantages claimed for this mode of operating are a diminution in the length of the spermatic cord, and the section of the veins at the several points where they have been twisted.

Operation of Breschet.—By means of a pair of clamps or com-

[1] *Opus citat.*

[2] Dict. de Méd., tome 30me, p. 560.

pressors, the circulation was interrupted, and sloughing of the vessels induced by the following operation:—

Pick up a fold of the scrotum, so as to include the enlarged veins, and inclose it in the branch of the forceps (Plate LII., Fig. 9), applying another pair in a similar manner, a short distance above the first. By tightening the screws from day to day, the constriction is sufficiently increased to result in sloughing, after which the ulcer is healed by the usual means.

Remarks.—The danger arising from operating upon varices in the limbs does not appear to follow the operation performed for the relief of varicocele, whilst the difference in the anatomical relations of the spermatic veins, and the absence of the free anastomoses that exist between the different veins of the extremities, usually render the operation much more successful in this region than it is in the veins of the leg. In selecting any one of the methods just described, the surgeon may be influenced by the peculiarities of the case; but, as a general rule, I should first try the operation of Drs. Gross or Watson, and then that of Ricord, as there is less risk of erysipelas of the scrotum arising from it than from the operation of Velpeau. The latter I have, however, performed without any bad results, and obtained a perfect cure.

Compression, as advised by Breschet, has resulted in death[1] in several instances, and is now seldom or never resorted to. Indeed, it may be useful to the young surgeon to offer a word of caution in regard to the performance of any operation for varicocele, until cold astringent washes, the constant use of a suspensory bandage, and the exercise of the function of the testicle have been fully tried, as these means usually suffice for the cure of the complaint.

§ 3.—OPERATIONS ON THE SCROTUM.

In cases of tumors of the encysted variety, or in hypertrophy of the scrotum, the same principle should be carried out, as would be applicable to similar tumors elsewhere. Hypertrophy, or elephantiasis of the scrotum has sometimes required very extended dissections, although limited generally to the scrotum. In a case reported in 1837[2] by Dr. Picton, of New Orleans, the weight of the tumor

[1] Philad. Med. Examiner, vol. iii. 1840.

[2] See Curling on Testis, Philad. edit. p. 537.

was fifty-three pounds, whilst it reached nearly to the patient's feet. In two months the man was cured, and the tumor is now in the Wistar and Horner Pathological Museum, Philadelphia.

SECTION V.

OPERATIONS ON THE TESTICLE.

The operations practised on the testicle are limited to such as are required for the relief of fluid collections within the tunica vaginalis testis, and to those performed for the removal of the gland itself.

§ 1.—HYDROCELE.

The term Hydrocele (υδορ water, and κελη a tumor) is one strictly applicable to any accumulation of serum within the scrotum. A serous infiltration of the scrotal celullar tissue, such as is seen in dropsy, might, therefore, be considered as a Hydrocele were it not that usage has limited the name to such collections of serum as are entirely within the sac of the tunica vaginalis.

When, by a careful examination, the presence of serum in this sac has been positively established, its evacuation may be readily accomplished, by a puncture of the cavity with a trocar or lancet; but, as the simple evacuation will not prevent the reaccumulation of the secretion, it is generally necessary to combine with it the production of such inflammatory action as will lead to the obliteration of the cavity by adhesion of its sides. The first, or the simple evacuation of the liquid, constitutes the palliative operation; the other is designated as the curative.

I. TREATMENT OF HYDROCELE BY INJECTION.

To accomplish the cure of Hydrocele by this means, there should be prepared two bowls, one empty, and the other containing the substance to be injected; a moderate-sized trocar and canula; a syringe with a nozzle capable of fitting the canula; and such an irritating fluid as may be deemed most appropriate for the injection, such as

port-wine and tepid water, a solution of sulphate of zinc, or corrosive sublimate and lime-water, or a solution of nitre, the latter having proved effectual in the hands of surgeons from an early period.

The experiments of Velpeau[1] having shown the great advantages possessed by the diluted, or even the pure tincture of iodine, over most of the other articles, most surgeons now resort to it alone, and obtain a cure in about twelve days.

Operation.—After being satisfied of the position of the testicle and the presence of the fluid, the patient should be made to sit upon the edge of a bed, table, or chair, with his thighs widely separated, or else permitted to lie on his back in bed with the limbs in the same position. The surgeon, then seizing the tumor with his left hand, and compressing it so as to render the tissues perfectly tense (Plate LII., Fig. 11), takes the trocar and canula, and punctures the swelling in front, but a little below its middle, directing the point of the instrument upwards and obliquely backwards and outwards, in order to avoid the testicle, which is generally situated behind, below, and towards the raphé, though occasionally it is in front or at the top of the swelling, where its position may be readily told by the sensibility shown on compression of the part. As soon as the free motion of the point of the instrument shows that it is within the cavity of the tunica vaginalis, the assistant should hold the empty bowl, and the surgeon, retaining the canula in his left hand, should withdraw the trocar with the right, and allow the liquid to escape. After the evacuation is completed, the nozzle of the syringe, charged with the injecting fluid, should be adapted to the canula, and the liquid injected by an assistant, whilst the surgeon, retaining the end of the canula in its position, takes especial care that the liquid is not thrown into the cellular tissue of the scrotum instead of the vaginal cavity. After creating sufficient pain to render the patient slightly faint and cause uneasiness in the lumbar region, the liquid may be allowed to escape, the canula withdrawn, and the patient placed in bed with the testicle supported.

After-Treatment.—As the object of this operation is to induce adhesion of the sides of the tunica vaginalis, care is required to guard against too much inflammation, and a moderate antiphlogistic treatment may therefore occasionally be demanded. After the lapse of about ten days, moderate compression by a bandage, or by ad-

[1] Velpeau, Op. Surg., by Mott, vol. iii. p. 717.

hesive strips, will prove useful by approximating the sides of the inflamed cavity and favoring adhesion. Should the lymph, which is sometimes effused into the adjacent parts, leave the testicle considerably enlarged after the operation, the induration may be made to yield to the use of iodine or mercurials.

II. CURE OF HYDROCELE BY THE SETON.

OPERATION.—Puncture the tumor with a seton-needle and strand of silk; allow the silk to remain until it excites sufficient inflammation; and then withdrawing it by a few threads at a time, so as to leave one or two to secure the continuance of the opening, pursue the treatment just referred to. Sometimes the trocar and canula are made to enter the tunica vaginalis from below, and pass out of the scrotum above, when, the trocar being withdrawn, a probe, armed with silk, will readily carry the seton through the canula; and, the latter being withdrawn, the seton will be left in position.

III. TREATMENT BY INCISION.

OPERATION.—Puncture the tumor from above downwards with a sharp-pointed bistoury, and, introducing the forefinger or director into the cavity, enlarge the opening downwards. After which, charpie, lint, or balls of dough may be placed in the cavity to excite irritation, and left there until discharged by suppuration.

IV. TREATMENT BY EXCISION.

This is the same operation as the preceding, except in the removal of a portion of the vaginal tunic either with the scissors or knife.

REMARKS.—The operation for the relief of hydrocele, though apparently simple, occasionally fails to evacuate the liquid, or does not accomplish a cure.

The first is usually the result of carelessness on the part of the operator, and may arise from an error of diagnosis, or from his not rendering the tumor sufficiently tense to cause the trocar to punc-

ture all the tissues instead of passing between the scrotum and the tunica vaginalis; and such an accident is by no means rare, as I have more than once seen the puncture made, the trocar withdrawn, and yet no fluid escape. If the tunica vaginalis is thickened, or slightly ossified, or if the sac is not rendered tense by compression, or if the trocar is not sharp at its point, or if the canula is not well adapted to the shoulder of the trocar, the perforation of the sac may fail, and the tunica vaginalis be pushed back before the instrument instead of being punctured. The evacuation of the fluid, and the consequent contraction of the scrotum, are also liable to displace the point of the canula, so that, on attempting the injection, the fluid passes with difficulty, and, instead of affecting the vaginal cavity, infiltrates the scrotum, and induces sloughing or gangrene. Every precaution should, therefore, be employed to prevent such mishaps in this apparently easy operation. In the selection of a plan of treatment, I usually prefer a combination of the injection with the seton, leaving a single thread in the cavity for several days in order to insure a vent for any liquid which may accumulate, and thus prevent the approximation of the walls of the cavity. By this method, I have never had occasion to repeat the operation, and when aided by the subsequent application of adhesive strips, as employed in orchitis, have usually obtained a speedy cure.

§ 2.—CASTRATION.

The removal of the testis, although a comparatively easy operation, is one that should not be performed without serious deliberation, and only resorted to when such degeneration is found as establishes the uselessness of the organ beyond a doubt, or the risk of further contamination of the system by its existence. In order to avoid the removal of the gland, ligature of the spermatic artery, or the excision of the vas deferens, has been practised by Maunoir and Morgan, of Europe, and Jameson, of Baltimore; but in the cases where these means would be advisable, it may be doubted whether castration would not be preferable, because it accomplishes the same object more effectually.

OPERATION OF CASTRATION.—The operation of castration consists in incising the scrotum so as to free the testicle, and in the division

of the cord. The exposure of the gland may be effected either by a simple linear incision, or by an elliptical cut so as to permit the removal of a portion of the skin. The division of the cord may be accomplished either by inclosing all its structure in a ligature, and excising the portion below it, or by separating the vas deferens, ligating the cord, and then dividing it by a sweep of the knife. As the selection of either mode must be regulated by circumstances, I shall refer only to the following one, which is adapted to the majority of the cases which demand the operation, and especially to those where the tumor has attained some size, or where the skin is either diseased or superabundant.

Operation.—The patient being placed upon his back, and the parts shaved of hair, the surgeon should seize the tumor in his left hand, with the palm presenting anteriorly, and force it towards the front of the scrotum, or an assistant may hold it so as to render the skin tense. Then, commencing an elliptical incision through the skin a little below the inguinal ring, let him continue it below the tumor, or to the inferior part of the scrotum, so as to insure the escape of pus, the two halves of the incision being made to include as much of the scrotum as it is desired to remove. Then, seizing the margin of either half, dissect off its loose cellular tissue from around the tumor, until the latter can be turned out of the pouch (Plate LII., Fig. 10).

After isolating the cord from the surrounding parts, feel for the vas deferens, which may be told by its cartilaginous consistence, and with a few longitudinal touches of the scalpel, separate it from the cord. Pass a ligature around the remaining portion, draw it firmly, tie it in a double knot, allow the ends to remain, and then divide the entire cord below this ligature.

Dressing.—In order to insure a vent for the pus that will subsequently collect in the scrotum, introduce a small piece of lint or linen into the lower angle of the incision, unite the centre of the wound by a stitch, and close its upper angle by adhesive strips.

CHAPTER II.

STONE IN THE BLADDER.

PATHOLOGY.—The development of urinary calculi in the bladder of the male may be the result of various causes, though most frequently it is due to such derangement of the general system, and especially of the function of the kidney, as leads to the formation and deposit of sabulous matter in the bladder, till, by the continual increase and agglomeration of particles, it results in the production of a mass termed a Calculus. These calculi may vary in size from a bullet to that of the diameter of the pelvis, though most commonly they weigh from two to sixteen drachms, those which are heavier than this being rare, and those which are smaller being designated as "pebbles."

As all calculi differ in size, so they also differ in composition and hardness; those containing a large proportion of oxalic acid being the most resisting. The scientific treatment of these formations requires a minute investigation of all the functions of the body, as the permanency of the cure depends upon the correctness of the surgeon's knowledge of the cause. Every possible means should therefore be resorted to, in order to learn all the peculiarities of the case, the microscopic and chemical characters of the stone being examined with the utmost accuracy. At present, however, I can only hint at this, and must refer those desirous of information on the more detailed pathology of the complaint to the elaborate treatise of Dr. Gross, of Louisville,[1] or to that of Civiale.[2]

Two operations have been suggested for the removal of calculi from the bladder, and the relief of the symptoms created by its presence, the one (Lithotomy) consisting in making an incision through the neck of the bladder by perforating the perineal structure; the other (Lithotripsy) being accomplished by instruments introduced into the viscus through the urethra, by means of which the stone

[1] On Diseases of the Urinary Organs, Philad. 1851.

[2] On the Medical and Prophylactic Treatment of Stone and Gravel, by Civiale, M. D. Translated from the French by Henry H. Smith, M. D., Philadelphia, 1841.

PLATE LIII.

INSTRUMENTS EMPLOYED IN LITHOTOMY.

Fig. 1. A strong round-bellied scalpel for the first incisions of the perineum. Schiveley's pattern.

Fig. 2. A sharp-pointed bistoury, to open the membranous portion of the urethra, and expose the groove of the staff, as it will do it better than the scalpel. In using it, the membranous portion of the urethra should be punctured as near to the prostate as possible, and then laid open from behind forwards. Schiveley's pattern.

Fig. 3. Dupuytren's double Lithotome cachè. 1. The beak adapted to the groove of the staff. 2, 3. The blades expanded laterally, but shutting up in the body of the lithotome. 4. The lever for expanding the blades. 5. A screw to regulate the expansion of the blades. Charrière's pattern.

Fig. 4. A side view of Physick's Cutting Gorget, the blade being detached at pleasure from the handle. 1. The handle. 2. The stem-beak. 3. The cutting edge. 4. The screw to fasten the blade to the beak and handle. Schiveley's pattern.

Figs. 5, 6, 7, 8 represent other blades, which may be adapted to the same handle, and selected in reference to the width of the perineum in each patient; they vary from one-fourth of an inch to one inch, increasing by fourths or eighths, at the option of the operator. The size and angle of the blade and handle are similar to that of the common gorget. The length from the beak to the angle of the handle is four and a half inches, and the handle is four inches. As the blade can be readily detached, it may be perfectly and readily sharpened, and made to cut directly up to the beak of the instrument.

Fig. 9. Barton's Stone Forceps with fenestra to diminish the expansion of the blades when holding the stone. Schiveley's pattern.

Figs. 10, 11. The ordinary Stone Forceps, of different sizes.

Figs. 12, 13. Different forms of the Scoop. Schiveley's pattern.

Fig. 14. Earle's Forceps, for crushing calculi, which are too large to be extracted whole. 1. The screw to close the handles. Schiveley's pattern.

Plate 53.

Fig. 1.

Fig. 2.

Fig. 3

Fig. 9.

Fig. 10.

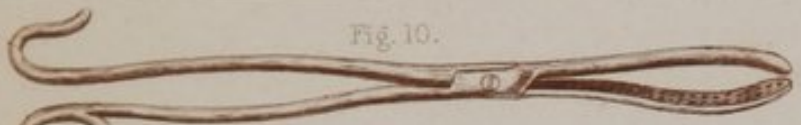


Fig. 11

Fig. 12.

Fig. 13.

Fig. 4.

Fig. 5

Fig. 6.

Fig. 7.

Fig. 14.

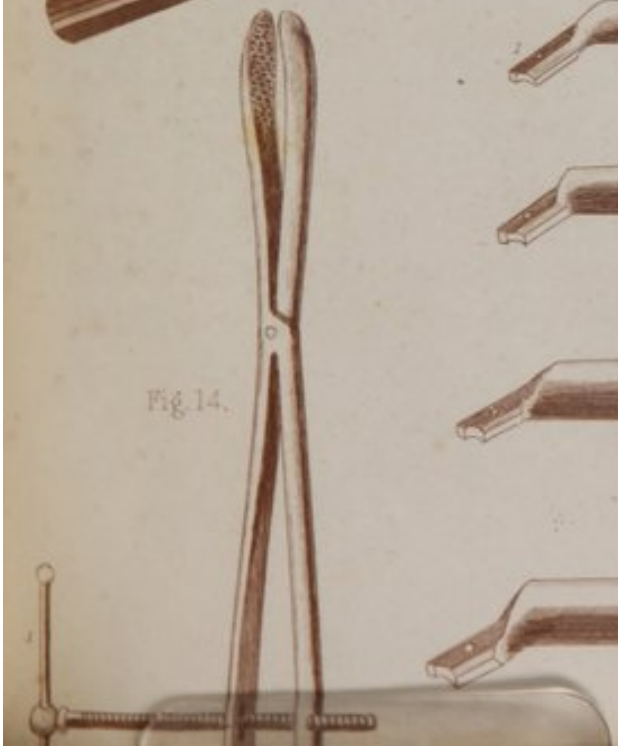


Fig. 8.

is broken into particles of such a size as permits their being voided with the urine.

In the selection of either, the surgeon should be mainly guided by the peculiarities of the case. If the patient is in feeble health, with disordered digestion, with a diseased bladder, and thickened, muddy, or muco-purulent urine, lithotomy may present the best chance; but if the stone is soft and friable (as may be told by the sensation given to the sound), if the bladder is apparently healthy, and the general constitution not much impaired, lithotripsy should be selected, as being attended with less risk, and also as least likely to give rise to trouble in the execution of the function of the bladder and testicles, at a subsequent period.

The operation of incising the male perineum and extracting a calculus has always been regarded as one of the most important efforts of an operator, and the anatomical relation of the parts cannot, therefore, be too often referred to by those contemplating its execution.

SECTION I.

SURGICAL ANATOMY OF THE MALE PERINEUM.

The Perineum (περι around, and νεος a temple) is formed entirely of such soft tissues as fill up the inferior outlet of the pelvis, and has in the male no openings except those for the urethra and rectum.

In its general outline, the perineum may be limited to the space included between the bones forming the inferior strait of the pelvis, though for the purposes of regional anatomy, it has sometimes been circumscribed yet more, by being described as "the isosceles triangular space formed by the bones of the arch of the pubis, and by a line drawn transversely from the tuberosity of one ischium to the other in advance of the anus."

The tissues entering into the composition of the perineum are the skin, superficial fascia, loose cellular tissue, loaded with fat, and varying very much according to the general condition of the patient, the perineal muscles, the triangular ligament or middle perineal fascia, and the deep or pelvic fascia.

In the middle of this region, as thus bounded, we should notice that the larger triangular space above described can be readily

subdivided into two equilateral triangles by the raphé, this line being the boundary of the symmetrical organs found on each side.

Of these organs we should note the root of the corpus cavernosum, the erector penis muscle, the transversus perinei, and sometimes the transversus perinei alter, part of the levator ani, or muscle of Wilson, as well as the branches of the internal pudic vessels and nerves.

In the middle line of the perineum, we also find, in addition to muscle, the skin and fascia, the accelerator urinæ, the sphincter ani, the bulb of the urethra, its membranous portion, the triangular ligament, the rectum, prostate gland, and orifice of the neck of the bladder.

The dimensions of the perineum in man have been carefully studied by surgical anatomists in order to decide how large a calculus can be extracted through this part. According to Dupuytren, the transverse diameter of the perineum varies from two to two and a half inches, whilst its depth, or antero-posterior diameter, is about four. The distance of the peritoneum from the skin on a level with the recto-vesical depression between it and the verge of the anus varied from two inches and eight lines to three inches and six lines, as examined upon twelve subjects, and from the mucous surface of the neck of the bladder to the raphé, ten lines in advance of the anus, it was from two inches to two inches and eight lines.[1]

The relative position of the prostate gland, and its capacity for dilatation, have also been accurately studied in consequence of its necessary division in the extraction of calculi through this region. According to Velpeau,[2] the prostate gland is situated about eight lines from the symphysis pubis, and its sides about an equal distance from the rami of the pelvis.

"The transverse incision on one side of the prostate, as ascertained by the measurement of the gland by Mr. H. Bell, in more than forty subjects, can only be about ten lines in length, give an entire opening of two inches and nine lines in circumference, and allow of the exit of a spheroidal body ten or eleven lines in diameter. The oblique incision downwards may be from eleven lines to an inch long, create an opening three inches and a line in circumference, and be large enough for a calculus one inch in diameter.

[1] Blandin, Anat. Topograph., p. 383.

[2] Anat. Chirurg., tome 2me, p. 236.

"When the prostate is incised on both sides, the transverse incisions being each nine or ten lines long, there will be an opening four inches five lines and a half in circumference, which will, therefore, permit the extraction of a calculus one inch and a half in diameter. Two perfectly oblique incisions form an isolated triangular flap, the base of which is one inch and three-fifths in extent, lays bare, when the flap is lowered in front, a triangular opening altogether a little less than four inches, and consequently less than the transverse opening. An oblique incision to the left side eleven lines, or an inch long, and another transverse one to the right ten lines long, permits the largest opening, and with the dilatation of the urethra, give an opening of four inches and eight lines, whilst it is one which can be easily expanded. This last is the incision preferred by Mr. Senn."[1]

The membranous portion of the urethra is ten lines long, and is situated behind the triangular ligament, and in front of the prostate.

The bulb of the urethra is attached to the anterior face of the triangular ligament, is formed by a spongy or erectile tissue, which is nearly deficient in children, fully developed at puberty, and is longer than its width in old men.[2]

The transversus perinei artery supplies the bulb of the urethra, and passes to it fourteen lines in advance of the anus. The branches of the venous vesical plexus, which surround the neck of the bladder, lie outside of the prostate in the thickness of its sheath.

SECTION II.

OPERATION OF PERINEAL LITHOTOMY.

Perineal Lithotomy may be performed in three ways: in one, the incision opens the membranous portion of the urethra and the prostate on the left side of the perineum, and is called the Lateral operation; in the second, both sides of the prostate gland are divided, constituting the Bi-Lateral operation; and in the third, it is divided in the line of the raphé, and is, therefore, termed the Median operation.

[1] Malgaigne, Op. Surg., Philad. edit. p. 497.

[2] Blandin, p. 386.

§ 1.—PREPARATORY STEPS.

Before proceeding to employ any of the means that are proper, as preliminary measures, in the operation of lithotomy, it is essential that the presence of the stone be positively established.

I. DIAGNOSIS OF STONE IN THE BLADDER.

Various symptoms have been recorded by surgical writers as pathognomonic of the existence of a calculus; but, though useful as aids in diagnosis, they cannot be relied upon by themselves; sounding, or the direct contact of an instrument with the stone, being the only certain sign of its presence.

SOUNDING.—To prove the existence of a stone by sounding, the surgeon should select two steel sounds of different curves, and with smooth polished handles, warm and oil them, and then introducing first one and then the other into the bladder in the manner directed for catheterism, move its point about until he can cause it to touch the calculus, when the sensation which will be communicated to the fingers will prevent a mistake. The advantages of employing sounds with different curves will be found in the facility with which the smaller curve may be made to sweep the bas-fond of the bladder, when the greater convexity of a more curved instrument might enable it to pass over the stone without touching it. When a sound is in the bladder, its point should be gently turned from side to side as well as to the top and bottom of the viscus, lest the stone be encysted.

In order to obtain an accurate touch, the broad handle of the sound should be perfectly smooth, and held between the thumb and forefinger, so as to obtain as great a surface of contact as possible. By attaching a flexible stethoscope to the handle of the sound by means of a little clamp, the sense of hearing may also be made to aid materially the diagnosis.

On the part of the patient, there are also certain circumstances which are favorable to the establishment of a diagnosis by these means. Thus the bladder, at the time of sounding, should hold sufficient water to keep its sides moderately distended. When, therefore, the patient has urinated a short time previous to the visit

of the surgeon, a silver catheter should be first introduced, and about twelve ounces of tepid water slowly injected, so as to distend the bladder, and prevent its closing on the instrument. If, after sounding with the bladder in this condition, a stone cannot be felt, the fluid may be allowed to escape, or be voided by the patient, in order that the contraction of the bladder may bring the stone in contact with the instrument. Small calculi in patients with diseased prostate are also sometimes difficult to detect, unless the finger is introduced into the rectum; and the same manœuvre will often prove useful in other cases. A change in the position of a patient sometimes renders the presence of a stone apparent, by causing it to touch the sound; thus, after lying on the back, a position first on one side and then on the other, cautiously taken, will often cause the instrument to touch it; and, in two instances, Dr. Physick succeeded in thus detecting a stone where other means had failed, the patient being placed in one instance so nearly on his head that the fundus of the bladder became the most depending part.[1]

The record of cases in which patients have been cut, without the operator finding any stone, as well as the history of those whose bladders contained large calculi, the presence of which had not been detected during life, are sufficiently numerous to lead every operator to use the utmost caution in sounding his patient. Thus, a fibrous tumor, attached to the prostate gland by a slender pellicle, is reported by Velpeau[2] to have been mistaken for stone; whilst Dessault, Cheselden, S. Cooper, and Velpeau[3] cite other cases where even large stones existed without being recognized. By a resort to Anæsthetics, many of the former sources of difficulty can now be removed, so that one familiar with the changes of structure liable to be produced in the bladder by disease can hardly fail, with proper care and repeated examinations, to satisfy himself fully of the actual condition of the viscus.

In addition to the knowledge gained, by sounding, of the presence of a stone, the operator should also learn the probable size, consistence, number, and position of the calculi, all of which will materially aid him in deciding upon the kind, as well as the steps of the operation, that may be required for its removal.

[1] Dorsey's Surgery, vol. ii. p. 179.

[2] Mott's Velpeau, vol. iii. p. 888.

[3] *Op. citat.*, vol. iii. p. 891.

§ 2.—CONSTITUTIONAL TREATMENT.

The presence of the stone being in most instances the cause of much of the suffering and general constitutional disturbance seen at this period of the complaint, it might be supposed that its prompt removal would afford the best chances for a recovery; but experience has firmly established the fact that the greatest success attends such operators as have first carefully watched the preparation of their patients.

To accomplish the proper preparation of a patient for the operation of lithotomy requires a correct judgment and the combination of the highest medical with the best surgical experience, as the means must vary in different cases; but in every instance the patient should be placed in as healthy a condition as possible. He must, therefore, neither be too much depleted nor stimulated, whilst every secretion should be noted, in order to tell the proper condition of his whole system. As a general rule, it is beneficial to evacuate the bowels thoroughly, but gently, before operating; to obtain perfect rest; to have the mind free from anxiety, and to place the digestive and thoracic viscera in a good condition by means of alteratives, sedatives, and diaphoretics. No better means can be resorted to for the relief of the train of symptoms that have been termed a "fit of the stone" than the free use of alkaline and diluent drinks; the hip-bath; anodyne enemata; and the occasional inhalation of ether. I have in several instances afforded much relief simply by administering boluses of the following alkalies and diuretics:—

℞. Saponis Hispan.,
Carb. sodæ exsiccat., āā ℥j;
Ol. juniperi gtt. lx.

M. Et ft. mass dein in pil. xii dividend. S. One every four hours.

In cases of gravel, the same formula, by neutralizing the uric and lithic acid, has caused the evacuation of such an amount of sand as induced patients to think the stone was being dissolved.

§ 3.—LOCAL PREPARATORY MEANS.

The local preparatory measures required in lithotomy refer both to the part of the body to be operated on, and to the apartment selected for the performance of the operation.

The perineum of a patient about to be cut for stone should in all cases be perfectly cleansed and shaved, in order to avoid the irritation liable to be caused after the operation by the adhesion of unhealthy discharges to the hair of the part. The rectum should also be thoroughly emptied by a laxative enema, and then put at rest by the use of an anodyne, but the bladder should be kept nearly full, either by inducing the patient to retain his urine, or if this cannot be done, or if the secretion is deficient, by injecting tepid water as directed in sounding.

In selecting a room, it is important to have one that is well ventilated, and with a good light falling either from above or from one side; to have a firm narrow table, and sufficient stands or tables for the reception of instruments, &c.

After selecting the table, it should be covered by a mattress and pillows, the end of the mattress being doubled under and tied or pinned firmly together, so as to elevate and support the hips. Over this should be placed a thick blanket, and over this a sheet, the end of which should hang down to the floor, in order to protect the clothes of the surgeon. The resort to a shallow box or pan of sawdust at the foot of the table, and placed just beneath the end of the sheet, will also aid in preserving the cleanliness of the apartment.

In addition to such instruments as may be required for the special mode of operating selected by the surgeon, there should also always be a large syringe and catheter; a pitcher of barley-water to wash out such fragments of the calculus as may be created in extracting the stone, together with a little cup of sweet oil, sponges, basins, water, towels, and stimulants should the occasion require them.

Five assistants may be required to aid the operator. The first should hold the staff and scrotum of the patient, according to the directions furnished by the surgeon. Two others should place the patient's knee in their axilla, whilst their forearms should be passed round his leg, so that by bearing their weight upon his pelvis they may steady it upon the table, and by keeping his thighs sepa-

PLATE LIV.

LATERAL OPERATION FOR LITHOTOMY.

Fig. 1. A view of the position of the patient, surgeon, and assistants, as far as they could be shown upon one figure, in the lateral operation for stone. 1, 2. Hands of first assistant holding the staff vertically, and holding up the scrotum. 3. Left forefinger of surgeon depressing the rectum in the deep incision in the perineum. 4, 4, 5, 5. The hands and arms of the assistants. Their arms are, however, represented as placed upon the thighs of the patient instead of nearly parallel with his legs, as they ought to be; but this position was incompatible with the view. 6. The appearance of the incision in a deep perineum, immediately after puncturing the membranous portion of the urethra. After Nature.

Fig. 2. Manner of holding and passing the knife in the groove of the staff when the bladder is opened by it instead of the gorget, its handle being gently depressed so as to keep its point in the groove of the staff as it enters the bladder. 1. The staff. 2. First position of the knife. 3. Its final position in the neck of the bladder. After John Bell.

Fig. 3. The right forefinger passed into the bladder along the staff, so as to recognize the position of the stone before passing in the forceps. 1. The staff. 2. Hand of the surgeon. After John Bell.

Fig. 4. An outline to show the manner of enlarging the wound by means of the probe-pointed bistoury. 1. The staff in position. 2. The forefinger of the surgeon introduced into the opening in the neck of the bladder with its palmar surface pressing against the back of 3, a probe-pointed bistoury in the act of enlarging the incision in the prostate gland. After John Bell.

Fig. 5. Outline representing the forceps as grasping one stone, whilst a second is represented below it. 1, 1. Improper line in which to attempt extraction, as it exposes the neck of the bladder to contusion against the arch of the pubis. 2. Forceps seizing the stone. 3, 4. Proper direction of the forceps in the last efforts for extraction of the calculus. After John Bell.

Fig. 6. A view of the mode of retaining the stone in the scoop during its extraction by this instrument. 1. The scoop. 2. Left forefinger of the surgeon. After John Bell.

Plate 54.

Fig. 3.

Fig. 4.

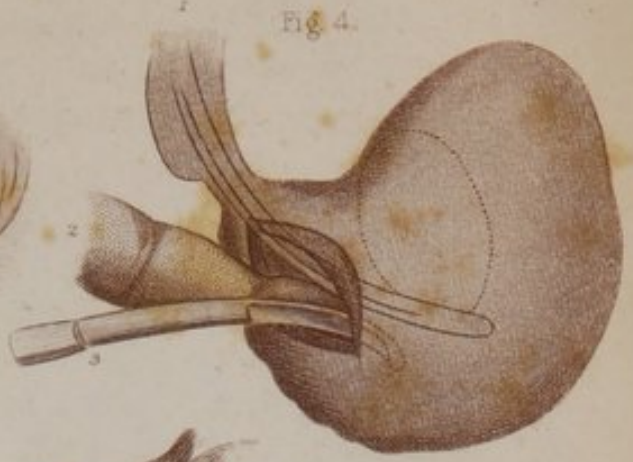


Fig. 1.

Fig. 2.

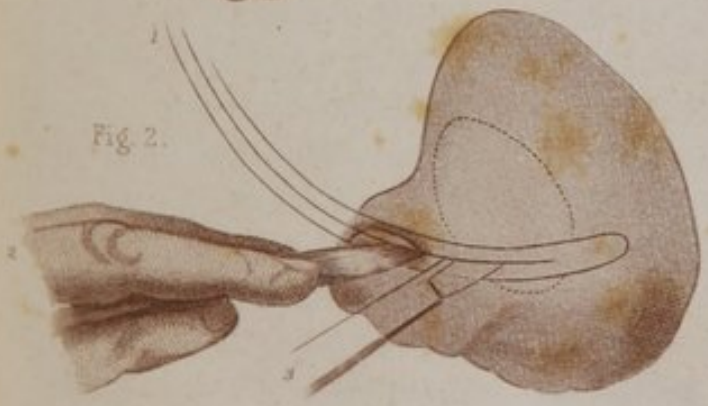


Fig. 6.

Fig. 5.

rated, render the perineum tense. The fourth should stand at the patient's head and shoulders, to administer the anæsthetic, watch its effects, and furnish drink or such other attentions as the circumstances may call for; the fifth should remain in the room to wait upon all.

SECTION III.

THE LATERAL OPERATION.

The division of the perineum upon the left side of the raphé, so as to open the bladder through the left half of the prostate gland, is an operation of considerable antiquity, and by many regarded as the best mode of operating where the stone is not excessively large. Although those selecting it have from time to time deemed it advantageous to modify the various instruments by which the division of the prostate was to be effected, there is but little difference in the other steps of the operation, and this account will therefore be limited to the operation as practised by Cheselden, Abernethy, Cline, and others in Europe; by Drs. Physick, Dudley, Barton, McDowell, and Norris, in the United States; and by such surgeons of the present day as prefer the use of the cutting gorget.

§ 1.—INSTRUMENTS THAT MAY BE WANTED DURING THE OPERATION.

In order to meet all the contingencies that may arise in the lateral method of lithotomy, the surgeon should prepare and place upon a tray the following articles, which are mostly shown in Plate LIII., to wit: one large and deeply grooved staff, to pass into the bladder; one large round-bellied scalpel with which to incise the perineum; one sharp-pointed bistoury to open the membranous part of the urethra, if the scalpel is not sufficient; a gorget or knife to incise the prostate; forceps of different sizes, with and without fenestra; a scoop; Earle's crushing forceps, or Heurteloup's lithontriptor; a tenaculum; Physick's forceps and needle, in case of wound of the internal pudic artery, and ligatures, needles, and lint for arresting the hemorrhage, or plugging the wound, if requisite.

Introduction of the Staff.—The patient being etherized, and

placed as before directed, the surgeon should oil and introduce a sound into the bladder to render the presence of the stone evident to his assistants, and, having done so, withdraw the sound and introduce the staff; or, the sounding may be practised the day before the operation, and verified simply by the staff at the time of the operation. The latter being then accurately adjusted in the median line of the body, the first assistant should hold it, whilst the patient's hands and feet are bandaged together, if the assistants are not men of experience, but with the employment of anæsthetics and with good assistants this is not necessary, though some deem it a safer practice. The patient being now in position, with the perineum fully exposed, the surgeon should feel for the ramus of the ischium, the bulb of the urethra, and the body of the staff, so as to recognize these points of reference, and, being satisfied with the position of the latter, direct the assistant how to hold it. On this point there is much difference of sentiment, such surgeons as prefer to be guided in their incisions solely by the staff, liking it to bulge out in the perineum and incline well towards the left side; while others, relying upon their anatomical knowledge, prefer having its point kept accurately in the bladder, with its concavity close under the arch of the pubis, and its handle turned a little to the right groin, so as merely to present its groove towards the left side of the raphé. Of the two methods, I prefer the latter, relying upon the staff rather in cases of error or deviations in incising a deep perineum than for the primary incisions. In my opinion, any surgeon who cannot open the membranous portion of the urethra without the aid of a staff, is but badly qualified for the performance of the operation of lithotomy.

§ 2.—LATERAL OPERATION WITH THE CUTTING GORGET.

The surgeon being conveniently seated on a moderately low stool or chair without a back, or else kneeling on one knee, should commence his operation by placing the first and second fingers of his left hand upon the perineum near the raphé, so as to steady the skin, and then holding the scalpel in his right hand like a pen, puncture the skin and fat by a perpendicular pressure, at a point near to the left side of the raphé, and immediately behind the scrotum, that is, at one which corresponds with the lower side of the

arch of the pubis, or is about one inch in advance of the sphincter ani muscle. Commencing at this point, let him now, by a steady pressure, continue the incision in a straight line to a spot corresponding nearly with the middle of the fibres of the sphincter ani muscle, and about half way between it and the tuber ischii, the incision being about three inches long in the adult, and boldly made, so as to divide the parts neatly, whilst it should be of sufficient depth, especially in its middle, to reach the membranous part of the urethra. The beginning and end of this first incision need not, however, be deeper than the skin and fat, whilst the greater depth of its middle should be such as would make a conical wound, the apex of which should be towards the bladder (Plate LIV., Fig. 1). If the first incision is not deep enough in its centre, two or three touches of the scalpel may be made, so as to divide the transversalis and levator ani muscles with the triangular ligament and expose the membranous portion of the urethra. The left forefinger should now be thrust into the wound, whilst the hand is in extreme pronation, so that the radial edge of the finger may be turned downwards, the ulnar side of its pulp and the point of the nail being made to touch the staff, whilst its back presents to the left descending ramus of the pubis. Then laying down the scalpel and taking up the sharp-pointed bistoury, pass it flatwise, or with its back to the rectum, along the left forefinger as a director; carry its point to the bottom of the wound; puncture the membranous portion of the urethra so as to enter the groove of the staff, as may be told by the escape of a little urine and the contact of the instruments; and then cutting from behind forwards, lay bare the staff by one stroke, from the prostate to the bulb, when more urine will follow, and the staff will be clearly felt and seen. Then promptly taking the gorget, dip its point into oil, place its beak in the groove of the staff; stand up; take the handle of the staff from the assistant; balance the two together, the edge of the blade being inclined downwards and outwards, and then by a steady movement press the gorget along the staff into the bladder. As its cutting edge progresses, the handle of the instrument should be made to descend in front of the anus so as to keep the beak perpendicularly applied to the staff, and prevent its slipping, when a gush of urine will follow and show that the bladder has been opened. Then withdraw the gorget promptly, but leave the staff in the bladder; again pass in the left forefinger; touch the stone with it (Plate LIV., Fig. 3); direct the

assistant to withdraw the staff; and taking the forceps in the right hand, with the thumb and fore or second finger thrust through the rings in its handles, pass the point of the forceps into the bladder along the left forefinger, with the blades closed; touch the stone, and endeavor to seize it in the forceps, so that its longest diameter shall not be transverse to the wound; or if this cannot be readily done by the right hand alone, take one handle of the forceps in each hand, turn the instrument flatwise, so that it may act as a scoop, and then fishing about, get the stone into the grasp of the instrument. After the stone is properly grasped by the forceps, withdraw the left forefinger, slide it along the forceps to the centre screw, and, by a gentle lateral and up and down movement, extract the calculus by such a moderate amount of force as may be necessary to dilate the wound, but not bruise it (Plate LIV., Fig. 5).

The calculus being removed, introduce the right forefinger and feel for others, or for fragments; then pass into the bladder, through the wound, a large catheter; adapt to its free end the nozzle of the syringe containing barley-water, and wash out the clots of blood, fragments, &c. that may be left behind; after which it only remains to arrest any severe hemorrhage that may show itself, and to dress the wound in the manner hereafter stated.

Remarks on the Lateral Operation.—The section of the prostate gland, as accomplished by Physick's gorget (Plate LIII., Fig. 4), is one of great certainty and cleanness, creating a wound which is admirably adapted to healing, in consequence of the accuracy with which the two surfaces may be approximated.

The advantages of the ordinary gorget have been variously estimated at different periods, some surgeons asserting that its operation was too mechanical, and its division of tissue a "stab in the dark;" whilst others have highly lauded it. In the United States, the English cutting gorget was the favorite instrument of Dr. Physick, who modified it so that its blade could be separated from the beak, and thus made to receive a perfect edge—a modification of great value, and one which really gave this instrument a new character, making it a perfectly firm and keen knife. The gorgets that have since been made in the United States have been mostly of this pattern, and have been employed by Drs. Gibson, Rhea Barton, Randolph, and McDowell, as well as by most of the lithotomists of Philadelphia. The venerable Dr. Dudley, of Kentucky, whose success as a lithotomist is so widely known, having operated more

frequently with success than any other surgeon, always employs the gorget, though he prefers that of Mr. Cline, of England.

An examination of the objections that have been urged against the use of the gorget shows that the faults charged upon it are chiefly due to the old English gorget, or that known as the gorget of Hawkins, as this cannot be sharpened close to the beak, and, in passing along the staff, is therefore apt to leave a portion of the prostate uncut at the sides of the staff, in consequence of which the gorget is liable to be thrown out of the staff, and made to cut towards the rectum. Many of the instances referred to by the opponents of the instrument are also rather examples of the want of skill in the operators than of defects in the instrument, as a good surgeon could hardly fail to lithotomize a patient with any instrument.

There are, however, many operators in the United States who do not use the gorget, preferring a beaked knife, of various kinds and shapes, most of which are apparently favorites, from personal peculiarities in operating, and some of which having been designated by the name of the inventor. In many instances such knives are only poor modifications of a gorget, act in the same manner, but do not make so accurate an incision, and are liable to create an opening in the pelvic fascia by leading the operator to incise the prostate to too great an extent laterally. In a deep perineum, it is always difficult to judge of the position of the point of a knife, even when apparently directed by the left forefinger; but with a staff held in the median line of the body, with its curve close under the pubis, and with the beak of a gorget well placed in it, it is impossible to extend an incision beyond the limits of the width of the blade. The advantages and disadvantages of the gorget is, however, a subject which has engaged powerful advocates on both sides, and I shall therefore dismiss it with the simple statement of individual preference for the gorget of Physick, though at the same time I should not hesitate to cut for stone with a staff and pocket bistoury, if nothing else could be obtained, nor doubt the possibility of any skilful surgeon operating neatly and properly with any instrument when a correct anatomical knowledge of the structure concerned was made to direct it. The choice of a knife is the least important part of any operation, and the discussions spent on the shape of instruments would be much more valuable if more closely connected with the anatomy of the region, and less with the mechanical ideas of the cutler.

§ 3.—OPERATION WITH THE SINGLE LITHOTOME CACHÈ OF FRERE COSME.

The single lithotome cachè or concealed lithotome of Frere Cosme resembles that of Dupuytren (Plate LIII., Fig. 3), and has but one blade. It is introduced into the bladder by passing its beak into the staff when the latter has been exposed as in the preceding operation; when carrying its point into the bladder and then opening the blade by pressure against the handle, the prostate and neck of the bladder are to be incised whilst the instrument is being withdrawn in a perfectly horizontal direction. If the handle of the lithotome is too much elevated, the lower surface of the bladder will be exposed to injury; whilst, if it is much depressed, the incision will be too small. If the blade is directed outwards, the pudic artery may be wounded, and if too much downwards, the rectum[1] may be opened.

Remarks.—In very many instances, I have operated in Paris upon the subject with this instrument, as well as with that of Dupuytren, in the manner usually directed by the French surgeons, but have always felt the uncertainty of the extent of the incision thus effected. The liability of the blade to spring; the difference in the resistance offered to its escape by different perineums; the liability to too great expansion, &c., have satisfied me that it cannot bear a comparison either with the gorget of Physick or with what has been termed the "beaked knife of Liston." Its chief recommendation appears to be the difficulty of wounding the rectum. Such an event would certainly be a strong recommendation of the instrument, if lithotomy was to be performed by every individual, but can not prove so to an accomplished surgeon—and none but good surgeons should attempt this operation.

SECTION IV.

THE BILATERAL OPERATION.

In the bilateral operation of lithotomy, the bladder is opened by an incision through each half of the prostate gland, and a wound

[1] Malgaigne, Philad. edit. p. 505.

made, through which a calculus may be extracted, of somewhat larger dimensions than is possible by the lateral section. From having been revived and brought into notice, as well as modified by Dupuytren in 1824, it is often spoken of as his operation, though Celsus, it is well known, was also familiar with a similar method.

Operation of Dupuytren.[1]—Instruments.—The instruments employed by Dupuytren were: 1. A sound, which was lighter than the ordinary sound, sloped off at the end of its grooves, and expanded for two inches in length, at the point where it is most curved, so that it might the better distend the urethra. 2. A double-edged scalpel fixed in a handle, and sharp on each edge for about one-third of an inch from its point. 3. A double lithotome (Plate LIII., Fig. 3), the two blades of which opened in one handle, and were so acted on by two levers as to separate in a curved direction, and divide each side of the prostate in its oblique diameter.

Operation.—The patient being placed as before directed, and the position of the various points of reference accurately recognized (Plate LV., Figs. 1, 2), the staff should be introduced and held in a perfectly perpendicular direction, whilst the surgeon extends the integuments of the perineum with the fingers of his left hand, and makes a semicircular incision with the double-edged scalpel held in his right, commencing on the right side at a point half way between the tuberosity of the ischium and the anus, passing half an inch in front of the anus, and terminating on the left side of the perineum at a point corresponding with the starting-point on the right. (Plate LV., Fig. 3.) By continued, but rapid incisions, the superficial fascia, anterior point of the sphincter ani muscle, and the cellular tissue are divided, and the membranous part of the urethra laid bare, when the nail of the left index finger enables the surgeon to feel the groove in the staff, which may then be exposed, as before directed, by means of a bistoury. The forefinger, during all this period, should be made to depress the rectum in order to prevent its injury. After opening the urethra for one-third of an inch, use the left forefinger nail as a guide to the lithotome cachè, and introduce the instrument by holding it in the right hand with the thumb beneath and the two fingers above, presenting it to the staff, so that its convexity may look downwards. The contact of the two instru-

[1] Malgaigne's Operative Surgery, Philad. edit. p. 507.

ments being now recognized, the surgeon should take the handle of the sound in his left hand, and, elevating it so as to place its curve close under the symphysis pubis, slide the lithotome along its groove into the bladder. Then withdrawing the staff, turn the lithotome so as to present its concavity downwards, or towards the anus, and, grasping the lever, depress it to the handle of the instrument so as to unsheath the blades, withdrawing the instrument progressively downwards until it cuts its way out. (Plate LV., Fig. 4.)

The left index finger, being then introduced through the wound into the bladder, should examine the extent of the incisions, and if they are not sufficiently large, direct a probe-pointed bistoury so as to enlarge them. (Plate LIV., Fig. 4.) But if they are large enough, the forceps should be introduced, and the stone extracted as before directed.

The width of Dupuytren's incision, when widest, was not more than two inches, so that the incision did not pass the circumference of the prostate.

Operation of Dr. T. S. Ogier, of Charleston.[1]—A boy, thirteen years of age, with a large calculus, was operated on as follows, in 1835. The rectum being emptied, and a staff placed in the bladder, a semilunar incision was made in the perineum just under the bulb of the urethra, commencing about half way between the anus and the tuberosity of the ischium on the right side, and terminating at the same point on the left side, so as to divide the skin and perineal fascia. This being rapidly increased in depth at its centre, the staff was soon felt with the point of the scalpel, a small puncture made in the membranous portion of the urethra, and then Dupuytren's double lithotome being introduced into the bladder, the staff was withdrawn, the lithotome turned with its concavity downwards and the neck of the bladder divided from within outwards by expanding the blades of the instrument so as to make it cut as it was drawn out. The stone having been then seized with the forceps, was readily extracted, though it measured two and a half inches in length, three and a half in circumference, and weighed one ounce three drachms.

Operation of Dr. R. D. Mussey, of Cincinnati.—With a rather narrow scalpel, the superficial crescentic incision is made with its convexity anterior, so as to expose the staff at the membranous

[1] Am. Journ. Med. Sciences, vol. vii. N. S. p. 504.

portion of the urethra. (Plate LV., Fig. 3.) A straight probe-pointed narrow bistoury being then passed along the groove of the staff, with its edge turned towards the left side until it enters the bladder, the point of the left index finger is slid along the back of the bistoury, and made to press it against the prostate so as to divide the latter sufficiently to admit the point of the finger into the bladder, when the staff should be withdrawn and the prostate further divided, if necessary. The finger being then rotated, the palmar surface of its point should be made to rest upon the right side of the prostatic portion of the urethra, the bistoury be turned upon the finger to the opposite side, and the right side of the prostate also divided as far as is necessary, the stone being afterwards extracted as usual.[1]

Operation of Mr. Fergusson, of England.[2]—Under the impression that a straight line in the course of the raphè with diverging slips on each side of the anus, like a ʌ Y reversed), would permit more expansion of the wound than any other form of external incision, Mr. Fergusson employed it with satisfaction in a case of lithotomy, after having tried it in the operation of lithectasy, or extraction of a calculus by opening the membranous portion of the urethra, and dilating the neck of the bladder, as proposed by Dr. Willis. Dr. Eve, of Nashville, Tennessee, has also recently adopted this incision in preference to the semicircular cut of Dupuytren.

Operation of Dr. Paul F. Eve, of Georgia.—The staff being introduced into the bladder, a short incision is made directly in the raphè at the bulb of the urethra, the direction being changed at a very oblique angle at the end of about three-fourths of an inch, in order to terminate at a point midway between the anus and the left tuber ischii. With the edge of the knife now turned upwards, penetrate the tissues, and commence the other leg of the ʌ at a point on the right side corresponding to the one just terminated on the left. This incision being deepened as the instrument ascends, arrives at the middle of the perineum with its edge turned directly upwards, when the urethra is opened and the staff exposed, after which the operation is completed by the lithotome in the usual way.

Remarks.—Of twenty-three cases operated on by Dr. Eve with the double lithotome, four died, three of which were from the ope-

[1] Am. Journ. Med. Sciences, vol. xi. N. S. p. 265.

[2] Fergusson, Pract. Surg., 4th Am. edit. p. 607.

PLATE LV.

THE OPERATION OF LITHOTOMY AS PERFORMED BY THE BILATERAL SECTION, WITH THE LITHOTOME CACHE OF DUPUYTREN.

Fig. 1. Position of the patient, with lines drawn on the perineum to show the points of reference and the direction of the incision. The subject being in the position of lithotomy, the testicles and penis have been turned up and the perineum divided into two equilateral triangles, the angles of which are made to touch the bones around the perineum. 1. Pubis. 2, 3. Tuber ischii. 4. Coccyx. 2, 3, 5. Line of external incision. From Froriep, but after Dupuytren.

Fig. 2. Dissection of the same subject. The fascia superficialis has been turned up from the edge of the incision, so as to show the accelerator urinæ muscle, and the transversus perinei arteries. The sphincter ani is seen below, and the divided fibres of part of the levator ani are shown in the cut. 1. The skin. 2. Fascia superficialis. 3. Sphincter ani muscle. 4. Line of median incision through the anterior fibres of the levator ani muscle. 5. Accelerator urinæ muscle. 6. Perineal arteries. 7. Perineal fascia dissected up, and turned over the body of the penis.

From Froriep, but after Dupuytren.

Fig. 3. External Incision in Bilateral Lithotomy. 1, 2. The hands of the first assistant holding the staff vertically, and elevating the scrotum. 3. The left forefinger of the surgeon depressing the rectum. 4. Right hand about terminating, 5, the incision. The external incision should be made from left to right, with its convexity forwards, so as to form an arc of about 100°. After Bourgery and Jacob.

Fig. 4. Section of the prostate with the double lithotome cachè upon a subject which had been dissected, so as to show the incision, the anterior portions of the sphincter and levator ani muscles having been removed. 1. Accelerator urinæ muscles. 2, 3. Internal pudic artery and nerve. 4. Transverse perineal artery. 5. Hand of the surgeon. 6. Levers which regulate the blades of the lithotome. After Bourgery and Jacob.

Fig. 5. Lateral section of the prostate as made by the single lithotome cachè, a portion of the sphincter and levator ani and anterior end of the anus being removed in order to show the prostate gland. 1. Bulb of urethra. 2. Membranous portion of urethra. 3. Prostate gland. 4, 5. Lithotome in position. 6. Corpus cavernosum. 7. Symphysis pubis. 8. Vesicula seminalis. 9. Rectum. After Bourgery and Jacob.

Plate 55.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

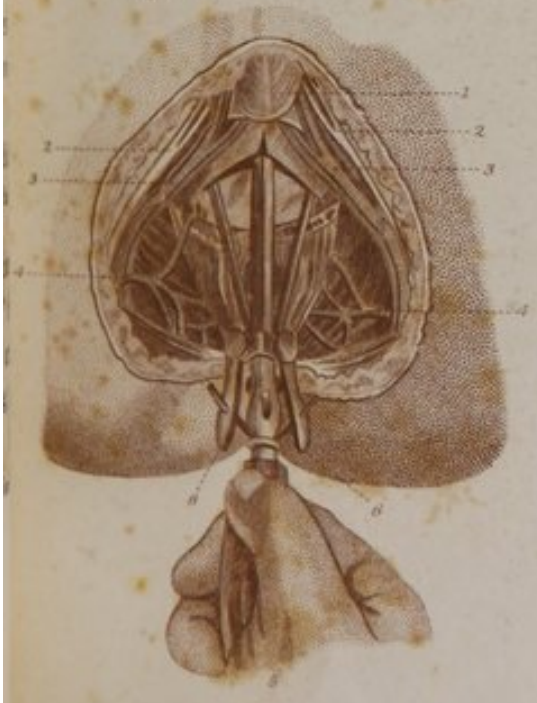
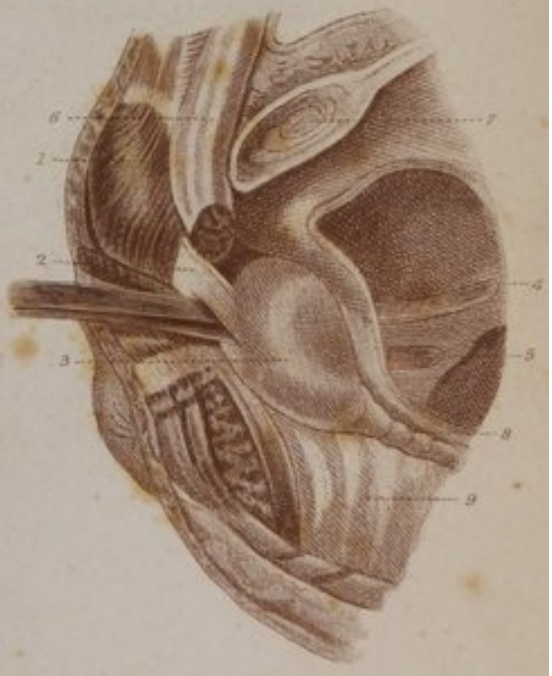


Fig. 5.



ration, two indirectly and one directly; and seventeen were well in two weeks after the operation.[1]

Operation of Dr. J. F. May, of Washington.—The patient being etherized, was cut as in the operation of Dupuytren, and a large stone readily extracted. Its longest diameter was two inches and a fraction, its shortest diameter one and five-eighths of an inch, and its circumference five and five-eighths inches.

Remarks.—Among American surgeons, the bilateral operation was first performed by Dr. Ashmead, of Philadelphia, in 1832, and by Dr. Ogier, of Charleston, in 1835, since which there have been many who have advocated and practised it, among whom may be mentioned Drs. Stevens, Hoffman, and Post, of New York; Warren, of Boston; Mussey, of Cincinnati; May, of Washington; Pancoast, of Philadelphia; Eve, of Nashville; Pope, of St. Louis; Dugas and Campbell, of Georgia, with many others; though several of them prefer the use either of a special instrument or of a probe-pointed bistoury to the lithotome of Dupuytren. My own experience, as gained upon the subject, corresponds entirely with this, as even with a lithotome, selected by the hands of Charrière, of Paris, I have found the blades to spring and yield to such an extent as to interfere with the accuracy of the section. The mode of operating, described by Dr. Mussey, is therefore, I think, preferable to that advised by Dupuytren.

As the incision of Dupuytren permits a very free dilatation of the perineal integuments, and also corresponds with the arch of the pubis through which a large calculus must pass, I cannot think there is any material advantage gained in the size of the wound made by the incision resorted to by Mr. Fergusson and Dr. Eve, whilst the central portion of it, except in very skilful hands, would expose an operator to much greater risk of wounding the bulb of the urethra than is the case in Dupuytren's operation. A median incision through the skin and perineal fascia, in the line of the raphè, will readily expose the bulb, though of course a skilful operator might expose it without wounding it.

The points of recommendation claimed for the bilateral operation over either of the others, are a more direct and free access to the bladder without injuring the vesical plexus of veins, as well as less risk of dividing important bloodvessels; but, on the other hand,

[1] Report to Med. Association, 1852.

the rectum is more exposed in the primary incisions, and perineal fistula, impotence, and a tendency to stricture near the prostatic portion of the urethra are said to be increased. Statistics alone can settle a question of this kind, though at present it is generally admitted that in cases of very large calculi, or in a case attended by anchylosis of the hip, as in that reported by my friend Dr. Pope, of St. Louis, or in analogous difficulties, the bilateral is preferable to the lateral section. The lateral incision is, however, fully capable of removing a large stone, and I have extracted one by this method that weighed two ounces and seventeen grains, and was six inches in circumference. The increased fondness of American surgeons for the bilateral rather than the lateral operation, seems, however, to indicate that experience proves its special advantages, though fashion occasionally regulates surgery to a certain extent as it does less important subjects.

SECTION V.

THE MEDIAN OPERATION.

Lithotomy having at one period been the especial province of one family, or class of individuals, it is not surprising that various plans of accomplishing it should have been each highly lauded, and handed down as perfect from generation to generation. Among all these methods, that in which the perineum is incised in the median line, and the stone extracted by opening the urethra in the same direction, at first sight would appear to be the safest. But this operation, though very ancient, has, in truth, nothing to recommend it, and is only now referred to because some of its steps may occasionally be found useful in extracting such fragments of calculi as lodge and become fixed in the urethra, or for the removal of such pebbles as are developed in the prostate gland. The operation of Giovanni di Romanis, as published in 1520, and since repeatedly modified, is as follows:—

Operation of Vacca Berlinghieri.[1]—The patient being placed as before directed, an incision is to be made in the median line of the perineum from the origin of the scrotum to the anterior border

[1] Malgaigne, p. 503.

of the anus, so as to divide the skin, superficial fascia, and anterior fibres of the sphincter ani muscle, and lay bare the groove of the staff in the membranous portion, without exposing the bulb. The knife, or probe-pointed bistoury, being then passed along the groove of the staff into the bladder, the neck was divided to the extent of four or five lines in a direction parallel with the median line.

§ 1.—LITHECTASY.

The term Lithectasy has been employed to designate the modification of this operation recently revived by Dr. Willis, of England.[1] In the operation of Romanis, as advocated by Marceaux, or the major apparatus (so called from the number of instruments employed in its performance), the membranous portion of the urethra was opened by an incision made near to, but on the side of the raphè. After which a probe was passed along the staff into the bladder, and then two conductors being passed along the probe, the prostate gland and neck of the bladder were forcibly dilated, or, perhaps, torn. As modified by Dr. Willis, this operation now consists in opening the membranous portion of the urethra by an incision in the line of the raphè above the anus. After thus opening the urethra, a sponge tent, or some similar dilator, is introduced and the opening dilated, in twenty-four hours, sufficiently to permit such forceps as will remove a small calculus.

REMARKS.—This operation has but little to recommend it. The dilating process is slow and apt to be a serious source of irritation to the patient. Owing to the difficulty of accurately deciding on the size of calculi, there is also the risk of having an opening which will not permit the stone to pass until the wound is further enlarged by the knife. It will, therefore, be but seldom adopted by any surgeon who is familiar with the performance of the ordinary lateral operation. Small calculi, to which it is chiefly adapted, had better be crushed, and in the event of these, or fragments, becoming lodged in the urethra, it will be better to attempt by skilful manipulation to replace them again in the bladder.

[1] Willis on Stone.

SECTION VI.

OF THE SUPRA-PUBIC OPERATION.

As the process of peritoneum which lines the abdominal muscles is reflected from above the pubis to the superior and posterior portions of the bladder, there is a space left anteriorly through which it is possible to open the bladder without incising the peritoneum, and it is at this point that the extraction of calculi by the Supra-Pubic or Hypogastric operation has been occasionally practised; though the majority of operators have preferred incising the perineum.

Operation of Sir Everard Home.[1]—An incision being made four inches long, between the pyramidales muscle in the direction of the linea alba, the tissues were divided down to the tendon, which was then pierced close to the pubes, and divided by a probe-pointed bistoury to the extent of three inches, a portion of the origin of the pyramidales being detached, so as to increase the size of the opening near the pubes. The forefinger being now passed into towards the pelvis, the fundus of the bladder was recognized, and a silver catheter, open at both ends, being carried into the urethra, its point could be felt pressing upon the fundus of the bladder. A stylet, which had been concealed in the catheter, being then forced through the coats of the bladder, was followed by the end of the catheter, and the stylet being withdrawn, the puncture in the bladder was enlarged sufficiently to admit two fingers, by means of the probe-pointed bistoury. The stone being now felt by one finger whilst the superior fundus of the bladder was held up by the other, a pair of forceps, with a net attached, was passed down into the bladder, and the stone directed into them and retained there by the finger till extracted. A slip of linen being then introduced into the bladder, one end was allowed to hang out of the wound, and the edges of the latter closed by adhesive plaster, a catheter being kept in the urethra in order to draw off the urine.

Remarks.—This operation, which was assigned to Franco, in 1561, and afterwards practised by Rousset in 1581, has seldom been

[1] Gibson's Surg., vol. ii. p. 259.

deemed advisable by surgeons, except for the removal of very large calculi, or in consequence of a diseased prostate.

In the United States, it was first performed by Dr. Wm. Gibson, of Philadelphia, but it has since been repeated by Drs. Carpenter, Van Valzah, and George McClellan, of Pennsylvania.[1] In a case reported by Dr. Wm. D. Johnson, of Georgia, the lateral operation was first performed, and then the supra-pubic, in consequence of the great size of the calculus, its weight being nearly six ounces, its longitudinal circumference seven inches, and its lateral circumference five inches and three-quarters.[2] The chief recommendation of the high operation appears to be the safety arising from the absence of hemorrhage; but this is more than counterbalanced by the risks of peritonitis, urinary infiltration, and abscesses.

§ 1.—THE QUADRILATERAL OPERATION.

Vidal du Cassis having suggested the incision of the prostate in several directions, like the radii of a circle, so as to admit of the greater distension of the opening, his mode of operating has been designated as the quadrilateral operation. Except in the very rare instances of enormous calculi, such incisions must, however, be unnecessary, and, when required, could be easily added to any of the other plans of operating, though originally suggested in connection with the bilateral operation.

SECTION VII.

GENERAL REMARKS ON PERINEAL LITHOTOMY.

In the consideration of the different methods of performing perineal lithotomy, little has been said in reference to the mode of extracting the stone; in relation to the accidents likely to occur during the operation; or in respect to the dressing and after-treatment, all of which demand special consideration.

[1] Gibson, vol. ii. p. 260. Gross, p. 500.

[2] Southern Med. and Surg. Journ., vol. vii. p. 393, 1851.

§ 1.—EXTRACTION OF THE STONE.

In extracting a calculus, after the bladder has been opened by either of the preceding methods, much care and skill are necessary, this part of the operation being, in many instances, the most difficult and tedious step of the proceeding. The wound may apparently be free, and the primary incisions rapidly and neatly made, with every appearance of a speedy termination to the operation; and yet the mere extraction of the stone through the wound will occupy more time than would suffice for several incisions. In order promptly to accomplish its removal, the operator should, therefore, first endeavor to learn its position and mode of presentation, and in this he may be materially assisted by recalling the shape of the bladder, its relations to surrounding parts, and the tendency of the stone to gravitate to the most depending point. Most calculi, especially when single, lie at the posterior inferior part, or bas-fond of the bladder, in consequence of their weight, or because the contraction of the muscular coat forces them to occupy such a position as is most favorable to the escape of the urine by the urethra, presenting, therefore, their longest diameter longitudinally, and their flattened side downwards. In order to seize a stone thus placed, the curved forceps should be introduced, so that the convexity of their blades may correspond with the posterior angle of the wound, their handles being at the same time elevated sufficiently to place their points in the lowest portion of the bladder. (Plate LIV., Fig. 5.) When the thickness of the perineum permits it, the left index finger should also be made to depress the posterior angle of the wound, especially in the bladder, and serve as a guide for the forceps; but as, in a large deep adult perineum, this is sometimes impossible, the operator will be compelled to rely upon the knowledge gained in his previous examinations for the probable position of the calculus. After touching the stone with the points of the forceps, the rings of the latter should be seized between the thumb and fingers of each hand, the blades cautiously expanded, and then by a half turn to the left, made to scoop up or seize the calculus as it is forced into the grasp of the instrument by its own weight, or by the contractions of the bladder. If, however, this should not be the case, the operator may gently expand and close the blades of the instrument, giving them at the same time a gentle lateral

and up and down motion, so as to sweep the bladder by their smooth and external surfaces, until the stone is brought within their grasp. When seized, the left forefinger should be slipped along the blades, so as to feel if the short diameter of the stone is parallel with the transverse diameter of the wound, and being satisfied of this, the calculus, if large, may be extracted by pulling it gently but steadily towards the operator, it being at the same time moved laterally, as well as up and down, in order to favor the dilatation of the wound. The use of Barton's forceps (Plate LIII., Fig. 9) will materially facilitate the extraction of the stone, as the fenestra diminish the space occupied by the thickness of the instrument; but if the calculus is of the ordinary size, and the incisions sufficiently large, little difficulty will be experienced from the latter source. In many instances, the incision in the prostate has not been sufficiently large, or the inferior angle of the wound, or the opening in the skin is too narrow; and when this is the case, much may be done by persevering and gradual dilatation of the part, or by enlarging the angle of the wound with the bistoury. When the size of the stone forbids all hope of its extraction entire, then it should be crushed by Earle's forceps (Plate LIII., Fig. 14), or by Heurteloup's lithontriptor, and extracted piecemeal, the fragments being removed by washing out the bladder with barley-water.

The Scoop is an instrument that may prove serviceable in cases where the size of the stone forbids the hope of introducing the additional thickness of the forceps, or in cases of numerous calculi, or in that of fragments of a calculus. Or, it may be resorted to for the removal of such calculous concretions as are occasionally found upon parts of the bladder, and which require to be peeled off. Whenever the attempt is made to remove a calculus by the scoop alone, the point of the forefinger of one hand should be placed against the stone to steady it in the hollow of the instrument (Plate LIV., Fig. 6).

After removing a calculus by any instrument, the finger should be again introduced into the bladder, and carefully passed around it in order to ascertain whether some particles have not been left. Should any be found, it will be better to wash them out by freely injecting barley-water than to attempt to seize them with forceps, or to remove them with the scoop. The injection will also prove useful by removing clots from the part.

If the stone should be *encysted*, or adherent, the steps to be pur-

sued will depend mainly upon the manner in which it is attached, and on the judgment of the operator. Sometimes the attachment is owing to folds of the bladder being introduced into asperities in the calculus, and these may be often overcome by passing the finger gently round, and hooking out the stone; or, a process from the stone may have entered a dilated ureter, or be placed in an abnormal pouch in the bladder. To relieve either of these latter attachments, it is usually necessary to exercise judicious traction upon the main portion of the stone; though the process of the mucous membrane may require to be ruptured with the finger, or, if it is a simple band, to be divided by the knife, in order to free it; but the necessity for the latter is very rare, and it should never be resorted to until every other means have failed.

§ 2.—ACCIDENTS CONNECTED WITH LITHOTOMY.

An accident that occasionally complicates the operation of lithotomy, even in careful hands, is hemorrhage, though, under ordinary circumstances, it is not sufficiently severe to demand active treatment. A wound of the rectum may happen, but it can generally only be regarded as evidence of the incompetency of the operator.

Hemorrhage may arise from several points connected with the incisions in lithotomy: 1st, it may come from the perineal arteries; 2d, from the vesical plexus of veins; and, 3d, from the internal pudic; the latter being, however, much less frequently wounded than an inexperienced surgeon might suppose, as it lies too near the ascending ramus of the ischium to be in the way of any ordinary incision. When, however, the hemorrhage from any point is sufficient to demand treatment, it may be arrested either by the application of the ligature, or by pressure.

I. LIGATURE IN HEMORRHAGE.

The ligature of the smaller perineal arteries does not differ in any respect from the ligature of other vessels, the open vessel being seized with a tenaculum, and then tied with the silk ligature. But if by any accident the main trunk of the internal pudic artery be divided, the hemorrhage will be more troublesome, though it may

be promptly controlled simply by compressing the artery with the finger against the ramus of the ischium until a ligature can be thrown around it. To accomplish the latter, few instruments will be found more serviceable than that resorted to by Dr. Physick under similar circumstances, and hence named Physick's forceps and needle (Plate III., Fig. 5). The needle being passed beneath the trunk of the artery, the ligature is carried around the vessel, and made to compress it by inclosing a portion of the flesh near the vessel.[1]

II. PLUGGING IN HEMORRHAGE.

From the varicose condition of the vesical plexus, especially in old men, a general hemorrhage or oozing is sometimes seen from the wound, without its being possible for the surgeon to detect any point suitable for a ligature. Under these circumstances, compression is the only alternative, and may be readily accomplished by passing a large catheter into the bladder through the wound, and then packing the latter full of lint or charpie, the escape of the urine through the catheter preventing distension of the wound in the neck of the bladder, whilst the lint at its sides favors the formation of the clots which tend to close the vessels. After the lapse of three days, or when there is evidence of suppuration in the wound, this lint should be carefully withdrawn, lest it interfere with the cicatrization.

III. WOUND OF THE RECTUM.

From want of attention to the entire evacuation of the bowel before the operation, or from the great dilatation of the prominent pouch or enlargement generally noted near the middle of the gut, or from the surgeon wandering from the staff in the prosecution of his incisions, the rectum has been perforated on its anterior surface, and the after-treatment of the case complicated with the production of a rectal fistula. Although such a fistula is a source of annoyance, adds an unnecessary risk to the chances of the patient, and is, I

[1] Dorsey's Surgery, vol. ii. p. 190.

PLATE LVI.

INSTRUMENTS EMPLOYED IN THE OPERATIONS OF LITHOTOMY AND LITHOTRIPSY.

Fig. 1. The sound employed in detecting the presence of a stone in the bladder of the male. 1. Its smooth handle. 2. A curve of a medium size. Schiveley's pattern.

Fig. 2. Staff employed in operating for lithotomy on the female. Schiveley's pattern.

Figs. 3, 4, 5, 6. Staves of different sizes and curves, so as to be adapted to the urethra of different patients in the ordinary lateral operation for lithotomy. The handles should be broad and well serrated, so as to furnish a firm hold, and prevent the groove slipping or turning from the position in which it is wished to be held during the perineal incisions. Schiveley's pattern.

Fig. 7. Jacobson's instrument for crushing a calculus in the bladder. 1. The articulated loop which holds and crushes the stone when it is caught in the grasp of the instrument. 2. The screw which closes and expands the loop. Schiveley's pattern.

Fig. 8. Heurteloup's Lithontriptor. 1. The female blade. 2. The male blade. 3. The vice in which the screw works in crushing the stone. 4. The screw. Schiveley's pattern.

Fig. 9. A Litholabe for extracting fragments of a calculus or pebbles from the neck of the bladder. Schiveley's pattern.

Fig. 10. Leroy d'Etiolles's articulated scoop for the removal of fragments which lodge in the urethra. Schiveley's pattern.

Plate 56.

Fig. 1.

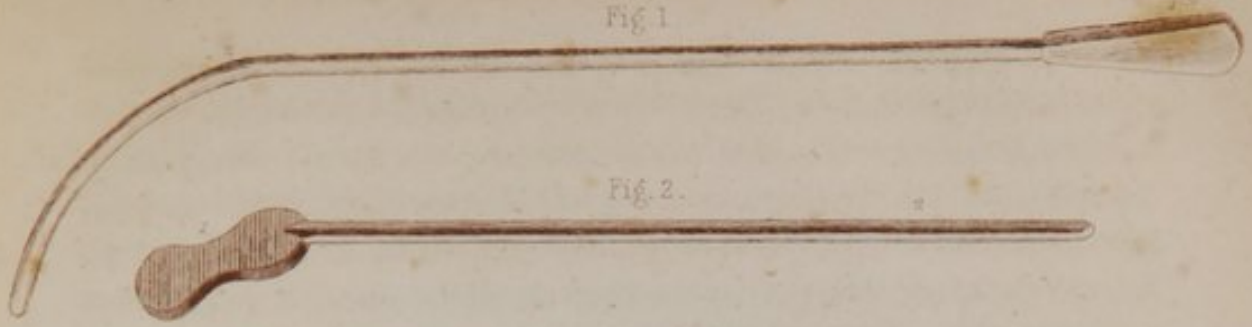


Fig. 2.

Fig. 3.

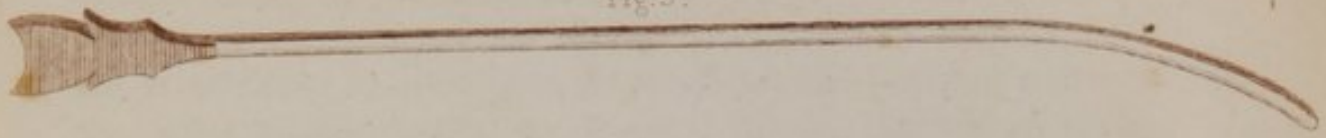


Fig. 4.

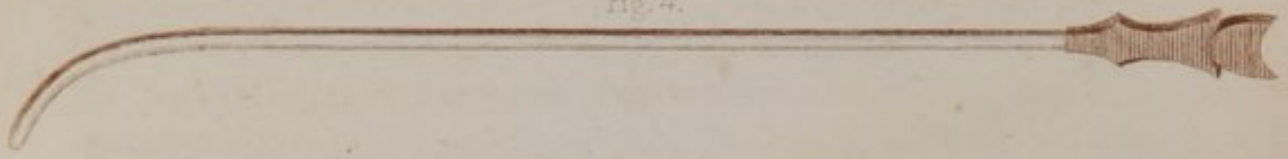


Fig. 5.

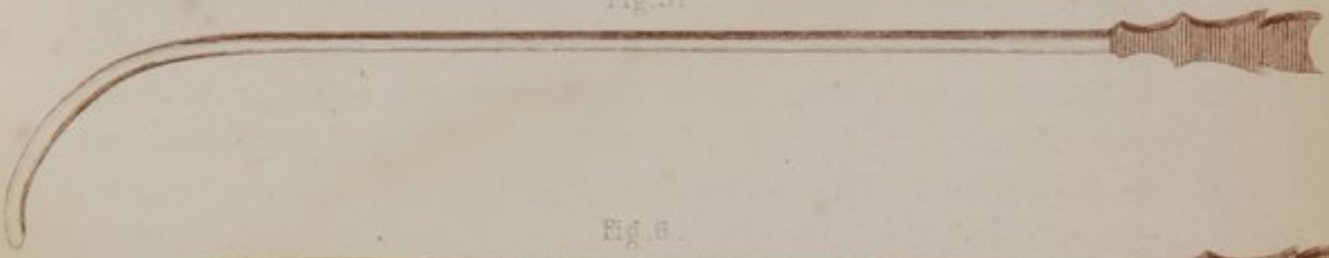


Fig. 6.

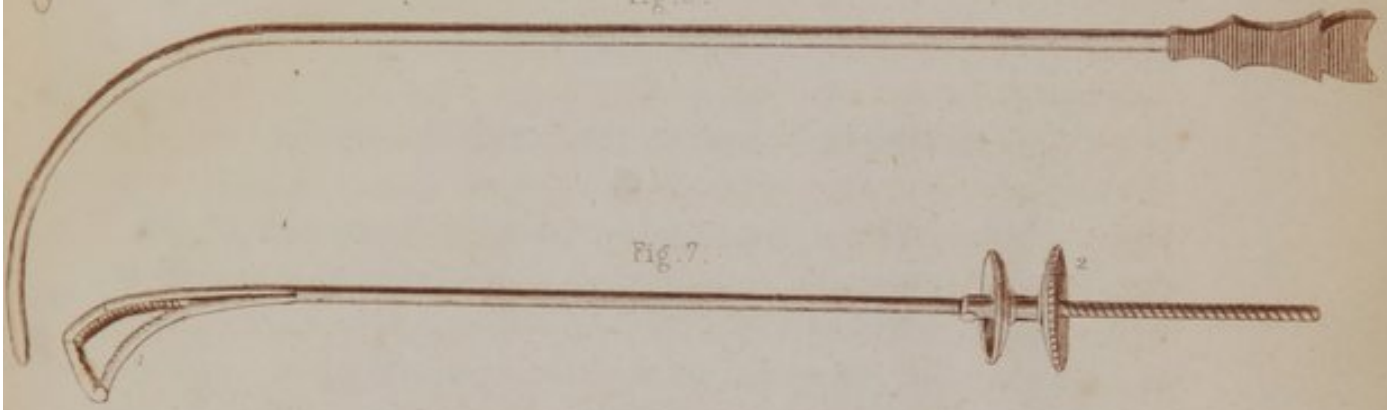


Fig. 7.

Fig. 8.

Fig. 9.

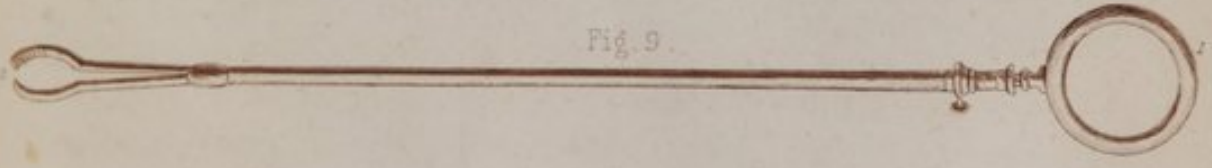
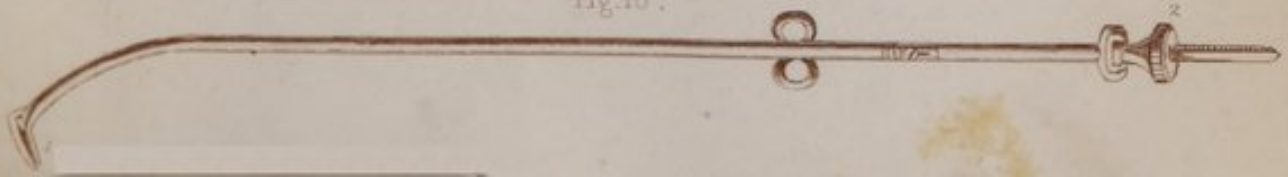


Fig. 10.



think, positive proof of the want of skill in the operator, its evils, in most instances, have been over-estimated, as it is usually readily amenable to treatment. In the simple case of a small puncture of the gut, which is detected at the time or soon after the operation, the best mode of obviating it is to evacuate the contents of the bowel, give a large anodyne enema to keep the parts at perfect rest, and then, by means of the catheter passed into the bladder through the wound, prevent urinary infiltration of the surrounding structures. In more extended injuries, the entire division of the sphincter ani muscle, as in rectal fistula, together with the free use of anodynes, by allowing the gut to collapse, will favor the union of the incision. But even where a recto-vesical fistula has resulted, cauterization and perfect rest have often sufficed to heal it. In two instances, I have seen this accident occur in the operations of careless surgeons, who were evidently desirous rather of operating quickly than carefully, and, in both, little or no treatment was requisite, the patients recovering without being aware of the occurrence.

SECTION VIII.

AFTER-TREATMENT IN PERINEAL LITHOTOMY.

The importance of a judicious after-treatment in every operation has been perhaps sufficiently insisted on in the previous pages, yet the knowledge of a case in which an inexperienced operator, after succeeding in extracting a calculus by lithotomy, felt compelled to seek directions respecting the proper steps of the after-treatment, induces me to give to it in this operation such extra attention as my limits will permit, and to refer those desirous of further details, both on this and other points connected with stone, to the excellent volume recently published by a distinguished surgeon of the west.[1]

[1] See A Treatise on the Diseases, &c. of the Urinary Organs, by Samuel D. Gross, M. D., Louisville, a work of great value, and indicative of the extended experience of this accomplished surgeon.

§ 1.—PUTTING TO BED.

After the completion of the operation, including the arrest of hemorrhage, the first point to decide upon will be the dressing. In most instances, nothing is required except rest, as the wound is intended to heal by granulation. According to some surgeons, certain advantages are to be obtained from tying the patient's knees together, and keeping him upon his left side, so as to favor the union of the edges of the wound and the escape of the urine without infiltration of the surrounding parts. Others, again, place a large catheter in the bladder by passing it through the wound, fastening it in position by a strip of adhesive plaster, which is attached to the perineum, so that the catheter, by leading the urine off to a saucer, may keep the patient dry. But the use of this catheter is liable to the serious objection of preventing union of the neck of the bladder by the first intention, as was the fortunate result in two of the operations of Dr. Physick;[1] and when it is retained in this way more than a few days, it is very apt to lead to the establishment of perineal fistula. For many years, and especially in the practice of the late Dr. Randolph, of Philadelphia, I have been accustomed to see patients removed directly from the operating table to the bed without any dressing, the bed being kept dry by the strict attention of the nurse, and the removal of the clothes placed beneath the wound as soon as they were wet. I would, therefore, urge the advantages of preparing the bed and patient as follows: Place a piece of oil-cloth upon a good elastic hair mattress at a point corresponding with the patient's hips; place over this the ordinary sheet; and place upon this, transversely, the end of another sheet folded in four lengthwise, so that as soon as one part is wet by the urine it may be drawn away and a dry part substituted. The position of the patient, "upon the left side, with the knees drawn up," has long been a standing rule, and so religiously observed by some that I have seen the great trochanter and crest of the ileum almost ready to come through the skin from the continued pressure, the patient being compelled to use large doses of opiates in order to obtain sleep. In cases which I have had occasion to treat, I have never paid much attention to the position

[1] Dorsey's Surgery, vol. ii. p. 191.

of the patient after the first twenty-four hours, as the lymph effused upon the edges of the wound during this period was generally sufficient to prevent smarting from the urine passing over it, whilst as soon as any amount of urine collected in the bladder, the patient invariably turned himself to one side, in order to favor its evacuation. It is, therefore, with much satisfaction that I find this practice sanctioned by the excellent authority of Dr. Gross, of Louisville, and the direction given to permit the patient to take, cautiously, any easy position, experience having taught him that "it matters little what posture the patient assumes after he has been put to bed."[1]

§ 2.—TREATMENT OF THE WOUND.

The urine escaping from the wound by the lowest angle occasionally induces some little cutaneous irritation, which, if it become an annoyance, should be obviated by anointing the part with mild cerate. After two or four days, the lips of the wound usually become tumid, and present signs of inflammation. In most instances, this is only indicative of the efforts of nature to close the perineum, and should not, therefore, be interfered with unless excessive, when warm, moist cloths, frequently changed, will suffice for its removal. If calculous matter forms around or in the wound, it should be washed away with a stream of water from a syringe, or loosened by the action of a weak solution of hydrochloric acid.

The bowels also should be kept at perfect rest by anodyne enemata until the fourth day after the operation, when the administration of a mild laxative, as castor oil or citrate of magnesia, will be serviceable. If, on the escape of urine through the penis, the perineal wound does not heal, a catheter may be placed in the urethra, and the union of the wound facilitated by the use of caustic or by means of pressure.

§ 3.—CONSTITUTIONAL TREATMENT.

As a general rule, the constitutional treatment, after the operation for lithotomy, should be antiphlogistic, though strict attention

[1] *Opus citat.*, p. 465.

should also be given to the previous habits of the patient. If the patient is an old man, good diet or even stimulants will often be demanded, and tardy healing of the wound will often be removed by such an increase of diet.

But among the most important of the steps connected with the constitutional after-treatment of lithotomy is the removal, if possible, of the calculous diathesis, as it is not sufficient for the cure of the patient that the surgeon should have removed the stone, unless he effects a change in the character of the urine. It is, therefore, advisable, in every case, to test the urine both before and after the operation by litmus paper, the microscope, or similar means, until its peculiar characters are known, and then to obviate the unhealthy action of the kidneys by acids, alkalies, diet, or other appropriate means of treatment.

SECTION IX.

GENERAL ESTIMATE OF THE VALUE OF THE DIFFERENT METHODS OF OPERATING FOR LITHOTOMY.

After what has been said under the preceding sections of the special advantages of the different modes of operating, there is but little that is new to offer in a general estimate of the whole of them; and yet such a summary is not without its value. Apart from the peculiar predilection of certain surgeons for instruments of their own invention (which really afford nothing that can materially aid a good anatomist in the performance of lithotomy), there is, however, little that is settled on this point, and, in examining the advantages derivable from the lateral, bilateral, or supra-pubic plans of operating, it is difficult to obtain anything like an accurate result when so much of the success of either must necessarily be due to the skill and judgment of the operator.

Statistics of the Lateral Operation.—The statistics of lithotomy, though presenting the results of a large number of cases, do not offer a perfectly reliable result, because in many instances nothing is said of the peculiarities of the case, the age of the patient, or other incidents which must exert a very important influence upon an opinion. Yet, as such statistics have a certain value, and are at present the only data upon which an inexperienced surgeon could

form even an approach to an estimate of the risks to which a patient is exposed by the operation, they are presented as obtained from the sources mentioned, with the addition of the opinion of Dr. Gross that about one out of every five of those cut in lithotomy die after the operation.[1]

	CASES.	DEATHS.
Dudley, of Kentucky[2]	207	6
Pennsylvania Hospital, Philadelphia[2]	83	10
Gardner, of Kentucky[3]	15	1
Davis, of Ohio[3]	72	6
Eve, of Georgia[3]	2	1
Bush, of Kentucky[3]	5	0
Gibson, of Philadelphia[1]	50	6
Mettauer, of Virginia[4]	73	2
Jno. C. Warren, of Boston[4]	30	2
Marsh, of Albany[4]	7	0
	544	34
Smith, of Bristol, England, reports for Great Britain	354	79

Mortality in Great Britain after the operation, 22⅓ per cent.
Mortality in United States, 6⅛ per cent.
Showing that the operation of lithotomy has been nearly four times as successful in the United States as in Great Britain.

STATISTICS OF THE BI-LATERAL OPERATION.—After examining the various tables, and separating these from the cases specially mentioned as operated on by the bi-lateral section, the following result has been obtained:—

	CASES.	DEATHS.	
Paul F. Eve, of Georgia[5]	25	4	specified.
Spencer, of Virginia[5]	16	2	
Mussey, of Cincinnati[6]	18	0	"
Hotel Dieu[7]	26	0	
Dupuytren[1]	70	6	
Warren, of Boston[1]	3	0	"
	149	8	

Or, a mortality of about 5⅓ per cent.

[1] Gross on Urinary Diseases, p. 470.
[2] Trans. Am. Med. Assoc., vol. iv. p. 273, 1851.
[3] *Ibid.*, p. 274.
[4] Trans. Am. Med. Assoc., vol. i. p. 161.
[5] *Ibid.*, vol. iv. p. 274, 1851, and again in a report, April, 1852.
[6] *Ibid.*, vol. ii. p. 226, 1849.
[7] Velpeau, Op. Surg., by Mott, vol. iii. p. 918.

In the twenty-five cases operated on by Dr. Eve, two were females, and in no case did he know either of a fistula in perineo, or of a stone having ensued upon the operation.

STATISTICS OF SUPRA-PUBIC LITHOTOMY.—A brief account of the cases operated on shows that this operation has obtained a sufficiently large success to justify its repetition where other means are not permissible. Out of twenty-five cases which I have collected from various sources, twenty-one have been cured and four died, thus presenting a mortality of about sixteen per cent.

Great allowance must, however, be made for the results, as shown in all these tables. In several instances, the deaths have not been specified; in others, the surgeon has relied upon his recollection, and supposed that he has operated on about fifty cases with a moderate number of deaths, and in the statistics furnished under the head of the lateral operation, it is not always certain that the lateral method was the one employed. I have, however, examined the statements closely, and endeavored to obtain a correct result, and my conclusion is that the only point that can be depended on in the above tables is that out of 715 cases, 541 were cut by the lateral, 149 cases by the bi-lateral, and 25 cases by the hypogastric operation, thus showing a decided preference among surgeons in favor of the lateral operation.

CHAPTER III.

LITHOTRIPSY, OR CRUSHING OF STONE IN THE BLADDER.

THE removal of a calculus from the bladder by the introduction of crushing instruments capable of reducing its particles to such a size as could pass out by the urethra, is an operation of great antiquity, having been spoken of by Ammonius about 110 B.C.,[1] though it appears to have been lost sight of, until again brought forward, through the efforts of Civiale, of Paris, about 1822. Like most other novel operations, the progress of lithotripsy was at first retarded by the great number of instruments supposed to be necessary for its performance. Enlightened by the experience of the

[1] Smith's Dict. Greek and Roman Antiquities, art. Chirurgie.

distinguished European surgeons who seconded Civiale's efforts, and simplified the method very considerably, the operation has now been brought to such perfection that any surgeon can accomplish it, if a sufficiently dexterous manipulator; gentleness, a delicate sense of touch, and a light hand, aided by a good crushing instrument, being the points most essential to its performance at the present period.

In the United States the operation of Lithotripsy has been practised to a considerable extent, in the employment of Heurteloup's instrument as well as with that of Jacobson.

The first operation was performed by Dr. L. Depeyre, of New York, in 1830; the second by Dr. Alban G. Smith, then of Kentucky, in 1831; and soon afterwards by Drs. Randolph of Philadelphia, Spencer of Virginia, Uttery of Rhode Island, Gibson of Philadelphia, Nathan R. Smith of Baltimore, as well as by many others. To the late Dr. Jacob Randolph, of Philadelphia, the American profession are, however, chiefly indebted for the early and progressive cultivation of lithotripsy in this country, his name being extensively known in connection with his labors on this subject. Few surgeons in the United States have repeated the operation more frequently than he did upon patients of all ages, and few have been more distinguished in this department of surgery either for the beauty of their manipulation, or for the success which attended their operations. In every case he was remarkable for the care he exercised in the preparation of his patients, as well as for the brevity of "the sittings."

Without entering into the general history of the progress of the operation, or spending time in the description of the multifarious instruments heretofore devised and employed, this account will be limited to the operation as performed with the "lithontripteur," or "stone-crusher," of Heurteloup, this being the instrument now most frequently resorted to.

§ 1.—PRELIMINARY TREATMENT NECESSARY IN LITHOTRIPSY.

As the principal danger in the operation of lithotripsy arises from the production of inflammation, it is of the utmost importance that every means be employed to prevent it. The preliminary treatment will therefore often be the chief source of success, and it

PLATE LVII.

OPERATIONS FOR THE REMOVAL OF STONE FROM THE BLADDER.

Fig. 1. Hypogastric Operation for Lithotomy. An incision having been made in the linea alba and the bladder opened, the left forefinger of the surgeon is seen holding up the superior angle of the wound. Whilst an assistant separates the left side by a blunt-hook, the right hand of the surgeon elevates the calculus from the bas-fond of the bladder by means of the scoop. 1. Left hand of the surgeon. 2. His right hand elevating the stone. After Bourgery and Jacob.

Fig. 2. The scoop which thus supports the stone and prevents its again falling into the bladder being now held by an assistant, the surgeon seizes it in the forceps with both hands, and is seen in the act of extracting it. 1, 1. Hands of the surgeon. 2. Assistant holding the stone near the wound, so that the forceps can readily seize it. After Bourgery and Jacob.

Fig. 3. A view of the Operation of Lithotripsy. A section of the parts around the pelvis shows the position of the patient, and the manner in which the stone is seized and held by the lithontriptor of Heurteloup. After Bourgery and Jacob.

Fig. 4. Another view of the same operation, showing the position of the fragments in the bladder and the mode of seizing them, after the stone has been crushed two or three times. After Bourgery and Jacob.

Fig. 5. Extraction of a fragment of a calculus from the prostatic portion of the urethra by means of the articulated scoop of Leroy d'Etiolles. The instrument is introduced as a straight sound, gradually passed behind the fragment, and then its end made to turn up at a right angle with its stem by means of a screw concealed in its shaft. 1. Handle of the instrument. 2. Its articulated point. 3. Fragment as held by it. 4. Prostate gland. After Bourgery and Jacob.

Plate 57.

Fig. 1.

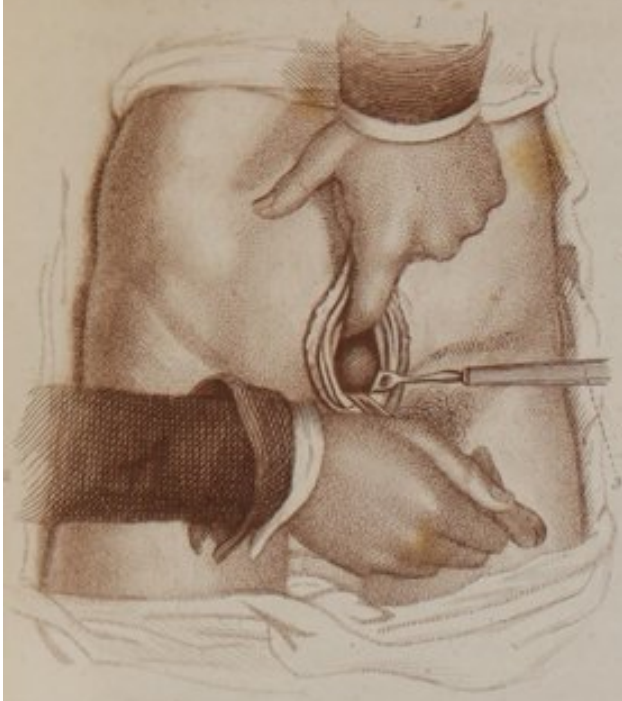


Fig. 2

Fig. 5.

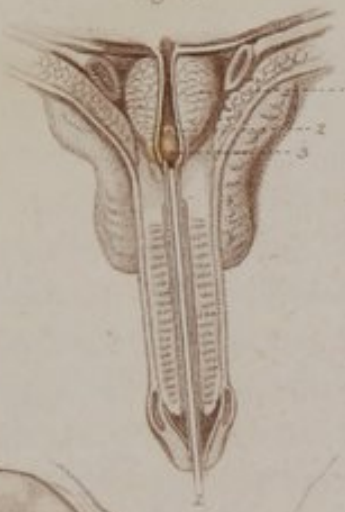


Fig. 3.

Fig. 4

should be pursued according to the following plan: After giving attention to the condition of each organ, especial efforts should be made to remove the irritability of the bladder by the free use of the warm hip bath, by anodyne enemata, and especially by the use of alkalies, as they, by depositing on and equalizing the surface of a rough stone, often counteract one great source of irritation. When these constitutional remedies have induced a less irritable condition, a local preparatory treatment should be commenced, especially the frequent introduction of bougies, so as to dilate the urethra gradually, and accustom the parts to the passage of an instrument. By perseverance in the daily use of a bougie for about eight days (allowing it to remain in the bladder for a half hour or hour, according to the irritation it causes, care being always taken to remove it if the patient complains much of pain), and gradually augmenting its size, the urethra may be prepared to receive the largest lithontriptic instrument not only without pain, but without much irritation. The preparation of a narrow bed or table of a convenient height, some tepid water, a little oil, and a good instrument, complete the preliminary measures.

The selection of the lithontriptor is a matter of the greatest consequence, and, unless it is of the finest temper and finish, it should never be used. I have been accustomed to test these qualities by crushing a moderate-sized tamarind stone in the instrument before attempting to break a calculus. The danger from an imperfect instrument is, however, not in its breaking, so much as in its bending or spreading at the point, so as to prevent its retraction. In two instances, in the hands of the late Dr. Geo. McClellan, of Philadelphia, the male blade of Heurteloup's instrument was broken short off in the bladder, and yet subsequently voided with the urine and sand; but when from want of temper the female blade is expanded, or either blade is twisted or bent, the withdrawal of the instrument may become impossible without a serious laceration of the neck of the bladder and urethra.

§ 2.—OPERATION OF LITHOTRIPSY.

Having in former years aided in carrying out the plan of treatment directed by Dr. J. Randolph, of Philadelphia, who was eminently accomplished as an operator in this department of surgery, I have

selected his method as that which may be advantageously followed; not that it presents anything peculiar, but because it is sanctioned by the experience of one of the earliest and most frequent operators in the United States.

Operation of Dr. Randolph, of Philadelphia.—The patient, after a careful preliminary treatment, being placed upon his back on a narrow table, covered with blankets, and with a pillow under the hips, bring the latter to the end of the table, elevate the head and shoulders slightly by pillows, and support the feet on chairs so that the knees may be wide apart. If the urine has now been retained, the lithontriptor may be immediately passed into the bladder in the same manner as the catheter, and with quite as much ease by a practised hand; but if the urine has escaped, a silver catheter should be first passed and tepid water injected into the bladder until it is partially distended, when the lithontriptor being gently introduced, its blades may be cautiously expanded and carried from before backwards, or from right to left, or from behind forwards, or from left to right, according to the position of the stone, the manipulation of a few seconds usually enabling the operator to catch it (Plate LVII., Fig. 3), though sometimes it apparently falls into the grasp of the instrument as soon as the latter is expanded in the bladder, and before the instrument is carried to any extent laterally. After seizing the stone, and moving it a little in the bladder so as to be sure that no portion of the mucous coat is included in the grasp of the instrument, close the blades by turning the screw with the hand, and thus break the stone, after which another part may be seized and broken. If the patient does not complain, it may now be seized a third time (Plate LVII., Fig. 4), after which, the instrument should be gently tapped and moved about in order to free it of the fragments, when the blades should be perfectly closed and the instrument withdrawn from the urethra. The "sitting" may sometimes last only about five minutes, but seldom over twenty, even when it causes the patient no pain.

After-Treatment.—The patient, if comfortable, should now be kept on a light diet; but if in pain, use a hip-bath, and take an enema of sixty drops of laudanum, or a dose of Dover's powder, when if, after the lapse of from three to five days, no constitutional or local irritation forbids it, the operation may be repeated.

After crushing a stone, it sometimes happens that a fragment in being voided, lodges and becomes fixed in the urethra, and this is

usually the most troublesome part of the after-treatment. If seated near the neck of the bladder, the better plan is to push it back into the bladder by means of a sound; but when it is near the fossa navicularis, it may become necessary to dilate the orifice of the urethra, and remove it, if possible, with fine forceps. Should it, however, be further back, an effort may be made to draw it out by means of Leroy's scoop (Plate LVI., Fig. 10); or, if fast in the spongy portion of the urethra, by cutting down and extracting it through the opening. (Plate LI., Fig. 5.)

Remarks.—In operating for lithotripsy, much will depend on the manual skill of the operator, as well as on his accurate knowledge of the anatomy of the structure operated on. In order to obtain the first, the young surgeon will find it very useful to practice upon stones introduced into the bladder of a subject, or to place them in a moderately soft buckskin bag, lay the latter upon a pillow, and then with closed eyes endeavor to catch the stone without inclosing also a portion of the buckskin. But, although the operation of lithotripsy may thus be made to appear an apparently simple one, it is only so when practice has rendered the operator dexterous. In the hands of Civiale and Randolph, I have seen a patient continue in conversation with a smile upon his face during the whole sitting, whilst other operators have given rise to the most intense suffering, by their heavy, clumsy, and thick-fisted manipulations. Since the introduction of anæsthetic agents, it has been thought that all pain from the operation could be avoided, and yet the dangers not increased, and such, I think, is truly the case, because, when the bladder is freely distended by the water previously injected, and the surgeon is a practised operator, the use of the anæsthetic will not only prevent any suffering, but facilitate the operation by preventing straining. To such a surgeon the sense of touch, and that mental perception which enables him to see with his fingers exactly where the point of the instrument is in the bladder, will prevent any injury to the coats of the latter. But, under other circumstances, and in the hands of those who can only imagine what they are doing, the use of anæsthetics will be attended by much danger, as the cries of the patient will be the only proof that can be offered of the coats of the bladder being injured; in other words, anæsthetics will facilitate the operation of lithotripsy, in most instances, though it may also lead to most serious accidents. In the primary operations of young surgeons, it will certainly be safer for them to omit it.

§ 3.—CASES ADAPTED TO THE OPERATION OF LITHOTRIPSY.

The merits of lithotripsy and its advantages over the operation of lithotomy, is a question that has engaged considerable attention at different periods since the early efforts of Civiale, and been discussed with a fervor that has shown the strength of individual predilection rather than the real merits of the question. It is sufficient evidence of the prejudice that has sometimes been exhibited in the expression of opinions on this subject, to know that very few surgeons, who prided themselves on their dexterity as lithotomists, have ever practised or advocated lithotripsy; whilst some of those who excelled in lithotripsy, as warmly designated lithotomy "as a barbarous operation," &c.

Such a result being very frequently the consequence of the enthusiasm, and reaction, observed in all new movements, it may suffice my present purpose merely to allude to it, as a caution to the young reader against allowing himself to be influenced by the authority of any name, no matter how high it may stand in surgical repute, and induce him to pursue the more judicious and eclectic system of selecting for his patient either lithotomy or lithotripsy, in accordance with the following general ideas:—

1st. Very soft and phosphatic stones are the best for lithotripsy.

2d. Hard and rough calculi the best for lithotomy, because, even if crushed, the fragments will prove a source of irritation both to the bladder and urethra.

3d. A sound condition of the urethra and bladder, as well as a good constitution, is essential to the success of lithotripsy.

4th. Lithotomy will do better than lithotripsy in emaciated, nervous, and dyspeptic patients, though these of course are not promising cases for any operation.

5th. Lithotripsy is applicable especially to the young and middle aged—the diseases of the prostate and the condition of the bladder consequent on it, forbidding the operation, as a general rule, in old age.

6th. Lithotomy, if judiciously performed, will afford a better chance of success than lithotripsy, in cases attended by symptoms of vesical catarrh, &c.

But in every case of lithotripsy, let it be remembered that the preliminary and after-treatment are quite as important in the result

as the operation itself. Rigors and fever, retention of urine, and cystitis, are among the results of lithotripsy in many instances, and a high degree of skill is necessary to protect the patient from the effects of this condition of the system. Both the preliminary and after-treatment are so essential to the success of the operation that it is difficult to decide between them, but if there is a difference I should assign the greater value to the preliminary treatment. To operate for lithotripsy without the most careful preparation of the patient's general health, is certainly indicative either of the ignorance or indifference of the operator, as to the result of the operation.

§ 4.—LITHOLIBY.

Litholiby (λιθος, stone, θλιβω, to crush), is the term recently adopted by Dr. Denamiel, of France, to express an operation in which a stone is crushed as it lies in the vesical triangle, by means of an instrument introduced into the bladder on one side, and the forefinger in the rectum on the other, a sound in the bladder serving as a point of support. As he expresses great confidence in the disintegrating qualities of alkaline fluids, he makes their administration precede the operation. As the distance from the perineum to the neck of the bladder is usually two and a quarter inches, though it may vary from one to four, the prostate and neck of the bladder are so slightly separated from the rectum that any hard body in the bladder may readily be felt by a finger in the rectum. He therefore operates as follows:—

Denamiel's Operation.—The bladder being moderately distended, place the patient in the horizontal posture upon the edge of a firm bed, the thighs being separated and raised, and the feet resting on chairs. Then introducing the left fore and middle finger into the rectum, feel the stone, and, having found its position, pass in a curved sound grooved on its convexity, so that it may readily hold the stone, and pressing the stone firmly against the sound by means of the fingers in the rectum, crush it thoroughly by directing the pressure to the right and left. If the calculus is very soft, Dr. Denamiel states that it may thus be readily crushed; but that if it is hard several sittings, and the free use of alkaline fluids to favor its disintegration, will be required. Warm water should also be freely

injected into the bladder after each attempt at crushing, in order to remove the particles.[1]

Remarks.—Of this operation I have no personal knowledge, nor am I aware that it has ever been repeated either in Europe or the United States; but without further data I should mistrust it. 1st, because it is well known that the supposed disintegration of calculi by the use of alkalies, is only the saturation of the acid constituents of the urine, which are then voided in the state of gravel, but which do not include any portions of a former stone; and 2d, because any compression that could be attempted upon a stone of even moderate firmness would necessarily bruise both the bladder and rectum; I therefore doubt whether it will prove to have any advantage over the more scientific operation of lithotripsy.

CHAPTER IV.

OPERATIONS ON THE FEMALE GENITO-URINARY ORGANS.

The operations required for the relief of the affections of these organs are comparatively limited in number; the removal of deformities and the evils resulting from injuries being those to which attention is chiefly directed.

SECTION I.

SURGICAL ANATOMY OF THE FEMALE PERINEUM.

The female perineum embraces a region that has been variously described by authors, some including in its boundaries most of the external organs of generation, and carrying it, as in the male, from the pubis to the coccyx; whilst others define it as the portion between the anus and vagina. For surgical purposes, the former is the most useful, though the changes produced in delivery are chiefly limited to the latter. Without entering upon all the details of this

[1] Med. News, p. 147. From Lond. Med. Times, 1853.

structure, it may suffice, at present, to allude briefly to such portions as are concerned in surgical operations.

The surgical relations of the Vulva require no other reference than the mention of the fact that the cellulo-adipose tissue is here freely developed, and that cysts, abscesses, or wounds of the part should, therefore, be treated with reference to the liability of this structure to liquid infiltrations.

The Clitoris is formed chiefly of an erectile structure like the corpus cavernosum of the male, arises by two branches from the ramus of the ischium and pubis, and has a small prepuce formed by the extension of the membrane covering the nymphæ. Occasionally the clitoris gives rise to such irritation as may demand its removal. As its vessels can be readily controlled, there is nothing in the operation requiring special attention.

Below the clitoris, and within the nymphæ, there is found a triangular smooth surface, about three-fourths of an inch long, called the Vestibule. This surface terminates inferiorly, or posteriorly, in the orifice of the urethra, and is one of the points in which lithotomy is performed.

The female Urethra is from twelve to fifteen lines long, and pursues a direction which passes in a line from below upwards and from before backwards. Its vesical extremity is the largest, and its vulvular orifice the smallest, representing in this arrangement a cone, the base of which is towards the bladder; hence, small calculi escape readily, and simple dilatation of the orifice facilitates the passage of those of a large size. At the orifice may be found a marked rising, or tubercle, which is an approach to the bulb of the urethra as seen in man, and serves as a guide to the finger of the surgeon when introducing the female catheter. Near its commencement, the urethra is close to the vagina, but as it ascends it becomes separated from it by a triangular space corresponding with the vestibule, which is occupied by a very loose cellular tissue.

Below the urethra is the orifice of the vagina, which, in virgins, is often closed by the membranous expansion known as the hymen. Most frequently, this membrane is thin, delicate, and readily lacerated, though sometimes, when dense and imperforate, it demands the use of the bistoury, in order to permit the escape of the menstrual fluid, or sexual intercourse.

The Vesico-vaginal septum is sufficiently extended, reaching

even as far as the boundaries of the anterior face of the vagina, and creating rather a vesico-uterine than a vesico-vaginal septum.

Between the vagina and the rectum, for a distance of fifteen lines above the anus, is a condensed cellulo-adipose structure, uniting the two canals, and constituting the recto-vaginal septum, and above this the peritoneum descends so as to form the recto-vaginal pouch. Below the recto-vaginal septum, or in the perineum proper of some anatomists, there is found the skin, anterior extremity of the sphincter ani muscle, the perineal fascia, and the posterior portion of the sphincter vaginæ muscle, together with a cellular tissue which is remarkable for its laxity and the number of bloodvessels which run to it.

The muscles of the female perineum are very much the same as those found in the male, but they are usually less developed, with the occasional exception of the sphincter vaginæ. The levator ani is also separated in front by an interval which is occupied by the vagina and neck of the bladder.

The bloodvessels and nerves do not differ materially from the arrangement found in man, being chiefly branches of the pudic artery and sciatic or sacral nerves.

In studying the layers of this region from before backwards, there may be noted: 1, the mucous membrane; 2, a vascular and cellular structure containing the roots of the clitoris, covered by the erector clitoridis muscle, and having the anterior extremities of the sphincter vaginæ muscle upon its sides; 3, the triangular ligament traversed by the urethra, and containing the transversalis perinei artery; 4, the dorsal veins of the clitoris and the plexus which surrounds the neck of the bladder; lastly, the inferior and anterior portion of the bladder, through which the incisions are made in lithotomy, as practised in the female.

SECTION II.

OPERATIONS ON THE EXTERNAL ORGANS OF THE FEMALE.

Among the operations belonging to this section, will be found such as are demanded for the relief of the bladder as well as the external parts.

§ 1.—OCCLUSION OF THE VULVA.

Whether the closure of the lips of the vulva be the result of congenital defect, or the consequence of inflammation, it will generally require prompt attention in order to make a vent for the urine.

In the cases of young children, where the labia are partially adherent, it is only necessary to introduce a stiff probe at some point which is open, and lacerate the adhesions. But, if the adhesions are more complete than this, or more firmly united, a careful dissection should be practised in the median line of the vulva, and reunion prevented by the introduction of lint, or by touching the surface with the nitrate of silver.

§ 2.—HYPERTROPHY OF THE NYMPHÆ AND CLITORIS.

Enlargement of these parts occasionally demands excision, and may be accomplished by seizing the portion with forceps, and excising it either with the scalpel or scissors. Should the hemorrhage not soon cease by the formation of the clot which will ensue on closing the thighs, or on more direct pressure when applied for a few hours, styptics may be resorted to.

Cysts and other tumors of the labia are to be removed in the same manner as would be proper in other parts, the wound being closed by a suture.

§ 3.—CATHETERISM.

In the introduction of the female catheter, the course and length of the urethra should be remembered, especially if a tumor or displaced womb exists at the same time.

OPERATION.—Place the patient either upon the side or back with the knees drawn up, and then, without uncovering her, pass the forefinger of the left hand, slightly flexed, to the posterior commissure of the vulva, separate the labia with the knuckle, pass the pulp of the finger to the anterior or superior margin of the orifice of the vagina, feel for the urethral tubercle, and, passing the catheter along this finger as a director, carry it gently upward and back-

PLATE LVIII.

INSTRUMENTS EMPLOYED IN OPERATIONS UPON THE VAGINA AND RECTUM.

Fig. 1. Lever Speculum of Dr. Marion Sims, for elevating the posterior face of the vagina. 1. Surface which is applied to the posterior face of the vagina. Schiveley's pattern.

Fig. 2. Sims's Smaller Speculum for elevating the anterior end of the vagina. Schiveley's pattern.

Fig. 3. Sims's Knife, for freshening the edges of a vesico-vaginal fistula. Schiveley's pattern.

Fig. 4. Sims's Needle, for inserting the sutures in a vesico-vaginal fistula. Schiveley's pattern.

Fig. 5. Sims's Crotchet, for sustaining the traction made in drawing upon the threads. Schiveley's pattern.

Fig. 6. Sims's Hook, for seizing the edge of the fistula, or the loop of a suture. Schiveley's pattern.

Fig. 7. A Small Blunt Hook, to support the edge of the fistula when being transfixed by the needle. Schiveley's pattern.

Fig. 8. A Fork to sustain the traction made in tightening the wire ligatures. Schiveley's pattern.

Fig. 9. Forceps for seizing the wires and fastening the shot in closing the sutures. Schiveley's pattern.

Fig. 10. Sims's Female Self-Retaining Silver Catheter, as employed in vesico-vaginal fistula. Schiveley's pattern.

Fig. 11. Ordinary Female Catheter of Silver. " "

Fig. 12. Meigs's Shield for the vulva in incurable vesico-vaginal fistula. Schiveley's pattern.

Fig. 13. Bivalve Speculum Vaginæ. " "

Fig. 14. Univalve Speculum. 1. Handle. 2. Vaginal portion. Schiveley's pattern.

Fig. 15. Fenestrated Speculum, open on the side, and applicable either to the vagina or rectum. 1. The fenestrum. Schiveley's pattern.

Fig. 16. Ordinary Rectum Speculum for dilating the anus. " "

Fig. 17. Dewees's Glass Pessary for prolapsus uteri. " "

Fig. 18. Physick's or Meigs's Ball Pessary—silver-gilt. " "

Fig. 19. Hodge's Curved Pessary. " " " "

Fig. 20. Chase's Vaginal Syringe. 1. Shield to close the vulva and assist in retaining the injection. Schiveley's pattern.

Fig. 21. Double Canula for ligating uterine polypi. " "

Fig. 22. A Rectum Bougie. " "

Fig. 23. A "Porte Meche" for inserting lint in fistula in ano. Schiveley's pattern.

Fig. 24. Gibson's Stylet for puncturing the rectum in incomplete fistula. Schiveley's pattern.

Fig. 25. Spring to carry the ligature after the puncture is made. Schiveley's pattern.


Fig. 1.
Fig. 7.
Fig. 21.
Fig. 3.
Fig. 9.
Fig. 11.
Fig. 10.
Fig. 8.
Fig. 4.
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Fig. 22.
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Fig. 17.
Fig. 12.
Fig. 19.
Fig. 20.
Fig. 13.
Fig. 14.
Fig. 15.

ward so as to present its concavity under the arch of the pubis. As soon as the point enters the bladder, close the end of the instrument with the finger, and apply a small bowl to receive the urine. In withdrawing the catheter, the end should also be closed with the finger, to prevent the urine soiling the bed, the motions by which the instrument was introduced being reversed.

§ 4.—IMPERFORATE HYMEN.

Puncture the membrane with a bistoury or thumb-lancet, and make a crucial incision, to prevent union of the wound from the collapse of the membrane.

§ 5.—OCCLUSION OF THE VAGINA.

Occlusion or imperforation of the vagina, whether due to congenital causes or to the effects of inflammation, frequently requires surgical treatment in order to restore the function of the canal, and especially to give exit to the menstrual fluid. As such cases necessarily vary much, it is impossible to lay down any precise plan of proceeding, and the surgeon should, therefore, be mainly guided in his operation by his anatomical knowledge of the part, and by the results that are well known to follow upon the formation of cicatrices.

When the imperforation is perfect, an accurate diagnosis of the existence of a womb should first prove the necessity for the operation, as, until this can be settled, no operation ought to be attempted. But should the evidences of the presence of this organ be satisfactory, the dissection may be prosecuted by placing the woman in the position for lithotomy, introducing a catheter into the bladder, a finger or bougie into the rectum, and then cautiously incising the intermediate portions in the line of the natural curve of the vagina, until the uterus is reached, or until the depth of the incisions excites a fear of penetrating the peritoneum at the point of its reflection from the bladder. Subsequently, the parts should be prevented from adhering by the use of emollient dressings and bougies. An instructive case of this operation has been reported by Dr. Charles

D. Meigs, of Philadelphia,[1] as performed by Dr. Randolph upon a patient injured in labor, and who, in consequence, had retention of the menses. Several others will also be found referred to in the Bibliographical Index at the commencement of the work.[2]

Operation of Dr. J. Randolph, of Philadelphia.—The operator being seated in front of the patient, and the latter placed upon her back, with the knees drawn up, a strong metallic staff, slightly curved, was introduced into the bladder, and held by the assistant. Then, whilst the left index finger was kept in the rectum, the tissue between the urethra and rectum was dissected very nearly up to the substance of the womb itself by horizontal strokes of the bistoury. Not being able to find the os uteri, the operation was now suspended, a silver-gilt bougie, four inches long, and as thick as the thumb, directed to be constantly employed to preserve the newly-formed canal, and the patient sent home. Three months subsequently, after constantly wearing the bougie, the lady returned to the city, suffering from uterine distension, when the vagina was found to be covered with a smooth surface resembling a mucous membrane, and a tumor could be distinctly felt through the upper end of the canal. On puncturing this with a trocar and canula, a viscid substance was evacuated, the patient relieved, and the menstrual fluid subsequently found to escape by the vagina. The latter, however, contracted until nothing was left but a sinuous opening sufficient for the menstrual fluid.

Remarks.—In operating for the relief of occlusion of the vagina, the surgeon should pay special attention to the previous history of the case, and if the defect has been the result of the inflammation developed by injuries to the part, should bear in mind the fact that he has an inodular structure to deal with, and be prepared to prevent its subsequent contraction. Great disappointment has ensued in two cases, that I have seen in consultation, from the return of the constriction, after the vagina had been incised and dilated, to remedy an atresia, which was the result of injury in parturition, and this contraction supervened in one case notwithstanding the efforts of a vigorous husband to prevent it. Dr. Mott, of New York,[3] and Dr. Ewart, of Charleston,[4] have also reported cases in

[1] Pract. of Med., 2d edit. p. 383.

[2] See Bibliographical Index, p. 125.

[3] N. Y. Med. Times, vol. ii. p. 1, 1852.

[4] Charleston Med. and Surg. Journal, vol. viii. p. 81, 1853.

which the contraction returned, notwithstanding every effort to prevent it. When the diseased tissue is extensive, I should therefore prefer to attempt the introduction of a slip from the vulva, by a plastic operation, or obtain the alterative effects of the frequent and light applications of the nitrate of silver rather than resort to the dissecting or incising operation just described. Though the latter may succeed sometimes, it will not invariably do so, and the patient had better be informed of the chances of a return of the complaint.

SECTION III.

LACERATION OF THE PERINEUM.

Laceration of the perineum, as the result of parturition, may result either in a slight or entire rupture of the recto-vaginal septum, and consequently demand different methods of treatment to effect its cure. Even a slight parturient laceration of the perineum proper causes, however, such a condition of the parts as is not favorable to immediate union, especially when the natural discharges from the womb are compelled, by the position of the patient, to pass over the wound. Union by the second intention is, therefore, that which most frequently accomplishes the cure, and though the close approximation of the edges of the fissure expedites the healing, and may seem at the first glance to result in direct union, close examination will often show that the appearance is deceptive, flatus or liquid matter sometimes escaping through parts which were thought to be solid. All sutures that are employed to approximate the edges of a laceration should therefore be retained in position as long as possible, in order to favor the union and prevent too early traction upon the newly-formed cicatrix.

Treatment of old Lacerations.—The interrupted or the quilled suture, with freshening of the edges of old injuries of the perineum, having been the means generally employed in the treatment of this injury, the modifications in the operation that have been suggested at different periods, are those which have resulted from the difficulties met with in particular cases.

Operation of Dieffenbach.—The parts having been well shaved and cleansed, the patient is to be placed in a good light, and in the position for lithotomy, when the edges of the fissure should

PLATE LIX.

OPERATIONS UPON THE FEMALE GENITO-URINARY ORGANS.

Fig. 1. Operation of Celsus for closing a recent laceration of the perineum, as modified by Dieffenbach. After uniting the sides of the laceration by the application of the quilled suture, two lateral incisions are made so as to relieve the tenseness of the perineum. 1. Quilled suture. 2, 2. Lateral incisions of Dieffenbach. After Bourgery and Jacob.

Fig. 2. Roux's Operation for the cure of a Recto-Vaginal Fistula, which was situated behind the recto-vaginal septum. A quadrangular flap has been detached from the posterior parietes of the vagina, drawn forwards, and then attached to the freshened edges of the integuments, near the fourchette. 1, 1. Fingers of assistants. 2. The needle-holder. After Bourgery and Jacob.

Fig. 3. Enlarged drawing of the same, showing the position of the sutures and the line of union. Two stitches of the interrupted suture are placed on each side as well as in front. After Bourgery and Jacob.

Fig. 4. Suture of a Longitudinal Recto-Vaginal Fistula. 1. The hand of an assistant dilating the vagina with a bivalve speculum, so as fully to expose the fistula. 2. The hand of the surgeon in the act of forming the suture after the edges of the fistula have been freshened either by caustic or the knife. After Bourgery and Jacob.

Fig. 5. Deyber's Operation for the cure of a Transverse Vesico-Vaginal Fistula. 1, 1. Fingers of the assistants exposing the parts. 2. The stylet, which, being introduced through the urethra, is about to pass the thread through the posterior lip of the fistula. 3. The forceps seizing it. The suture at the opposite angle is seen as applied, but it is not tied until all the threads are placed. After Bourgery and Jacob.

Plate 59

Fig 1

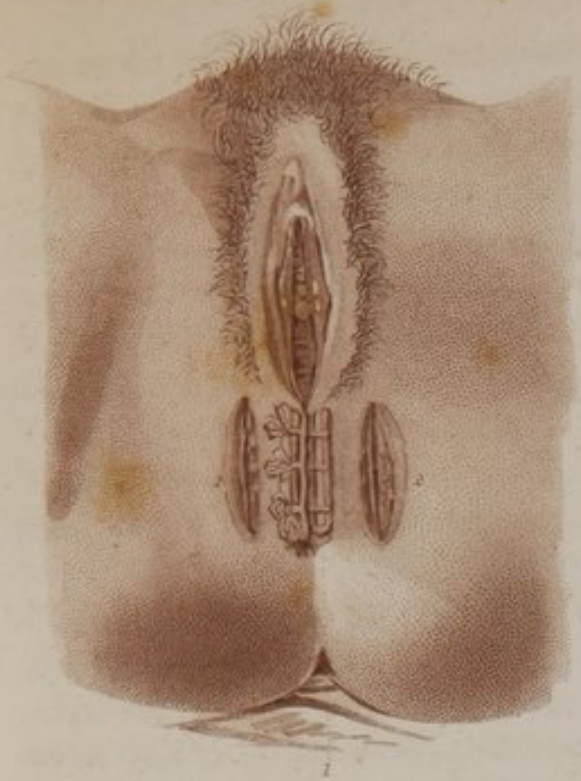


Fig 2

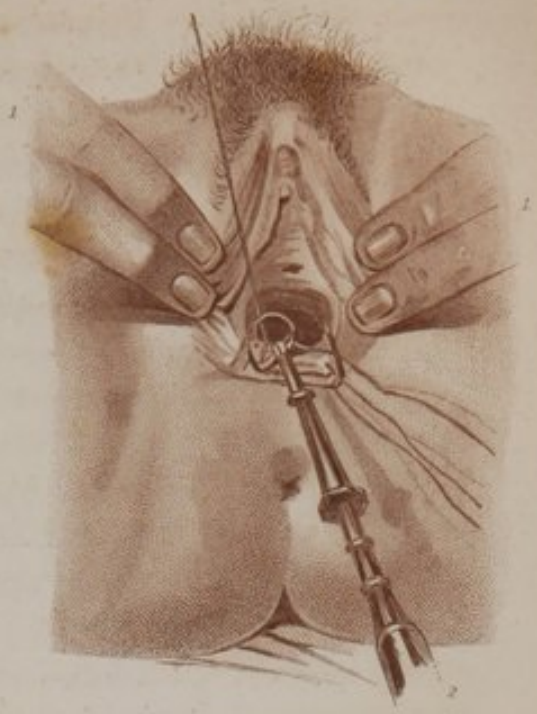
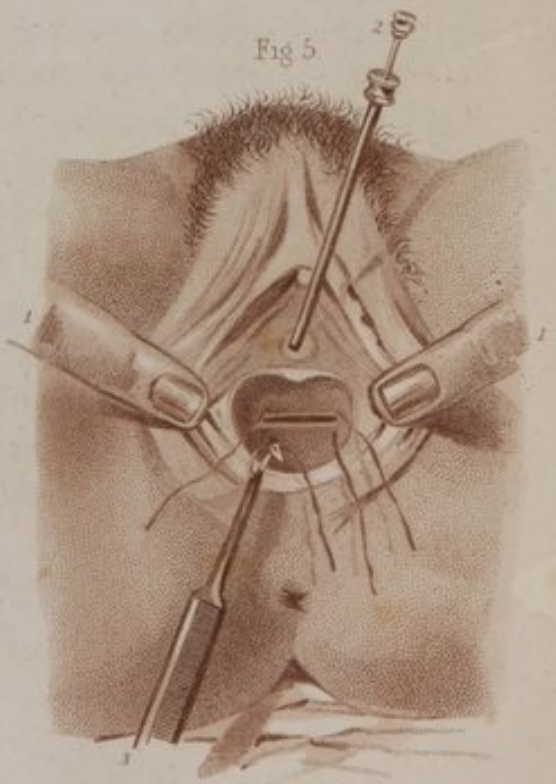


Fig 3

Fig 4

Fig 5



be raised by forceps, and freshened by excising them with curved scissors or a bistoury. The side of the rectum being now united by a fine stitch, a single point of the interrupted suture, deeply introduced, closed the middle of the fissure, when four stitches of the quilled suture, applied at equal distances, approximated the parts accurately. The loss of substance putting the united parts upon the stretch, he next made two lateral incisions, half an inch on each side of the posterior margin of the external labia (Plate LIX., Fig. 1), which soon relieved the tension of the line of the fissure, and, by filling up with granulations, prevented future traction on the cicatrix until it had become firm. The sutures being allowed to remain till loosened, care was taken to keep the bowels in a soluble condition by employing daily injections after the seventh day.

Operation of Dr. Mettauer, of Virginia.[1]—In this case, a lady, thirty years of age, suffered a laceration of the perineum during parturition six months previously, from which there resulted "a complete disunion of the recto-vaginal wall from the verge of the anus three inches up the rectum, terminating superiorly in an obtuse angle; the rectum being contracted upon itself so as to render its several teguments a mere band of the width of five-eighths of an inch, whilst the retaining power of the sphincter ani was destroyed."

Operation.—The patient being placed in the position for lithotomy, with the knees held wide apart, denudation of the margin of the fissure to the extent of three-fourths of an inch was accomplished by the aid of hooks, scissors, and scalpels, according to circumstances. The bleeding being arrested, leaden ligatures were introduced in succession from within out, and from the angle to the verge of the fissure, at the distance of one-fourth of an inch apart, by means of curved needles threaded with silk, to the loop of which a leaden wire was attached. Physick's needle proved very useful in introducing these threads, and, as the leaden ligatures were successively tightened by twisting them sufficiently to bring the abraded surfaces in contact, their ends were cut off. Twelve ligatures were required to close the breach, and these being subsequently tightened, the margins of the wound were cauterized with nitrate of silver. The patient was then kept perfectly quiet in bed, with the

[1] Am. Journ. of Med. Sciences, vol. xiii. p. 113, 1833.

knees tied together; the bowels were not moved for four days, and then the matter did not escape through the fissure. The ligatures were removed in six weeks, and the union was perfect.

Plastic Operation of Dr. Horner, of Philadelphia.[1]—In this patient, the laceration was complete from the vulva to the anus, the parts were cicatrized over an inch deep, and but one fissure was apparent from near the os coccygis to the clitoris; there was a constant tendency to diarrhœa, and much of the fecal matter passed through the rima vulvæ.

Operation.—A previous operation by freshening the edges, and the use of sutures, having failed, the patient submitted to the following operation fifteen months after the first:—

After being thoroughly etherized, two flaps were made from the perineum adjacent to the vulva, one on the right and the other on the left side, twisted on their bases, crossed between the rectum and vulva, and fastened by sutures, so that the right flap formed the upper part of the rectum, and the free side of the left the lower part of the vagina; stitches of the interrupted suture along the rectum and along the vagina closing each of these cavities by the approximation of their raw surfaces. For ten days there was no fecal discharge, but at this time the union, though not perfect, kept the septum in position, and ultimately benefited, though it did not cure, the deficiency.

§ 1.—ATRESIA VAGINA.

Atresia, or a contraction of the vagina, is usually the result of a congenital defect, though it may ensue upon laceration of the perineum, and is usually limited to some portion of the canal. At first sight, the relief of this defect would appear to be a simple and certain operation, yet experience has proved that in most instances the efforts of the surgeon have been only partially successful. In most of the cases reported by surgical writers, the constriction has been overcome, or attempted to be overcome, by dilatation with bougies, sponge tents, or similar means, in the hope that, after once enlarging the canal, it would retain its proper size, especially in the married female. But the failures, or rather partial success, that has

[1] Amer. Journ. of Medical Sciences, vol. xx. p. 329, 1850.

followed these means, all tend to show that this plan of treatment is not a judicious one. Like strictures in all other parts, constriction of the vagina, as well as its occlusion when the result of injury, requires more than a mere mechanical dilatation. There must be a change of action in the part, and, when the contraction is the consequence of inflammation, the inodular structure must be removed or modified. When, therefore, the surgeon finds that such cases fail, after being treated solely by the use of the bougie, let him try other means, and, by repeated incisions (as in some of the plastic operations), gradually add, through the medium of the adjacent parts, to the new matter that may be required in the canal; or let him continue the operation of dilatation, and combine with it dissections of the walls of the vagina from the exterior cellular tissue. As the detailed account of the operations practised on these parts would extend my limits so as to exclude matter of more general utility, I must refer those desirous of further information to the papers quoted in page 127 of the Bibliographical Index.

CHAPTER V.

OPERATIONS FOR VAGINAL FISTULA.

From the relative position of the female bladder, urethra, and rectum, to the vagina, it occasionally happens that sloughing or ulceration of the intermediate tissues produces a direct communication between these parts through which either urine or feces escape into the vagina. Such openings are usually designated as vaginal fistulæ, and may be either vesico-vaginal, utero-vaginal, or recto-vaginal, according to the viscus into which they open.

SECTION I.

VESICO-VAGINAL FISTULA.

Pathology.—In vesico-vaginal fistula, there exists an opening of greater or less extent between some portion of the vagina and the urethra or bladder, or both, which varies under different circum-

stances. Most frequently this opening is the result of sloughing consequent either upon the long-continued pressure of these parts against the pubis by the child's head in parturition, or of the inflammation or laceration induced by the improper use of instruments, or from the presence of foreign bodies in the bladder or vagina.

When any of these causes impairs the vitality of the part, the portion affected is liable to separate or slough out, and leave an ulcerated opening with irregular edges, which, by the effusion of lymph in the efforts of nature to repair the loss, become thickened and indurated. From the loose character of the attachment of the mucous coat of the bladder, and the efforts at straining, a fold or two of the latter is also often forced into the vagina at the edges of the ulcer. Tedious labor and neglect of the condition of the bladder being the most common cause, the fistula will be found at some point either of the bas-fond or neck of the bladder, or at the posterior two-thirds of the urethra. When the result of labor, the opening is most commonly transverse, the size of it being diminished by the os uteri being drawn downwards and forwards, so as to relax the anterior wall of the vagina. But when the fistula has been excited by the action of instruments, it is more frequently longitudinal.

The evils resulting from the existence of a vesico-vaginal fistula, as well as the difficulties of the cure, will depend in a great measure on the diameter and position of the opening; these evils and difficulties being greater in proportion to the proximity of the fistula to the bas-fond of the bladder, and least when it is in or near the anterior portion of the urethra.

The treatment of a vesico-vaginal fistula may be either palliative or curative, but the latter is so rare in a perfect degree that Velpeau and others have asserted that, "among all the cases related of cures, there were but a very small number that were entirely free from doubt,"[1] though he subsequently modified his statement by making it especially applicable to those in which the bas-fond of the bladder was involved. The experience of Dr. Marion Sims, of New York, as well as that of Drs. Hayward, Mettauer, and others, in the United States, has, however, frequently proved that these fistula are perfectly amenable to treatment. The complaint may, therefore, be treated either by the palliative or the radical plan of proceeding.

[1] Velpeau's Op. Surg., by Mott, vol. iii. p. 858.

§ 1.—PALLIATIVE TREATMENT.

Without spending time in referring to the treatment of these fistulæ by means of sponges and plugs introduced into the vagina, they being at best but imperfect means of preserving cleanliness and preventing excoriation, I shall at once call attention to a simple contrivance and bandage, originally suggested, I think, by Dr. Charles D. Meigs, of Philadelphia. This instrument, which explains itself (Plate LVIII., Fig. 12), resembles somewhat an oyster-shell, fits accurately to the vulva, and is held in its place by the attachment of a T bandage, whilst a caoutchouc bottle, which is fastened to the opening at its lower end, receives the urinary secretion. In old and incurable cases, such a shield, made of silver and gilt, will be found of great service, and add much to the comfort of the patient.

When the fistula is comparatively recent, even though very large, the patient may be much benefited by the frequent application of the nitrate of silver to the edges of the ulcer so as to favor the formation of granulation, whilst in recent cases, and in those limited to the urethra, the use of the catheter, and of highly astringent injections into the vagina, with perseverance in such a position as will favor the escape of the urine through the upper half of the urethra, combined with the use of nitrate of silver, will often diminish very materially, if it does not entirely heal the fistulous orifice.

§ 2.—OPERATIONS FOR VESICO-VAGINAL FISTULA.

The difficulties attending the closure of vesico-vaginal fistula by freshening its edges, and approximating them by various kinds of sutures, has led surgeons to suggest the use of different instruments, and to recommend various modes of operating. To recapitulate all these would be as tiresome as it would be useless, and this account will, therefore, be limited to a few which have been selected from among the cases reported by such surgeons in the United States as have paid special attention to the subject.

OPERATION OF DR. GEORGE HAYWARD, OF BOSTON.[1]—At the

[1] Cases of Vesico-vaginal Fistula, by George Hayward, M. D. Boston, 1851.

PLATE LX.

OPERATIONS ON THE FEMALE GENITO-URINARY ORGANS.

Fig. 1. Jobert's Operation for Elytroplasty, or closure of a vesico-vaginal fistula, by means of a flap taken from the integuments of the labium majus, and twisted upon its base round to the orifice of the fistula, where it is retained by sutures. After Bourgery and Jacob.

Fig. 2. Freshening the edges of a vesico-vaginal fistula whilst they are secured in 1, the forceps of Fabri. One blade of the forceps, being furnished with a plate of wood, is passed into the bladder through the urethra, and serves as a point of support for the other blade, which has a fenestrum capable of containing and approximating the lips of the fistula. After Bourgery and Jacob.

Fig. 3. Velpeau's Operation of Anaplasty for the cure of a recto-vaginal fistula, the flap being taken from the side of the vulva and attached to the freshened edges of the fistula. After Bourgery and Jacob.

Fig. 4. Ligature of a large Uterine Polypus. The orifice of the vagina being kept open by the fingers of the assistants, the polypus has been seized with 1, Museux's hooks, and drawn down to the os externum by another assistant. The surgeon having then thrown a ligature around the pedicle of the tumor by means of the two ligature bearers 2, 3, has drawn the ligature 4 through the knot-tier 5, and is about to strangulate it. After Bourgery and Jacob.

Plate 60

Fig 1

Fig 2

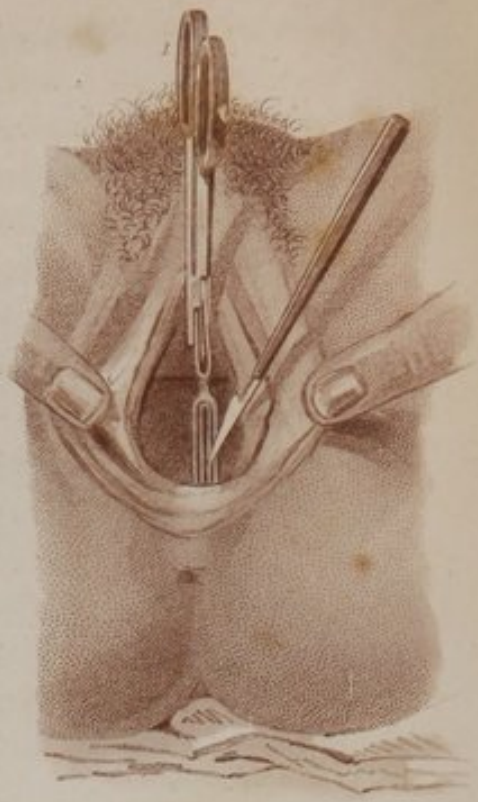
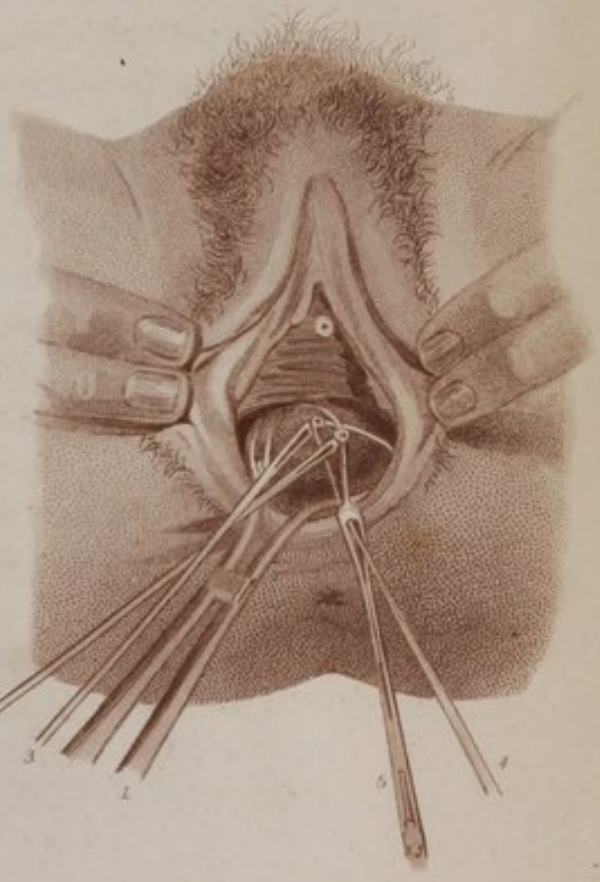


Fig 3

Fig 4



close of a series of cases reported by this distinguished surgeon, the following account of the operation is given:—

Operation.—The patient being placed as for lithotomy, and thoroughly etherized, but not tied, a large-sized bougie made of whalebone and highly polished should be introduced through the urethra to the very fundus of the bladder, so as to depress it towards the vagina by elevating the end of the bougie towards the pubis. After bringing the edges of the fistula fully into view, the callous portion should then be excised either with the curved scissors or knife, or both, the edges being held by means of a double hook, whilst the vaginal covering is dissected from the mucous coat of the bladder to the distance of two or three lines.

A short needle, with an eye near the point, and made to fit on a long handle, being then passed through the outer covering of one side of the fistula, should be seized by the forceps and withdrawn from the handle, then drawn through the lips of the wound, fitted again to the handle, and passed through the opposite side in the same manner. As many stitches as are necessary being thus taken, one thread of each should be cut off and the other left to show when the ligature has separated from the bladder. A large-sized female catheter being now secured in the bladder by a T bandage, the patient should be laid on her side with the shoulders raised so as to facilitate the escape of the urine, and the instrument removed every twenty-four hours, in order to prevent its clogging. After three days, it may be removed altogether, but the urine should be drawn off every three hours for ten or twelve days more, so as to prevent any strain on the bladder. The diet should consist entirely of liquid, mucilaginous food, until the ligatures separate; and the bowels (which should always be freely evacuated prior to the operation) be kept at rest for some days, as little effort as is possible being also made by the patient to empty the bladder.

Remarks.—Out of nine cases operated on in this manner by Dr. Hayward, three succeeded perfectly; five were relieved, and the others not benefited. I also performed a similar operation on one occasion, with much relief to the patient,[1] before seeing Dr. Hayward's paper.

Operation of Dr. John P. Mettauer, of Virginia.[2]—A fistula

[1] Medical Examiner, vol. v. N. S. p. 155, 1844.

[2] Am. Journ. Med. Sciences, vol. xiv. N. S. p. 107.

about the central part of the vesical triangle of the size of a Spanish dollar, and nearly circular, which had existed six months, and was the result of sloughing, was treated as follows:—

Operation.—After a preparatory constitutional treatment, the woman was placed and confined as in the operation for lithotomy, and the vagina dilated by two broad spatulæ pressed against its opposite sides, the edges of the fistula being denuded by seizing them with delicate hooks, and trimming them with keen scissors, curved flatwise. A straight needle, thirteen lines long, being then armed with a silk ligature, doubled so as to form a noose fully six inches long at one of its free ends, the bent extremity of a leaden wire, of small size, was fastened upon it, and then by forceps and a porte-needle, introduced through the edges of the ulcer so as to form the first stitch of the leaden suture, the ends of the leaden thread being loosely twisted so as not to pucker the edges of the fistula. Eight distinct sutures, being then formed and loosely twisted, were progressively tightened until the opening was perfectly closed, when the ends of the leaden wires were brought out at the vulva, and the soft parts protected by investing them with oiled silk, after which a catheter was fastened in the bladder. The wires being tightened on the third, and again on the seventh day, the bowels were not moved until the eighth, and on the thirteenth day the sutures were removed, "perfect union having taken place throughout the entire line of contact." The use of the catheter was, however, persevered in for four weeks for fear of vesical efforts, and the patient subsequently had two children without a return of the accident.

Operation of Dr. J. Marion Sims, of Alabama (now of New York City).—Being dissatisfied with the success attending the repetition of the ordinary operations upon three cases in which he tried it, Dr. Sims, after devoting much time and study to perfecting instruments, and a mode of operating which could render this formerly intractable affection perfectly curable, has, in a well-written paper,[1] described very minutely his views of the subject. To his more extended account, I must refer the reader who desires further details than is compatible with my present limits, confident that the perusal of the original article will furnish him with such information as will prove practically useful.

[1] Am. Journ. Med. Sciences, vol. xxiii. N. S. p. 59, 1852.

Operation.—Having prepared the instruments figured in Plate LVIII., Figs. 1 to 10, and given every attention to the general condition of the patient, the operation should be conducted in the following manner:—

Position of the Patient.—In order to obtain a correct view of the vagina, place the patient upon her knees on a table two and a half by four feet, and have the nates elevated whilst the head and shoulders are depressed. The knees should also be separated six or eight inches, the thighs placed at about a right angle with the table, and the clothing so loosely arranged as not to compress the abdomen. An assistant on each side should then lay a hand in the fold between the glutei muscles and the thigh, the ends of the fingers reaching to the labia majora, and by simultaneously pulling the nates upwards and outwards open the os externum. The pelvic and abdominal viscera being thus made to gravitate towards the epigastrium, the presence of the atmosphere will suffice to distend the vagina to its utmost limits, thus freely exposing the os tincæ and the fistula. To facilitate the view of the operator, the assistant on the right side of the patient should now also elevate the perineum and recto-vaginal septum by means of the lever speculum (Plate LVIII., Fig. 1), a smaller speculum (Plate LVIII., Fig. 2) being used to press the urethra downwards against the symphysis pubis, when circumstances demand it. In most cases, a good northern light on a clear day will suffice for the display of the canal, but if more is requisite, a looking-glass should be so arranged as to throw the rays of the sun upon the part. The orifice of the fistula being now distinctly seen, the next step in the operation is to freshen its edges.

To Freshen the Edges of the Fistulous Opening.—A delicately curved tenaculum (Plate LVIII., Fig. 6), being inserted into the margin of the fistula, a sharp-pointed knife (Plate LVIII., Fig. 3) is made to shave off the edge of the opening to the extent of a quarter or third of an inch, so as to denude the part thoroughly on the vaginal surface, but without removing any of the lining membrane of the bladder, unless it project so much into the vagina as to obstruct the operation, which is rarely the case.

When the fistula is small, there is abundance of tissue, and there need be no fear about removing the parts freely, the success of the operation depending much upon the perfection of the freshened edges. During the scarification, there is always some hemorrhage,

which may be readily removed by little probangs of sponge, one assistant attending solely to the preservation of the cleanliness of the orifice.

THE SUTURE.—The object of all the sutures being to unite the freshened edges of the fistula, the interrupted, quilled, and twisted of ordinary wounds have been employed. From its peculiar method of action, Dr. Sims designates his as the "clamp suture." It is composed of fine annealed silver-wire, about the size of a horse-hair, which is fastened to crossbars, after the manner of the quilled suture. The bars may be made of silver or lead, either solid, or tubular, highly polished and without any asperities, particularly at their extremities. Acting as clamps, the embraced parts swell up and overlap them, while they produce sufficient ulceration of the vagina to permit their becoming imbedded, and sometimes so hidden from view that they will often remain until surrounded by granulations. This suture may be left untouched for six or ten days, or longer, and has never ulcerated out. If removed too soon, the cicatrix may yield, and judgment must, therefore, direct the proper period for the removal of the clamps.

PLACING THE SUTURES AND CLOSING THE FISTULA.—With a long needle (Plate LVIII., Fig. 4), armed with a silk thread, a puncture is made in the middle of the scarified edge of the fistula, about half an inch anterior to its border, the needle carried deeply into the vesical septum, but without transfixing it, brought out just at the edge of the mucous membrane of the bladder, carried across the opening, entered at the opposite side at a point corresponding with its anterior direction, and brought out on the vaginal surface about half an inch beyond the scarified edge, but without touching the vesical mucous membrane, when the first thread is placed in position. The passage of the needle through the anterior edge is sufficiently easy, but the loose and yielding nature of the posterior margin renders some support necessary before it can be made to appear on the vaginal surface. To accomplish this, a blunt hook (Plate LVIII., Fig. 7) should be placed flatwise at the point of exit of the needle, so as to make a fixed point for it, when it will readily pass, after which the small tenaculum (Plate LVIII., Fig. 6) may be made to hook up and draw out the ligature from the side of the needle, when the latter may be withdrawn, and the other ligatures passed in like manner. To prevent the cutting and pain which would ensue upon drawing the thread upon the posterior edge of

the fistula, a crescent-shaped fork (Plate LVIII., Fig. 5) should be passed in, and made to serve as a pulley for the thread.

The three threads being thus placed, the most difficult part of the operation is finished, and it only remains to substitute the wires and apply the clamps, which is readily accomplished as follows:—

To apply the Wires and Clamps.—Take a piece of the wire, twelve or eighteen inches long, make a small crook at one end, and, fastening it to one end of the silk thread, draw the wire through the edges of the fistula, and bring its ends out of the vagina. Then do the same with the remaining wires, and having made small oblong openings in the bars, either of silver or lead, at distances corresponding with that between the points of the suture, fasten the distal ends of the wire to one bar, either by twisting it round it, or by passing it through a perforated shot, and then bending it over the former. This being done, pull upon the proximal ends of the wires, or that nearest to the orifice of the vagina, and draw the bar up into the vagina above the fistula, or between its upper margin and the os tincæ, using a fork (Plate LVIII., Fig. 8) broad enough to serve as a pulley for all the wires whilst being drawn into position. Now pass the proximal ends of the wires through the other bar, push it into the vagina till it is placed in front of, and parallel with the anterior edge of the fistula, and then using the fork to press up the clamp, draw firmly on the wires until the denuded edges of the fistula are so closely in contact that an ordinary probe would not pass between them, when the following simple contrivance will suffice to hold the clamps in position and fasten the wires. Slide a perforated shot over the free end of each wire, push it up to the clamp, and then firmly compressing it on the wire by means of forceps (Plate LVIII., Fig. 9), the shot will be made to serve as a knot to the wire and prevent its being drawn through the clamp. The ends of the wires being then cut off about one-fourth or one-eighth of an inch from the shot, and bent over, they will be effectually prevented from slipping.

The whole operation, which usually occupies twenty or thirty minutes, or under any circumstances an hour, being now completed, the patient should be put to bed, and a self-retaining catheter (Plate LVIII., Fig. 10) applied to keep the bladder empty; an anodyne administered, the bowels kept at rest as long as possible, being usually ten or fifteen days after the operation, and the whole followed by a careful after-treatment. The sutures should be examined on

the third or fourth day, again on the sixth or seventh, and if not doing mischief (exciting too much inflammation or ulceration), not removed until the ninth or tenth day.

Removal of the Clamps.—Clip off the flattened shot, and elevate the anterior clamp from its bed by a blunt hook, when the posterior clamp may be hooked up with the wires attached, pushed backwards into the vagina, disengaged entirely, and then lifted out with forceps. The patient should then remain in bed, and use the catheter for several days to prevent any strain upon the new cicatrix.

Remarks.—Although vesico-vaginal fistula cannot be regarded as a common complaint, it is unfortunately too often met with, and every means of affording relief will, therefore, be readily seized by a patient thus dreadfully afflicted. There is, however, a great difference in the utility of the means that have been proposed, and to estimate the value of each of these, is by no means easy, when so much must depend upon the position, size, and duration of the fistula, as well as upon the mechanical skill of the operator. The space for manipulation is necessarily small, and yet the neat and accurate apposition of the parts is essential to success; the selection of any one plan of treatment must, therefore, be left to individual judgment and delicacy of manipulation. In three cases, I have obtained relief from different methods of treatment. In a small fistula, in the posterior edge of the urethra, cauterization closed the opening. In a larger orifice, at the anterior end of the vesical triangle, the twisted suture and harelip pins induced the union of more than two-thirds of the original fistulous opening. In a third, who had an opening at the neck of the bladder, the interrupted suture, carefully applied, afforded but partial relief. The recent appearance of Dr. Sims's paper at the time, prevented the entire performance of his operation in the latter case, owing to the want of his instruments, though I was enabled to test the value of the position of the patient, as recommended by him, and the facility with which the fistula could be exposed. To his operation I should, therefore, give the preference, and as complete sets of his instruments can now be readily obtained, I hope to hear of its successful repetition by others. By supporting the edges during the adhesive process, preventing traction in the transverse line of the vagina, and readily keeping the bladder empty, this operation seems to present every prospect of success, and, in the hands of its inventor, has afforded relief to many sufferers. In the incurable cases, the vulva

shield and bottle (Plate LVIII., Fig. 12) will be found to furnish much comfort, both mentally and physically. Plastic surgery has also been brought to bear upon the treatment of this complaint in the hands of Jobert, of France, and of Pancoast[1] in the United States.

In very extensive fistula, Jobert, of Paris, has advised the performance of a plastic operation, which he terms "Elytroplasty," whilst Velpeau has recommended "Anaplasty." As these operations are figured in Plate LX., Figs. 1, 3, a detailed account of them is here unnecessary.

SECTION II.

VESICO-UTERINE FISTULA.

In a recent treatise by Jobert, of Paris,[2] on the treatment of vaginal fistula, attention has been especially called to the existence of a rare form of fistula, in which a communication exists between the bladder and uterus above the insertion of the vagina, in consequence of which the urine escapes into the vagina through the os uteri. This complaint is stated by Jobert to arise from the long continued pressure of the child's head, especially in a deformed pelvis, or from the unskilful use of instruments, or the injury resulting from craniotomy. To relieve this, Jobert advises the lateral division of the neck of the uterus, by means of a pair of long blunt-pointed scissors, so as to gain a good view of the fistula, after which he proceeds to treat it by turning up the anterior flap of the neck of the uterus, freshening the edges of the fistula and uniting them; or by applying the flap as a plug, by a plastic operation, the details of which I am compelled to omit, as the rarity of the disease would not justify the space that it would require in a work of the general character of the present treatise.

Vesico-uterine vaginal fistula is another form of the complaint to which he has alluded, which is also very rare, and the details of which I therefore omit.

[1] Operative Surgery, by Joseph Pancoast, M. D., Philad.

[2] Quoted in Dr. Sargent, of Philadelphia, in a note to Miller's Practical Surgery, p. 599.

SECTION III.

RECTO-VAGINAL FISTULA.

PATHOLOGY.—In recto-vaginal fistulæ, a communication is established between the rectum and vagina by an opening which is in the anterior wall of the rectum, and the posterior of the vagina. The aperture may be of various sizes, and either congenital or the result of such injury as induces sloughing or the formation of an abscess. Congenital fistula of this kind, or an artificial anus opening into the vagina, is comparatively rare, though I have seen one in the case of a child six months old, it being in this case complicated with a deficiency of the lower portion of the rectum, the gut opening into the vagina nearly a half inch above the os externum, and the anus being deficient. The occurrence of cholera infantum preventing any attempt at relief, the child returned to its home in the country, and has not since been heard of. Recto-vaginal fistulæ are mostly, however, the result of laceration or consequent on the improper use of instruments during delivery; they are also generally longitudinal, and give exit to fecal matter and flatus through the vagina as well as the rectum. Position and rest, coupled with a natural tendency in the orifice to close, are often sufficient to effect a cure, and yet it occasionally happens that considerable skill and attention will be required in order to heal them. As the various means referred to in the treatment of the vesico-vaginal fistula are equally and more readily applicable to this class also, the operative methods need not be so fully detailed as in the preceding class of fistula.

OPERATION OF DR. JNO. RHEA BARTON, OF PHILADELPHIA.[1]—A young lady, after suffering from an abscess, which was discharged, was left laboring under a fistula for four years, which resisted the ordinary treatment by tents, setons, and caustics. This fistula commenced about three-fourths of an inch within the right labium, and passed by a very irregular course up the pelvis, inclining to the rectum, into which it opened at about three and a half to four inches from its inferior aperture in the vagina, giving exit to fluids and flatus through the genitals.

[1] Am. Journ. Med. Sciences, vol. i. N. S. p. 305, 1840.

As the sinus could not be included in a seton, and ulcerated through, or laid open without destroying the perineum, it became necessary to adapt an operation to the case.

OPERATION.—The sinus having been dilated for a few days by a tent, a seton was introduced into the fistlua per vaginam, by means of an eyed probe, thence passed through its whole extent, till it entered the rectum by its orifice to that cavity, whence it was brought down to, and out at the anus, the two ends being loosely tied merely for security. After a few days the loop was undone, and the end of the seton which came out of the vagina was passed through the eye of a probe previously bent at its other end. This probe being then inserted into the vaginal orifice of the fistula, was carried about an inch and a half up the sinus, and its point directed towards the perineum, just exterior to the sphincter ani muscle, where a small but deep incision was made, the probe pushed through, and the end of the seton brought out and tied to the rectal end of the ligature, thus including in the loop the parts between the outer surface of the sphincter ani muscle and the rectum, the seton being subsequently twisted and drawn tighter and tighter, until it cut its way out, as in the ordinary operation for fistula in ano with the ligature. So soon as the new channel thus formed had attained a larger size than that entering the vagina, the discharges deserted the latter, and it healed up. It only then remained to treat the seton in the same manner as in fistula in ano till it ulcerated out, when the parts healed, and the lady recovered perfectly. Four years subsequently she was free from disease.

Dr. R. D. Mussey, of Cincinnati, has also reported a case of recto-vaginal fistula, in which he accomplished a cure by using the "clamp suture" of Dr. Sims, as referred to in the section on vesico-vaginal fistula.

ROUX'S OPERATION FOR ENTERO-VAGINAL FISTULA.[1]—"In a case where the ilium terminated in the vagina, Roux opened the abnormal parietes, separated from the vagina the portion of the intestine that terminated in it, and tried to invaginate it into the inferior end, by means of a suture. The patient dying afterwards, the autopsy showed that, instead of invaginating the portion of the ilium in the

[1] Malgaigne, Philad. edit. p. 529.

inferior end of the large intestine, it had been inverted to its superior end."

VELPEAU'S OPERATION BY ANAPLASTY.—A lady, after undergoing an operation for the closure of a recto-vaginal fistula by means of the suture, was left with a perforation in the lower part of the recto-vaginal partition, above the front of the suture. To close this, a flap two inches long, and eight or ten lines wide at its base, was cut from the tissues about the left labium majus, and, a thread being affixed to its upper extremity, it was drawn from the vagina into the fistula in the rectum, so as to be fastened near the anus (Plate LX., Fig. 3). Two-thirds of its extent, however, mortified, and as it adhered only on one of its sides, the fistula was diminished but one-third of its size. Velpeau, however, thinks that in more tractable patients, and by taking every possible precaution not to weaken the vitality of the flap, such an operation will offer some prospect of success.[1]

CHAPTER VI.

OPERATIONS PRACTISED ON THE DEEP-SEATED ORGANS OF THE FEMALE.

THE deep-seated genito-urinary organs of the female consist of the uterus, ovaries, and bladder, upon each of which operations are sometimes demanded, as will be hereafter shown.

SECTION I.

LITHOTOMY AND LITHOTRIPSY IN THE FEMALE.

The great dilatability of the female urethra favoring the escape of pebbles of considerable size, the existence of urinary calculus is much more rare in the female than in the male, though it is occasionally seen. Before the revival of lithotripsy, the treatment of such cases was usually accomplished by opening the neck of the

[1] Op. Surg., by Mott and Townsend, vol. i. p. 674.

bladder at various points, as in the operation of lithotomy in man. Such an operation was, however, often followed by incontinence of urine and by other evils, which did not ensue in the case of males, and as all calculi can now be readily removed by crushing, and the easy dilatation of the female urethra especially fits it for the crushing operation, as well as for the passage of large fragments, I do not regard the operation of lithotomy as justifiable in women, and shall, therefore, omit all description of it.

§ 1.—LITHOTRIPSY IN THE FEMALE.

Although a simple operation upon the male, the performance of lithotripsy in the female is even more readily accomplished, the urethra of the latter being shorter and much more distensible, and the bladder so near to the vagina that the introduction of the forefinger into this canal will sometimes enable the operator to push the stone into the grasp of the instrument if he is otherwise unable to catch it. The position of the patient and the other details are very much the same as those described in the previous chapter, but there is less trouble in the after-treatment, owing to the facility with which women can void large fragments by the urethra. It may be incidentally mentioned that this operation does not require exposure of the patient's person.

SECTION II.

OPERATIONS UPON THE UTERUS.

The assistance rendered by the surgeon in the complaints of this organ may be made to include all the organic disorders to which it is subject, or limited to those in which he merely aids the accoucheur. The present account will, therefore, be confined to the operations which are purely surgical in their character, such as those required for the relief of obstructions of the os uteri; of polypus; prolapsus; excision of the neck, and extirpation of the entire womb.

§ 1.—PUNCTURE OF THE UTERUS.

Puncture of the neck of the uterus is an operation that may be required by various circumstances, but is mainly demanded in cases where, from mechanical causes, such a degree of inflammation has been excited as has led to the closure of the os uteri. Occasionally the obliteration of the mouth of the uterus is congenital, but, in many instances, it is simply closed by an adventitious membrane. The restoration of its patulous condition, or the formation of a new orifice, must therefore be regulated by the peculiarity of each case.

Puncture of the uterus may be accomplished by means of a sound, pushed steadily into its cavity if the obstruction is slight and the orifice otherwise normal; but, in more difficult cases, the use of the speculum, with a guarded bistoury (Plate LXI., Figs. 3, 4, 5), or the trocar and canula, will be requisite. Under any circumstances, when the perforation is made, care should be taken to preserve the continuance of the opening by the use of bougies or sponge tents.

§ 2.—POLYPI OF THE UTERUS.

Polypi of the womb, like those found elsewhere, present us with a peculiar class of tumors, whose characteristics are mainly dependent on the mucous membrane to which they are attached, and the specific peculiarities of which have been already described.[1] When developed in the womb, polypi may be removed by very much the same means as were detailed as applicable to them when seated in the nostril, the chief difference being due either to the structure of the part, or to the great size sometimes attained by polypi in this organ. In some cases, uterine polypi have attained a very great size, an instance of which is reported[2] by Dr. O. Keefe, of Georgia, in a case which occurred in the practice of Dr. King, of Alabama, where the tumor after removal weighed three pounds. Dr. H. H. Campbell, of the same State, also reports a case, in which the tumor was the size of a child's head. When uterine polypi attain this size, it may be necessary to act upon them piecemeal, and so to modify the operations practised on the same class of tumors in the

[1] See Operations on the Nostrils, vol. i. p. 343.

[2] Report of Committee on Surgery to Med. Society of Georgia.

nostril, as to permit their more ready extirpation. Repeated punctures, so as to evacuate the blood from the mass, with the long-continued use of astringents, or the formation of sloughs by the application of the actual cautery, may all, therefore, be made to precede the entire removal of these tumors by the ligature or knife. The strangulation of uterine polypi by the ligature being, however, the safest as well as the most common method of removing these tumors from the womb, especially when they are pedunculated, it will be taken as illustrating the principal operation demanded for their cure, though it is liable to the serious objection of causing irritation by the discharge from the tumor whilst sloughing, as well as delay in the tardy removal of the tumor. For these reasons many prefer excision, disregarding the hemorrhage.

I. LIGATURE.

By means of the double canula, a loop of a wire ligature may be drawn tight enough to strangulate the tumor in the following manner:—

OPERATION.—Place the patient on her back with the knees drawn up; introduce the speculum so as fully to dilate the vagina; and, recognizing the position of the os uteri, pass the canula (Plate LVIII., Fig. 21) and loop of the ligature over the polypus to the mouth of the uterus by means of a probe, so as to place the loop as high up as possible. Then, whilst an assistant retains the loop in position by means of the probe, draw upon the wire so as to strangulate the tumor and leave it to slough off, tightening the ligature, from day to day, by means of the screw of the instrument.

Another mode of strangulating uterine polypi is shown in Plate LX., Fig. 4. Should the hemorrhage resulting from any mode of operating be profuse, it may be checked by the application of the tampon or the use of astringents.

Excision of polypi may be accomplished by seizing them with forceps, and removing them either with the bistoury or scissors.

§ 3.—AMPUTATION OF THE NECK OF THE UTERUS.

Excision or amputation of the neck of the uterus has been frequently performed for the relief of carcinomatous affections of this part, and though, like operations for cancer when seated elsewhere,

it only furnishes temporary relief, yet, in some cases, even this may become a matter of some consequence, and the surgeon may, therefore, desire to perform the operation, though not anticipating the accomplishment of a cure.

Operation of Lisfranc.—The woman being placed in the position of lithotomy, before a good light, the vagina should be dilated by a bivalve speculum, the diseased neck of the uterus seized by Museux's long hooked forceps, or by a pair of tumor forceps (Plate I., Fig. 19), with handles ten inches long, and steady traction made upon them, until the uterus is forcibly prolapsed and brought near to the orifice of the vagina, when its neck may be excised either by a probe-pointed bistoury, or by a pair of scissors curved on the flat, as was done by Dupuytren. The hemorrhage, which is often very profuse, should be checked by plugging the vagina.

Remarks.—Having repeatedly witnessed Lisfranc's operations, I am satisfied that this operation, when once performed, will prove so serious and troublesome, that its repetition will be attempted with great unwillingness by any surgeon. The most dangerous hemorrhage supervened in all the cases that I witnessed, and in several (about four) Lisfranc was compelled to defer the operation. Nor has his success been such as would induce any one who is familiar with the true results of operations for cancer, to rely upon the permanency of the relief which it can afford. Excision of the neck of the uterus has, however, been performed in the United States by Drs. Jameson, of Baltimore, in 1824; Strachn, of Virginia, in 1829; Warren, Sr., of Boston, in the same year; N. J. McL. Moore, of New Hampshire, in 1847; W. Atlee, of Philadelphia, in 1848; Eve, of Georgia, in 1850; Usher Parsons, of Rhode Island, in 1852; and Ogier, of Charleston, also in 1852;[1] but as the results of these operations have not been tabulated, it is difficult to estimate their success. In thirty-six cases, Lisfranc was much troubled by the hemorrhage;[2] two of his patients died of peritonitis, two under cancer of the spleen or liver, and eleven sunk under more or less speedy relapses. If then it is desired to get rid of a cervix uteri, I should prefer attempting it by the application of the actual cautery or caustic potash, cautiously made to the part through a speculum, or by excision, as practised above, but I should prefer the position recommended by Dr. Sims in vaginal fistula to that advised by Lisfranc.

[1] Bibliographical Index, p. 127.

[2] Malgaigne.

§ 4.—EXTIRPATION OF THE WOMB.

The complete extirpation of the womb has been successfully accomplished by Dr. Essellman, of Nashville, by means of the ligature applied on the inverted uterus, whilst the entire womb has been excised by Dr. Paul F. Eve, of Georgia.

COMPLETE EXTIRPATION OF THE UTERUS BY LIGATURE AFTER CHRONIC INVERSION OF THE ORGAN, BY JOHN M. ESSELLMAN, M.D., OF NASHVILLE.—A lady, thirty-two years of age, had labored under inversion of the uterus for several years, in consequence of the manipulation of an old woman. Various symptoms inducing the belief in the existence of a polypus, a ligature of saddlers' silk, well waxed, was applied around the tumor and tied tight, causing great pain and prostration for the first four or five hours, her pulse sinking to a mere thread. Reaction ensuing, she rested well the first night; and the ligature was tightened each morning for eighteen days, at which time the tumor came away, proving, to the surprise of all who saw it, to be the uterus instead of a polypus.[1] The patient did not leave her bed for months after the operation, "but was finally restored to perfect health."

OPERATION OF DR. PAUL F. EVE, OF GEORGIA.[2]—A negro woman, twenty-eight years of age, married, but never pregnant, had been laboring for a long period under a malignant tumor of the uterus, to cure which she consented to excision of part, or the whole of the womb.

OPERATION.—The bowels and bladder having been thoroughly evacuated, the patient was put fully under the influence of chloroform, the tumor drawn down to the os externum by forceps, and then the mass carefully excised from above downwards, or in an antero-posterior direction by the knife, it being suspected at the time that the uterus was involved. One artery bled quite vigorously, but it was tied, and the hemorrhage arrested by a solution of sulphate of zinc. There was no protrusion of the bowels, or any severe symptoms; a rigid diet and the horizontal position were maintained for ten days, and the opening into the peritoneum was closed by agglutination and adhesion.

[1] Am. Journ. Med. Sciences, vol. vii. N. S. p. 254, 1844.

[2] *Ibid.*, vol. xx. N. S. p. 399, 1850.

The uterus, with the Fallopian tubes and broad and round ligaments, could be distinctly seen in the mass, and the preparation is now in the hands of Dr. Charles D. Meigs, Professor of Obstetrics in Jefferson College, Philadelphia.

§ 5.—REMOVAL OF FIBROUS TUMORS FROM THE UTERUS.

Dr. Washington L. Atlee, of Philadelphia, has recently called professional attention[1] to his method of operating for the removal of fibrous tumors of the uterus through the os uteri, and has reported many cases in illustration of his mode of proceeding. This paper having been deemed by the Committee of the Association so valuable as to deserve the honor of a prize, its contents are doubtless well known to every American reader, and the expression of an individual opinion of the plan of treatment would therefore be inappropriate. Those familiar with fibrous tumors of the uterus are, however, well aware that, when left to nature, the patients continue to live for a long period.

SECTION III.

EXTIRPATION OF THE OVARY, OR OVARIOTOMY.

When the ovary has been the seat of such changes as have induced a degeneration of structure, and especially when it has resulted in the formation of a cyst or other tumor, it has been proposed, within the last century, to remove the entire mass by means of an incision through the abdominal parietes. Such an operation is not as difficult as it is dangerous from its subsequent effects, and the prognosis should, therefore, be well considered before the operation is attempted.

Ovariotomy may be accomplished by an incision into the abdominal parietes, of sufficient extent to permit the escape of the mass. As the diagnosis is not easy, and the size of the tumor varies considerably under different circumstances, two operations have been described, and have been designated as the great and lesser opera-

[1] Transact. Am. Med. Association, vol. vi. p. 547, 1853.

tion, the distinction being chiefly owing to the length of the external wound.

In the Minor, or exploratory operation, or that proposed by Mr. Wm. Hunter, the incision should be about two inches long, and the ovarium tapped, or the condition of the part, and especially the extent of the adhesions, learned by introducing the finger through the small wound. The Major operation lays open the abdomen from the umbilicus, or even beyond it, to within an inch and a half or two inches of the pubis, so as to make the cut from eighteen to twenty-four inches long. The minor operation is palliative, or intended to assist the diagnosis, whilst the major is for the removal of the mass.

§ 1.—THE MAJOR OPERATION.

OPERATION OF DR. MCDOWELL, OF KENTUCKY.[1]—In December, 1809, a patient, with an enlarged ovarium, was operated on as follows: Being placed on a table of the ordinary height, and all the dress removed that could impede the operation, an incision was made in the abdomen, parallel with the line of the rectus abdominis muscle, but about three inches from it on the left side, and extended from the margin of the ribs to the pubis.[2] On opening the abdomen, its parietes were found to be a good deal contused from the tumor having rested on the pommel of a saddle, on which the patient had travelled. The tumor, after being fully exposed, being found to be too large to be removed entire, a strong ligature was placed around the Fallopian tube near to the uterus, and the tumor cut open (Plate LXI., Fig. 1), when it was proved to consist of the ovarium and fimbriated extremity of the Fallopian tube. About fifteen pounds of a dirty, gelatinous-looking substance being evacuated, the Fallopian tube was divided, and the sac, which weighed seven pounds and a half, extracted.

As soon as the external incision was made, the intestines fell out on the table, and could not be replaced during the operation, which lasted twenty-five minutes. The patient was, therefore, placed on her left side, so as to permit the blood to escape, after which the

[1] Eclect. Repert. and Analyt. Review, vol. vii. p. 242, 1817.

[2] *Ibid.*, vol. ix. p. 547.

PLATE LXI.

OPERATIONS ON THE FEMALE GENITO-URINARY ORGANS.

Fig. 1. McDowell's Operation for Ovariotomy. An incision has been made through the linea alba, the abdomen opened, and a ligature passed around the pedicle of the tumor, near to its uterine extremity. The hands of the assistants are seen retaining the tumor in position, whilst the surgeon, grasping the section of the broad ligament of the uterus, is about to divide it with the scalpel, beyond the ligature, so as to avoid unnecessary hemorrhage. 1, 1. Hands of the assistants. 2, 2. Those of the operator.

After Bourgery and Jacob.

Fig. 2. Extirpation of the Uterus by means of the Ligature, in a case of procidentia uteri. The uterus and the vagina having been prolapsed beyond the vulva, and the viscera which had been invaginated in the utero-vaginal pouch having been reduced, an assistant kneels below the operator, and seizes the vagina and uterus between his thumbs and fingers, 1, 1, in order to prevent their escape, whilst the surgeon passes a needle, with a double ligature, vertically through the vagina, ties the right half, and is about to tie that on the left, the ends of which are seen pendent.

After Bourgery and Jacob.

Figs. 3, 4. Uterotomy, or incision of the neck of the uterus, either by a straight or curved bistoury, in order to enlarge the os uteri and facilitate the extraction of a polypus.

After Bourgery and Jacob.

Fig. 5. Section of the abdominal parietes, in order to show the operation of puncturing the os uteri, when it is requisite to evacuate the menstrual secretion. 1. Left hand of the surgeon, as placed upon the hypogastrium, in order to steady the uterus. 2. Right hand of the surgeon, holding the trocar, and directing its point upon the right forefinger, which is curved so as to carry it to the position of the os uteri.

After Bourgery and Jacob.

Plate 61.

Fig 1.

Fig 4.

Fig 2.

Fig 3.

Fig 5.

intestines were replaced, and the wound closed by the interrupted suture, the ligature around the Fallopian tube being left out of its lower angle. Between every two stitches there was placed a strip of adhesive plaster, which aided the union, and after applying the usual dressings, the patient was put to bed, kept on a strict regimen, and in twenty-five days returned to her home, which was sixty miles off. This patient was a Mrs. Crawford, of Kentucky, and subsequently of Indiana, where she died in 1841—thirty years after the operation—in the 79th year of her age, having enjoyed excellent health up to the period of her death. She had no children after the operation.[1] Of ten cases operated on by Dr. McDowell, eight were cured.

Operation of Dr. Washington L. Atlee, of Philadelphia.[2]

Preparatory Measures.—The diagnosis being carefully established, the bowels and bladder should be evacuated, the room warmed to the temperature of 80° Fahr., the finger-nails of the operator and his assistants trimmed close, and the following instruments placed upon a tray, to wit: two good and large scalpels for the abdominal incision; one probe-pointed bistoury; one director; one tenaculum; two dissecting-forceps; one pair of dressing-forceps; together with ligatures, sponges, towels, brandy, &c., a narrow table, being also well covered, and placed in a good light, with two chairs to receive the patient's feet.

Operation.—The patient, clothed in an ordinary nightgown, rolled up around the waist, being placed upon her back upon the table with her hips near the end, and covered by a sheet, applied like a diaper, her feet are to be supported by two chairs, her limbs covered with another sheet, and her head and shoulders moderately raised. The surgeon should then place himself upon the patient's right side, and, commencing an incision immediately below the umbilicus, carry it boldly through the skin and subcutaneous tissues to the sheath of the recti muscles, extending the incision in the median line to within one inch of the symphysis pubis. A small incision being then made through the linea alba, the peritoneum is to be cautiously cut and opened to the extent of the external wound by means of the probe-pointed bistoury.

The hand being now introduced into the abdominal cavity, the connections of the tumor should be examined, and an effort made

[1] Gross, History of Kentucky Surg., p. 8.

[2] Am. Journ. Med. Sciences, vol. viii. N. S. p. 51.

to tilt it out, when, if the abdominal opening is too small, the incision may be continued below to the pubis, and above to three inches beyond the umbilicus, passing around the latter on its left side. The tumor being then turned out on the side opposite to its pedicle, the latter was found, in the case operated on by Dr. Atlee, to consist of a broad ligamentous sheath five or six inches broad, extending from the left hypochondrium into the pelvis; had the sigmoid flexure of the colon incorporated in it; was highly vascular, one vein as large as a goose-quill, extending along its attachments, and sending out ramifications which were much gorged with blood. This pedicle consisted of a double fold of peritoneum, arose from the broad ligament of the uterus, had a triangular form, and its lower edge, which ran from the uterus to the left side of the pelvis, was several inches long, whilst the upper, which ran from the tumor to the uplifted sigmoid flexure, was one inch long. The Fallopian tube, which was also very much elongated, and somewhat attenuated, was stretched up to the top of the tumor.

A surgeon's needle, armed with a single strand of saddler's silk, being waxed, was now passed so as to include an inch of the lower border of the pedicle, and firmly tied, after which this part of the pedicle was divided near the tumor, exposing some of the large veins upon its surface, which broke as soon as they were deprived of their peritoneal coat, and gave rise to most of the hemorrhage that was seen. A second ligature of double stranded silk was then introduced about an inch above the first, made to embrace several veins, and being then firmly tied, the remainder of the pedicle was tied with another ligature, and then severed, when the whole tumor was removed. The blood which flowed into the pelvis did not exceed six ounces, and was carefully removed by soft and warm sponges. The ends of the pedicle being then examined, and no oozing noticed, the four ligatures were brought out at the lower end of the wound, and the latter closed by nine harelip sutures and intervening adhesive strips, covered by patent lint and a soft compress, and the whole secured by a broad towel, which extended from the thorax to the trochanters. The operation occupied about an hour; peritonitis supervened, and death ensued on the fifth day.

Statistics of the Operation.—The formation of tables showing the results of the operation of Ovariotomy has, fortunately for the profession, been so well attended to, that the question of its success up to the present period is readily settled. Through the industry

of Dr. Washington L. Atlee, of Philadelphia, as well as of Dr. Thomas Safford Lee, who has pursued a similar course of inquiry in Great Britain, the profession have been for some time familiar with the result of most of the cases operated on, and an accurate idea may now be formed of the mortality which has ensued upon the operation.

From the tables of Dr. Atlee,[1] it appears that—

"Of the 222 cases thus collected, 52 were of the minor section, 153 of the major, and 17 unknown.

"Of the 52 minor operations, 39 recovered and 13 died, or 1 in every 4, or 25 cases in 100.

"Of the 153 major operations, 95 recovered and 58 died, or 1 in every $2\frac{37}{58}$, or 29.41 cases in 100.

"Of the whole 222 cases, 146 recovered and 76 died, or 1 in every $2\frac{35}{38}$, or 33.78 in 100.

"Of 222 cases, the operation was not completed in 57, or 1 in every $3\frac{7}{19}$, and there was no tumor in 6."

After carefully analyzing his cases, Dr. Atlee gives, as the mortality of the operation, "1 in every $3\frac{21}{38}$, or 29.74 cases in 100."

Remarks.—The operation of ovariotomy is one which, at the present time, has excited much discussion, and must yet be regarded as *sub judice*, the statistics not having as yet satisfied many in the profession of the propriety of its performance. The frequency with which the operation has lately been repeated, and the valuable tables above referred to, have, however, induced many to admit that, though great difficulties are to be anticipated in the diagnosis as well as in the after-treatment, sufficient success has been obtained to justify a calm consideration of the question. From the usual spirit of conservatism exhibited by the profession (a conservatism which is highly laudable as well as advantageous to the public interest), much criticism has been exercised in relation to the accounts of the operations already furnished, and those who continue to operate, and to advocate the means of treatment, being in the position of those who propose and practice an innovation upon old-established rules, must anticipate opposition, strict investigation, and possibly unjust condemnation, as well as to be subject to such charges as are dictated by prejudice, and constantly renewed through

[1] A Table of all the Known Operations of Ovariotomy from 1701 to 1851, comprising 222 Cases, including their Synoptical History and Analysis, by Washington L. Atlee, M. D., Philadelphia, and published in the *Transactions Am. Med. Association*, vol. iv. p. 286, as well as in pamphlet form.

envy. Such a result is no novelty, but has been seen heretofore in numerous instances, of which it may suffice to mention the cases of the discoverer of vaccination, of the attempt to introduce etherization, as well as other novel points of practice with which all are familiar. Instead, therefore, of anticipating any general approbation, the few surgeons who dare to advocate the propriety of this operation must be content to stand forward and bear the criticisms of its opponents, consoling themselves with the principle, that "the honest physician knows no other interest than the life and health of his patient."[1] The candid inquirer after truth may readily, it seems to me, obtain a clear view of this question, by laying aside all preconceived opinions, and examining it under the following or similar heads:—

1. Are such tumors proper subjects for an operation?
2. Is their removal attended by any extraordinary difficulty or danger during or after the operation?

I. ARE OVARIAN TUMORS PROPER SUBJECTS FOR AN OPERATION?

In investigating the merits of ovariotomy, this question stands prominently forward, and must mainly regulate an opinion of the value of the operation.

To show the views of a few experienced surgeons, I cite the following opinions:—

VELPEAU[2] says "the diseases which require ovariotomy are, if left to the resources of nature, almost always fatal; but, though incurable, they do not generally cause death until after a long-protracted period, which lasts, as a medium, five or six years." Under certain conditions, such as the medium size and mobility of the tumor, he deems them proper subjects for the operation.

CHURCHILL[3] thinks "there are cases in which this operation would be justifiable on the grounds that the disease is incurable by medical means; that the patient will ultimately die from constitutional disturbance, after suffering more or less inconvenience, and that tapping in ovarian dropsy is attended with great danger."

COLOMBAT,[4] who seems to be least decided in his views, says:

[1] Hufeland.
[2] Velpeau, Operat. Surgery, by Mott and Townsend, vol. iii. pp. 538, 539.
[3] Notes on Ovariotomy, quoted from Meigs's Colombat, p. 418.
[4] Diseases of Females, Meigs's translation, p. 432.

"Without wishing to proscribe the operation, it ought not to be resorted to except as an extreme resource."

CHELIUS[1] thinks, "unless the disease causes great annoyance, no operation is allowable, but puncture only affords a short relief, as the fluid recollects so much the quicker the oftener it is evacuated."

BLUNDELL[2] says: "We may be justified in operating, provided it be the wish of the patient." But he also says:[3] "All the operations upon the ovaries are worthy of consideration; for, if one can be made to cure an unhappy individual, who would otherwise fall a victim to disease, it will be an invaluable good to the fairest and least offending part of our species."

From an examination of these opinions—and they are certainly those of great professional worth, and might be readily augmented, did my space permit—we are, I think, justified in concluding that the majority of ovarian tumors cannot be controlled by medicine; that their natural course is to terminate fatally in about five years; that tapping them is attended with considerable danger; and that, when they create great distress to the patient, and the latter is fully informed of the possibility of failure or the chance of death, such tumors are proper subjects for an operation.

II. IS THE REMOVAL OF THE OVARIAN TUMOR ATTENDED BY ANY EXTRAORDINARY DIFFICULTY OR DANGER DURING OR AFTER THE OPERATION?

In attempting to decide this portion of the question, little more than a general opinion can be given, as individual cases will often be found in this disease, as in others, in which peculiar difficulties must be overcome. As a general rule, the dangers attending the removal of ovarian tumors are mainly due to an error of diagnosis; and yet, though many such instances are on record, they are few, compared with the great number of cases in which the diagnosis was correct and the operation successful.

Thus, "out of 81 cases collected by Mr. B. Phillips in 1844, in which ovariotomy was attempted, no tumor was found in 5, and in 6 others it was not ovarian;" and "in 15 of the 81 cases it was im-

[1] Chelius's Surgery, by South, vol. iii. p. 212.

[2] Diseases of Women, p. 118, quoted from Churchill, Philad. edit. p. 304.

[3] Churchill, p. 305.

possible to remove the tumor after the abdomen was opened, owing to the adhesions."[1]

In the elaborate tables of Dr. Atlee,[2] it is also shown that there was no tumor present in 6 cases out of 222 operated on. In 83 cases there were adhesions, but of these 49 recovered. In 57 cases the operation was left unfinished; in 27 of which other important diseases coexisted, 13 of which were diseases of the uterus, and in 5 of the cases, complicated with other diseases, the operation was left unfinished.

But, on the other hand, it appears that, out of 211 cases, 146 have been successfully operated on, a statement which strongly tells for the other side of the question, and positively establishes the fact that the difficulties that may be met with can in very many instances be overcome.

The following table shows most of the American surgeons who have performed the operation, and the results in their hands as far as I have been able to collect them.

As the success attending ovariotomy seems to be constantly leading to its repetition, the number of patients who suffer from such tumors is rapidly developed in their desire to obtain relief. As an operation, the suggestion of ovariotomy for the removal of so large a mass as an ovarian tumor, is certainly indicative of great boldness as well as the possession of perfect coolness in the first surgeon who attempted it; and it is one which the United States, and especially Kentucky, may justly claim for itself. In referring to the history of this operation, it has long been the practice to ascribe its origin to a French surgeon of Rouen, named L'Aumonier, who, in 1776, is reported by most writers to have attempted ovariotomy. The investigations of Prof. Samuel D. Gross, of Louisville, Kentucky, in connection with the formation of a history of Kentucky surgery, have, however, led to a different conclusion, and enabled him to show[3] that L'Aumonier's case was simply the puncture of an ovarian abscess, and that Dr. Ephraim McDowell was the first who attempted and performed the entire extirpation of a diseased ovary by means of an incision through the abdominal parietes. The claims of Prof. Dzondi and Galenzowski, Dr. Gross

[1] Druitt's Operat. Surgery, Philad. edit. p. 422, 1848.

[2] Table of all the Known Operations of Ovariotomy from 1701 to 1851, Philadelphia, 1851.

[3] History of Kentucky Surg., p. 32, 1852.

shows to be equally unfounded. Dzondi's operation was the removal of a pelvic cyst, from a boy, after inducing mortification by long tents, and Galenzowski's operation was not performed until 18 years after that of Dr. McDowell. Malgaigne[1] also credits Dr. McDowell as the first to perform it.

§ 2.—STATEMENT OF THE CASES OPERATED ON BY AMERICAN SURGEONS,[2] WITH THE RESULTS.

SURGEON.	CASES.	CURES.	DEATHS.
E. McDowell, Kentucky	7	5	3
Nathan Smith, Yale College	3	3	0
Alban G. Smith, Kentucky	3	3	0
Jos. Gallup, Vermont	1	0	1
D. L. Rogers, New York	1	1	0
Jno. C. Warren, Boston	1	1	1
R. D. Mussey, Cincinnati	4	3	1
Jno. L. Atlee, Penna.	2	1	1
W. L. Atlee, Phila.	16	10	6[3]
Webster, Boston	8	1	0
Bellinger, Charleston	2	2	0
Bayless, Kentucky	1	1	0
S. G. Parkman, Boston	1	0	1
H. Miller, Louisville	1	1	0
J. Deane, Mass.	2	1	1
J. P. Buckner, Ohio	4	3	1
D. Meeker, Indiana	1	0	1
Wm. H. Van Buren, N. York	2	1	1
J. H. Bigelow, Boston	1	1	0
Alden March, Albany	1	1	0
David Prince, St. Louis	1	1	0
A. H. Grimshaw, Delaware	1	0	1
E. R. Peaslee, Maine (double)	1	1	0
A. Dunlap, Ohio	1	1	0
Ezra P. Bennett, Conn.	1	1	0
D. D. Franklin, Ohio	1	0	1
S. D. Gross, Ky.	1	0	1
D. M'Ruer, Maine	1	1	0
G. W. Bayless, Mo.	1	0	1
R. L. Howard, Ohio	2	1	1
	73	45	23

[1] Op. Surg., Phila. edit., translated by Britton, p. 392.

[2] These accounts have been condensed from the Bibliographical Index, p. 129, as collected by myself from various sources, as well as from the tables of Dr. Atlee, before referred to.

[3] Reported to 1851.

In No. 17 of the *British and Foreign Medico-Chirurgical Review*, January, 1852, the question of the merits and demerits of ovariotomy have been ably discussed. In this paper, the writer contends that it is necessary to correct the prevalent notion that a person may live for years with an ovarian tumor, as more than half the cases quoted by Mr. Safford Lee (63 out of 123) died in two years, and 90 out of 123 within four years. He therefore thinks it more correct to say that ovarian diseases, like other organic affections, tend to run their course in a space of three years; that these years are emphatically years requiring patience, resignation, and sweet temper to render them even tolerable to the sufferer.[1] Tapping, he contends, is also more fatal than is generally thought.

That the dangers arising from the operation are great, will be admitted, and so they are in ligating the large arteries, and in many other operations; but that these dangers may be overcome, is evident from the success which has attended its performance. According to the tables of Dr. Atlee, the rate of mortality for the operation is twenty-six and a half per cent., or a rate which places this operation on as good or even a better footing, than some of the other capital operations, and, in my opinion, justifies its repetition by a skilful surgeon in the case of a tumor of medium size, which is comparatively movable, uncomplicated with other disease, and in a patient whose sufferings render her anxious for the operation. Since the discovery of etherization, several objections to the operation have been removed; thus, it has ceased to be painful, the intestines remain quiescent, and do not protrude at the wound, whilst the latter can be accurately closed, and the risks of peritonitis thereby diminished. Experience has also reduced the accidents likely to arise during the operation in the after-treatment. The points most essential to success appear to be the extreme care exercised in the diagnosis, the selection of proper cases, the preservation of a high temperature in the chamber whilst the patient is uncovered, perfect quiescence through etherization, and a neat and close application of the dressing. Such adjuvants materially change the character of any operation, and, when combined with a skilful after-treatment, must do much to diminish even the mortality which has hitherto followed ovariotomy. A few years must, however, enable any one to add materially to the statistics now collected,

[1] *Opus citat.*, p. 231.

and will, I think, place upon a firm basis the merits of an operation which I admit is now viewed with distrust by many. But until this period arrives, it is to be hoped that prejudice will not be allowed to check the formation of a candid opinion of a means of treatment, which, if established beyond all cavil, is capable of adding materially to the comfort of a large and interesting class of the community.

SECTION IV.

ON THE CÆSARIAN OPERATION.

The term "Cæsarian operation" has, from a very early period, been assigned to that in which the parietes of the womb were incised through the walls of the abdomen, in order to permit the removal of the child in this manner when the pelvis was too small or deformed to allow of its delivery *per vias naturales*. Few of the operations proposed for the benefit of mankind present the surgeon with as many scruples in regard to the course to be pursued as this; and he may well hesitate before deciding upon an operation which, though it may offer a prospect of saving the life of the infant, exposes the mother to almost certain death. As the preservation of the life of the child is also by no means certain, the surgeon, when thus called upon, should endeavor to weigh correctly the value of each life to society, and if satisfied of the greater value of that of the mother, remove the child piecemeal through the vagina. In Paris, as stated by Velpeau,[1] every woman died on whom it was performed during forty years, and in Great Britain, there had been no well-attested cure, as reported by Mr. S. Cooper. Out of 424 others reported by other surgeons, as occurring elsewhere, 210 died, making the chances of success about one out of two, supposing all the accounts to be accurate, but yet presenting a fearful odds when it is remembered that the delivery may be accomplished without risking the life of the mother more than in an ordinary instrumental accouchement. In the United States, the operation has been performed in a few instances with nearly similar want of success, though it was attended by a most fortunate termination in

[1] Op. Surg., *loc. cit.*

PLATE LXII.

OPERATIONS UPON THE UTERUS THROUGH THE ABDOMEN.

Fig. 1. Langenbeck's Operation for Extirpation of the Uterus. An incision having been made through the linea alba, the hands, 1, 1, of two assistants elongate the angles of the wound, and retain the intestines in the abdomen whilst the surgeon, after applying a ligature to the broad ligaments of each side, seizes the womb with 2, his left hand, and is about to extirpate it above the vagina with the knife, 3, in his right hand.

After Bourgery and Jacob.

Fig. 2. A view of the Median Cæsarian Operation. The incision having been carried from just below the umbilicus to a little above the pubis, the abdominal parietes and the peritoneum have been divided in the line of the linea alba—the uterus opened; and whilst 1, the left hand of the surgeon, separates the right lip of the abdominal wound, the right hand, 2, has seized the head of the fœtus, which presented in this instance, and is about to deliver the child.

After Bourgery and Jacob.

Fig 1

Fig 2.

the patient operated on by Dr. Wm. Gibson, of Philadelphia,[1] and on whom it was performed twice, thus proving successful in two different pregnancies. Dr. H. M. Jeter, of Georgia, in 1852 also operated successfully on a patient thirty years old, who had been confined to bed two months previously, and labored under general anasarca.[2]

PREPARATORY MEASURES.—The operation having been decided on, there should be prepared one or two good large scalpels, one sharp and one probe-pointed bistoury, dissecting-forceps, dressing-forceps, director, scissors, harelip pins, ligatures, a syringe, catheter, brandy, ammonia, sponges, adhesive strips, spread cerate, compresses, and bandages. The abdomen should also be entirely free from hair, and the rectum and bladder thoroughly evacuated. The arrangement of the bed or table, as directed in lithotripsy, will usually be useful in this operation.

OPERATION.—The patient being etherized, so as to tranquillize the bowels, two assistants should compress the abdomen with their hands, so as to steady the uterus and prevent its variation from the abdominal parietes. The surgeon then, with a large scalpel, should incise the integuments in the line of the linea alba from just below the umbilicus to within about one inch of the pubis, not passing too near the latter, in consequence of the position of the bladder, and passing on the left of the umbilicus, if he extends the incision upwards, in order to avoid the anastomosis between the epigastric and umbilical veins. The abdominal parietes being thus divided, the peritoneum should be punctured, the left forefinger introduced as a director, and the membrane slit up with the probe-pointed bistoury to the extent of the outer incision. The uterus, being now fully exposed, should be cautiously incised, layer by layer, until the membranes around the fœtus are exposed, when an assistant should rupture them, if possible, per vaginam; but if not, the sides of the abdomen should be closely pressed against the womb, and the liquor amnii discharged through the wound. Two assistants should now hook up the uterus with their fingers at the angles of the wound, in order to prevent its variation from the external incision, and the surgeon then extract the child according to its

[1] Am. Journ. Med. Sciences, vol. xvi. 1835, and vol. xxii. 1838.

[2] Transact. Med. Society of Georgia. Report on Surgery. See Southern Journ., vol. viii. p. 744.

position (Plate LXII., Fig. 2); the membranes and placenta being subsequently removed per vaginam, or through the wound, according to circumstances.

The parts being now thoroughly cleansed, and any clots that may have collected washed out through the vagina, by means of the syringe and catheter, the bleeding vessels may be ligated, if the uterine contraction is not sufficient to arrest the flow of blood. A strip of linen should then be placed in the pubic angle of the abdominal wound, and the sides of the latter united by the harelip suture and strips, the uterine contractions diminishing and closing the opening in that organ. Spread cerate, a compress, and a body-bandage complete the dressing, when opiates may be administered, and an appropriate after-treatment directed, in order to combat peritoneal inflammation.

CHAPTER VII.

OPERATIONS PRACTISED ON THE RECTUM.

THE operations performed on this portion of the body are such as are demanded for the relief of congenital defects, for the cure of a disordered condition of the rectal veins, and those owing to the development of abscesses in the neighborhood of the gut.

SECTION I.

SURGICAL ANATOMY OF THE RECTUM.

Arising at the inferior and left side of the fifth lumbar vertebra, the rectum descends obliquely downwards to the centre of the sacrum, and following thence the middle line of the bones, it terminates near the point of the coccyx, in the anus. Although nearly cylindrical in its entire length, the rectum yet presents a considerable dilatation or pouch near its lower end.

The rectum has the same number of coats as the other intestines, but its inferior third is not covered by the peritoneum. In man, it

corresponds with the position of the bas-fond of the bladder, vesiculæ seminales, prostate gland, and membranous portion of the urethra, to all of which it is very loosely attached by its anterior face; but in the female, it adheres directly and closely to the posterior face of the vagina.[1]

The peritoneum stops about two inches from the end of the rectum in woman, but it is from two to three inches above the anus in man.[2]

The muscular coat of the rectum, like that of the other intestines, is composed of circular and longitudinal fibres; but when the latter reach the lower margin of the anus, they do not terminate, but turn under it between the internal and external sphincters, and then ascend in contact with the mucous coat, or the submucous cellular tissue, into which they are finally inserted. This connection exerts considerable influence on the mucous coat in hemorrhoids, as well as in prolapsus ani.

The mucous coat at the lower end of the rectum is thrown into longitudinal folds (columns), at the lower end of which are numerous small pouches of from two to four lines in depth, which point upwards, and are occasionally the seat of a disease (encysted rectum) which is characterized by intense itching.[3]

The arteries of the rectum are known as the hemorrhoidal, and are sufficiently large and numerous, about an inch and a half from the anus, to cause troublesome hemorrhage. When diseased, the hemorrhage from them is also apt to be profuse, even when they are divided near the anus.

The hemorrhoidal veins are very numerous, and form, at the lower part of the gut, between the mucous and muscular coat, the hemorrhoidal plexus, which anastomoses freely with the adjacent veins, all of which are without valves. The thinness of the mucous coat over these veins gives to internal hemorrhoids the very smooth, shining, and bluish or purple tint which is characteristic of this complaint.

On the exterior face of the rectum, the hemorrhoidal plexus is applied to the internal sphincter muscle, and branches of it pass through the muscle in so many directions, that its fibres are some-

[1] Dict. de Méd., tome 27me, p. 271.
[2] Malgaigne.
[3] Horner's Anat., vol. ii. p. 47, 9th edit. 1851.

times, and especially in bad cases of hemorrhoids, so intermixed with enlarged veins as to appear like an erectile tissue.[1]

The orifice of the rectum (Anus) is closed by a sphincter muscle, which is under the control of the will; the contraction of which has an effect in producing the folds or wrinkles found in the skin about the anus, whilst its relaxation permits, in certain diseased conditions, the eversion of the mucous coat, together with the bloodvessels and nerves. Even in the ordinary evacuation of the bowel, the loose adhesion of the mucous to the adjacent tissues permits the formation of a circular pad which is formed of the inverted portion of the gut, and favors the escape of the fecal contents by forcing the matter to free itself from the surface of the bowel, whilst the skin of the part is thus protected from contact with the discharges, when of the ordinary solidity. Certain diseased conditions change this action, as will be again referred to under the operations for fissure and prolapsus ani.

SECTION II.

OPERATIONS ON THE RECTUM.

The affections of the rectum requiring operative treatment are so numerous, and its structure so important, as to have engaged a large portion of the time of those surgeons who have devoted themselves specially to their study, and were they at present to receive the detailed consideration that might therefore be expected by some, would occupy the remainder of my space. A condensed description must therefore suffice.

The aid of the surgeon may be required in this region for the removal of foreign bodies; for encysted rectum; fissure of the anus; imperforate anus; prolapsus ani; fistula in ano; hemorrhoids; stricture of the rectum; and extirpation of the lower portion of the bowel for cancer.

§ 1.—REMOVAL OF FOREIGN BODIES.

The removal of foreign substances from the bowels may be accomplished by the finger, handle of a teaspoon, scoop, forceps, or other

[1] Dict. de Méd., tome 27me, p. 274.

similar instrument, according to the circumstances of the case. In the removal of articles which have sharp points or cutting edges, it will be found advantageous to dilate the anus by means of a speculum ani, so as to protect the mucous coat, unless the size of the object should forbid it. In a case reported by Dr. Ruschenberger, of the U. S. Navy,[1] where a glass goblet, three and a half inches high, with a brim two and five-eighths inches, and a base one and seven-eighths inches, was introduced into the rectum of a Chinaman, the whole was removed by Dr. Parker, of Canton, by crushing it with strong forceps, protecting the parts with folds of cloth, and removing the smaller fragments with a teaspoon; and a similar treatment would be requisite for the removal of all fragile articles.

§ 2.—ENCYSTED RECTUM.

In 1792, Dr. Physick, of Philadelphia, called the attention of the profession to a condition of the rectum in patients who had been previously thought to labor under neuralgia of the anus, or a series of symptoms which some regarded as an imaginary complaint, and which had then been generally overlooked by surgical writers.[2] This condition is characterized by the following symptoms: "Sometimes the patient experiences little or no uneasiness between the stools; at others, he has a sensation of discomfort, as if a worm or insect were in the canal; or it produces an intense itching which is often sufficient to prevent sleep; and there is occasional pain after a stool, though this is uncomplicated with spasm of the sphincters. The touch shows no tumor or other disease of the gut; no pus is present, except when the disease is complicated; but an examination made by passing a hooked probe a short distance within the anus, and withdrawing it, will demonstrate the existence of a little pouch or pocket, which is so exquisitely sensitive to the point of the probe as to cause acute suffering."

These pouches were subsequently minutely examined by the late Dr. Horner, of the University of Pennsylvania, and their anatomical relations strictly defined,[3] so that now they are usually regarded as

[1] Am. Encyclop. of Med. and Surg., article Anus, by Reynell Coates, M. D.

[2] Am. Journ. of Med. Sci., vol. xvii. N. S. p. 410, 1849.

[3] Special Anat. and Histol., vol. ii. p. 147, 9th ed.

a normal portion of the gut, which only demands interference when it becomes the subject of diseased action. To relieve the symptoms above detailed, Dr. Physick proposed the excision of the affected pouch.

Operation of Dr. Physick, of Philadelphia.—Bend the point of a probe backwards on itself for about half an inch, so as to form a hook, pass it into the anus, and by a movement backwards and forwards, and with the point close to the side of the gut, draw down the membranous portion or wall of the sac, and snip it off with the scissors, so as to lay the pouch completely open. As these pouches are liable to be reproduced, a repetition of the operation may be called for. Injections of cold water, and attention to the fecal evacuation will subsequently facilitate the cure.

§ 3. FISSURE OF THE ANUS.

Fissure of the anus is the term employed to designate a long, narrow, linear ulceration of the verge of the anus, which sometimes extends from the sphincter ani to the folds of the skin on the margin of the anus, and is invariably attended by spasm of the sphincters, a characteristic sign which has been much insisted on since the time of Boyer. This disease being usually well described in works on surgery, it is only necessary at present to designate the treatment. When something more than a palliative treatment by anodynes, and similar means of producing relaxation of the sphincters, is demanded, a cure may be accomplished by frequently cauterizing the surface, until the ulcer is healed, or by paralyzing the external sphincter by a transverse division of its fibres. This may be accomplished either by dividing the muscle from the inside of the gut outwards, or by a subcutaneous incision, or by lacerating the ulcerated edges by dilating the anus, either by introducing the fingers or tents, or an anal speculum, as advised by Maisonneuve.

Operation of Dilatation.—The operation of dilatation is performed by introducing the index fingers of both hands into the anus, and then forcibly dilating the contracted muscle first anteroposteriorly, and then transversely. The relief afforded by this simple means is sometimes almost instantaneous, and the operation is well worthy of trial before resorting to a division of the fibres of the muscle. But if it fail to cure, then the application of the knife may be practised as follows:—

OPERATION OF BOYER.—Place the patient on the side, introduce the left forefinger, well greased, into the gut, and pass a very narrow probe-pointed bistoury flatwise along the finger as a director. The cutting edge of the bistoury being then directed to the right or left side, according to the direction of the fissure, cut through the mucous membrane, sphincters, cellular tissue, and integuments at a single cut.[1] In the subcutaneous incision, the point of a very narrow, sharp-pointed bistoury is to be passed beneath the mucous coat near the fissure, and the fibres of the muscle divided by cutting outwards. Then, turning the bistoury flatwise, withdraw it at the point of entrance.

Mr. Copeland, of England,[2] asserts that the incision of the mucous and cellular coat is sufficient, without dividing the fibres of the muscle.

§ 4.—IMPERFORATE ANUS.

The term imperforate anus designates those malformations in which the natural outlet of the rectum is closed either by a membrane, by a contraction of the anus, or by a congenital deficiency of the rectum, the gut terminating in a *cul-de-sac* at a distance which varies from a half inch to three inches. Its relief is to be accomplished by dividing the obstruction, as in the following plan:—

OPERATION.—Puncture the membrane or the integument at the proper point, for the anus, either with a trocar, abscess lancet, or bistoury, and dilate the opening by means of a tent. Should contraction of the orifice supervene, as is frequently the case, make a crucial incision in the part, or dissect out a portion of the integuments.

Although the operation for imperforate anus is one which does not present any very great difficulties in its performance, it is as well that the surgeon should be reminded that there is no immediate haste necessary in performing it, and that its execution will be easier in proportion as the delay gives time for the accumulation of feces in the rectum so as to cause a protrusion of the end of the bowel and the formation of a tumor. In one case, reported in the *Provincial Medical and Surgical Journal* (March, 1851), a child with

[1] Am. Encyclop. of Med. and Surg., *loc. citat.*

[2] Lond. Med. Gazette, vol. xvi.

PLATE LXIII.

OPERATIONS PRACTISED ON THE RECTUM.

Fig. 1. Removal of hemorrhoids by means of the ligature. On the right side is seen the double canula and wire ligature of Physick, and on the left the application of the double silk ligature. 1, 2. Two ends of the ligature passed through the piles, and intended to strangulate one-half of the tumor. 3, 4. The other ends of the ligature about to surround the opposite half. 5. The wire ligature as applied by Dr. Physick.

After Nature.

Fig. 2. Horner's Operation, for the removal of hemorrhoids. The patient being placed on the side to be operated on, the hand of one assistant draws up the buttock of the opposite side. A ligature being then passed through the largest pile and tied in a loop, the thread is held by another assistant, or by the surgeon. A short tenaculum transfixing the base of the pile now draws the tumor off from the buttock, whilst the surgeon makes an incision around the external side of its base, so as to free it from its connection with the skin. The loop of a wire ligature being then thrown around the pile, so that one side of the loop lies in the incision, whilst the other is applied on the mucous surface of the tumor, the latter is perfectly strangulated without the integuments being involved in the ligature. 1, 2. Hands of assistant. 3. Ligature passed through the tumor to prevent its retraction within the rectum. 4. Tenaculum raising it from the side of the anus. 5. Double canula and wire ligature.

After Nature.

Fig. 3. Operation for Imperforate Anus, and extirpation of a small flap. 1. Forceps. 2. Scissors. After Bernard and Huette.

Fig. 4. Dupuytren's Operation for Prolapsus Ani. 1. Forceps. 2. Scissors excising a fold of the skin at the verge of the anus.

After Bernard and Huette.

Fig. 5. Ricord's Operation for Prolapsus Ani. 1, 2. Ligatures passed through the mucous coat so as to elevate the portion to be excised. 3. Curved scissors. After Bernard and Huette.

Fig 1.

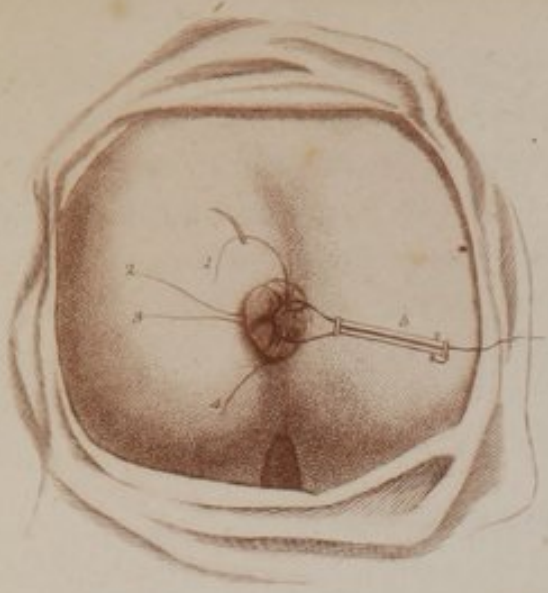


Fig 2.

Fig 3.

Fig 4.

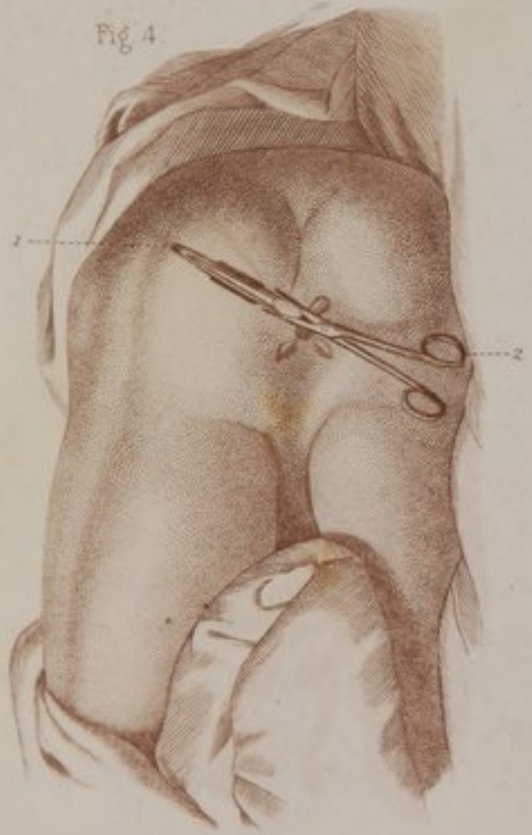
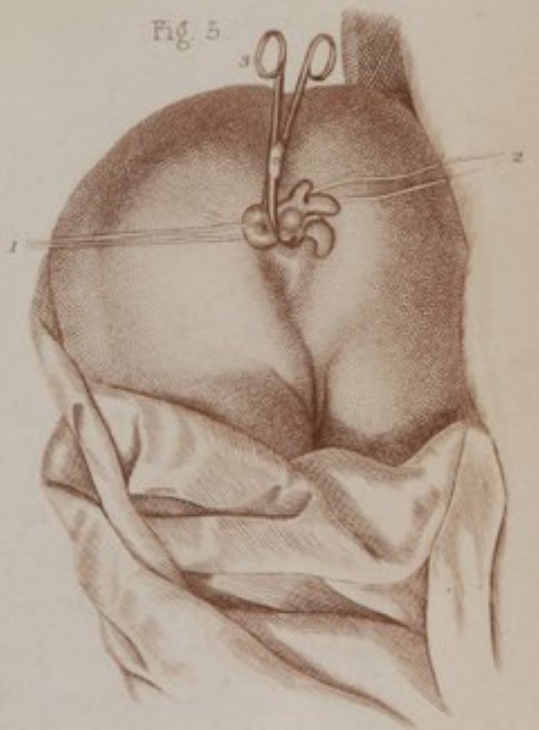


Fig 5.



imperforate anus lived for 102 days without any evacuation, and during this time never vomited; and though such an instance is a rare one, it yet suffices as an example of the tolerance of infants under these circumstances.

In four cases which have come under my observation, I have operated at periods which varied from forty-eight hours to five days, and lost only one patient. Three of them were males, and one a female.

§ 5.—PROLAPSUS ANI.

By prolapsus ani is usually understood such an eversion of the rectum as is not replaced by the natural action of the levator ani muscle. Whether this eversion is limited to the mucous coat, or formed of the other portions of the bowel, it has been usual to designate the complaint under the same name, though the inversion of any other than the mucous coat should be regarded as an intussusception, and treated accordingly. The complaint is seen both in children and in old age, the prolapsus of children being much more amenable to treatment than that of adults, and seldom or ever requiring an operation. In the chronic cases of adults, an operation is sometimes the only means of removing the complaint.

PATHOLOGY.—In the natural condition of the bowel, the efforts at defecation create a disposition to partial eversion of the mucous coat in order to facilitate the escape of the fecal matter, as is daily seen in the defecation of the horse. In man, however, such a protrusion is rarely noticed, except when infiltration of the submucous cellular tissue, and a relaxed condition of the sphincter ani favors its production. But when once the mucous coat is fully everted, spasmodic contraction of the sphincter ani and the interruption of the circulation may so favor the congestion and infiltration of the part as to induce pain and the other symptoms of inflammation. For the relief of these evils, when simpler means have failed, various operations have been suggested, all having for their object either the diminution of the protruded coat itself, of the folds of the skin about the anus, or of the sphincter ani muscle, these operations being always, however, preceded by an appropriate local and general treatment. One of the simplest and most effectual means of affording relief in prolapsus ani, is the immediate restoration of the gut by the following plan:—

I. TO RESTORE THE PROLAPSED PORTION.

The restoration of a prolapse of the rectum may be accomplished as follows:—

When the patient is a child, little more is necessary than to oil the forefinger and push in the protruded portion; but in the adult, and especially if the protrusion is large, and the complaint of longer standing, a more systematic effort will be required, and should be thus made:—

Place the patient on the side, with the knees drawn up and the shoulders flexed, so as to relax the abdominal muscles; or, if the parts are sensitive, etherize him thoroughly, so as to prevent any resistance, and wash the tumor. Then, with the first and second fingers, well oiled, press the centre of the prolapsed bowel within the sphincter ani muscle, retain it there with one finger whilst another portion of the bowel is similarly inverted, and continue this manipulation until the entire tumor is replaced, when a compress applied with a T bandage will often suffice to retain it. If the submucous cellular tissue and sphincter muscle have been much relaxed, the introduction of an ivory or wax stem, or about two inches of a rectum bougie, will prove useful by supporting the upper folds of the gut until the proper tone of the part is acquired. But if these means fail, a diminution of the bulk of the part, or of the anal orifice, may be demanded, so as to create a cicatrix that will induce sufficient contraction of the cellular tissue to reduce the size of the opening.

II. OPERATION OF DUPUYTREN.

With the patient in the position just recommended for the restoration of the bowel, pick up with a pair of Liston's forceps one of the radiated folds of the skin on the verge of the anus, and cut it off by means of scissors curved on the sides, prolonging the cut about one-fourth of an inch into the mucous coat of the gut.

After this one, two or more similar folds may be excised, and the wounds left to cicatrize.

Velpeau,[1] instead of this, prefers union by the second intention,

[1] Mott's Operat. Surgery, vol. iii. p. 1106.

and introduces a little lint into each wound, in order to insure suppuration and favor the subsequent contraction of the cicatrix. The cure, in either plan, being dependent on the contraction of the parts thus induced, the surgeon should be cautious in regard to the amount excised, lest he produce such a diminution of the anus as will interfere with the subsequent efforts at defecation.

III. EXCISION OF A PORTION OF THE SPHINCTER ANI.

OPERATION OF ROBERT.—Remove, either by scissors or the scalpel, a transverse portion of the sphincter ani muscle, and unite the wound by a twisted suture.

IV. CAUTERIZATION.

OPERATION OF CHESELDEN.—Apply caustic potash lengthwise upon one or more points of the mucous coat, favor the suppuration, and await the cicatrization. The French surgeons sometimes prefer the actual cautery or strong nitric acid similarly applied.

V. EXCISION OR AMPUTATION OF THE TUMOR.

In very bad irreducible cases, the adhesions of the adjacent portions of the tumor prevent its reduction; suppuration and sometimes hemorrhage ensue, and the aged patient is exhausted by the discharge and suffering. Under these circumstances, the removal of the tumor by excision or ligature has been practised, and may possibly, though rarely, be again demanded.

OPERATION OF RICORD.—Pass a needle and ligature through the mucous coat alone, near the base of the tumor, so as to retain it in position, and excise it by a circular cut either with the scissors or bistoury, arresting the hemorrhage by ligating each vessel as cut. Then removing the retaining ligature, guard against secondary hemorrhage, and obviate excessive contraction by the use of bougies.

REMARKS.—In the operations just quoted, but little difficulty will be found in their performance, but much judgment will be requisite in deciding upon their necessity. In young patients, such operations

will seldom be required, as these cases usually yield to an appropriate treatment, without surgical aid. If the prolapsus is so marked and obstinate as to require the adoption of any operation, that of Cheselden should be first tried, and then, if requisite, resort had to the operation of Dupuytren. In excising the folds as there directed, four generally suffice, one being in front, another behind, and two others laterally, as directed by him; the amount included in the forceps, and excised, being regulated by the degree of relaxation of the anus.

SECTION III.

HEMORRHOIDS, OR PILES.

PATHOLOGY.—Hemorrhoids (αιμα blood, and ρεω to flow) consist of tumors seated at or near the verge of the anus, which are sometimes liable to bleed at each effort at defecation. Although this complaint has been so long known to the profession, there is yet a diversity of sentiment in regard to its pathology. By some writers hemorrhoids are described as a varicose condition of the anal veins (Jobert), or as tumors resulting from a laceration of the veins and the effusion of blood into the adjacent submucous or subcutaneous cellular tissue (Ribes), or as preternatural cysts, which are sometimes distended with blood and very much swelled, whilst at others they are more empty and flaccid. These different views, as thus expressed by distinguished surgeons, can only be reconciled on the supposition that a condition of parts similar to each of those described may accompany every case of hemorrhoids at some period of its course. On this supposition, and with a knowledge of the minute anatomy of the anus and rectum, it appears to me an easy matter to harmonize these varied conditions, and explain the pathology of the complaint. The mucous membrane, at the verge of the anus, being continuous with the skin, and having beneath it a fine anastomosis of veins without valves, which veins are seated in a cellular tissue, and directly continuous with those of the mesentery, it is certainly possible to create precisely such a condition of parts as has been described by Ribes, and yet refer the whole complaint to a varicose condition of the veins of the anus, and especially of the hemorrhoidal plexus, as stated by Jobert. Thus,

constipation, straining, and all the usual causes of hemorrhoids would first induce fulness of these vessels, then serous or lymphy infiltration of cellular tissue, in which the distended veins would freely anastomose, whilst the rupture of the veins would readily lead to effusion of blood, and the formation of a cyst covered by mucous membrane or skin, according as the vessel was above or on the line of the external sphincter ani. If, then, absorption of the more liquid parts of such a cyst were to ensue, it would certainly create a semi-solid or mulberry-like tumor, such as is described by Ribes, whilst the inflammation and ulceration of either the mucous or cutaneous surface of the tumor might give rise to a hemorrhage, the amount of which would depend on the size of the vein opening into it. If, then, I wished to define the pathological characters of an external pile, I should say it is a tumor covered by the skin or mucous membrane on the verge of the anus, which tumor is due either to a laceration of the hemorrhoidal veins, and the escape of blood into the subcutaneous cellular substance, or to a varicose condition of the vessels. The first tumor, when excised, will not bleed, but simply give vent to a clot, or perhaps present the appearance of the semi-erectile tissue, before referred to.

An internal blind pile being, on the contrary, a varicose enlargement of one or more branches of the same veins higher up the rectum, would consequently be a tumor covered by the mucous coat of the part, which mucous covering would be liable to become elongated by infiltration of its submucous cellular tissue; whilst if it inflamed, ulcerated, and opened the vein, it would give rise to a hemorrhage, which would of course be most marked when the efforts at defecation created a congestion of the veins. Such a tumor will, therefore, require to be treated with an especial regard to this inflammation, as well as with reference to the hemorrhage likely to follow the opening of veins without valves, or of small arteries so situated as not to be readily seen.

§ 1.—TREATMENT OF HEMORRHOIDS.

The principal plans of treatment employed by surgeons at the present time, for the cure of hemorrhoids, consist in the daily use of injections of cold water, with cold washing before and after defecation; in the application of strong nitric acid, of the ligature and in excision.

I. APPLICATION OF NITRIC ACID.

Strong nitric acid, when applied for the relief of hemorrhoids, as suggested[1] by Dr. Houston, of Dublin, in 1843, is especially applicable to those cases in which there is hemorrhage, and, of course, ulceration and thickening of the mucous coat over the pile. It proves useful by its caustic effects inducing the cicatrization of the ulcer. It also changes the action in a chronic swelling, or induration of tissue, so as to cause the effused lymph to serve the purposes of healthy organization, instead of creating a diseased enlargement in the cellular tissue around the veins.

In applying it, the piles may either be protruded, or else the rectum be dilated by means of a glass speculum with an opening in its side, the opening being turned to the tumor. Then, with a piece of soft wood or a hair pencil, dipped in the strong acid, touch the tumors in a longitudinal direction, so as to destroy entirely the vitality of the part touched. In order to prevent the extension of its action, the adjacent parts should be painted with sweet oil, and the cauterized portion washed with the same immediately after the application of the acid.

The advantages claimed for this treatment, by Dr. Houston, are safety from hemorrhage, and contraction of the vessels and tissues consequent on the separation of the slough. The objection to its use is the continuance of severe pain, when the cauterization is not sufficient to *kill* the part, or when any portion of the acid escapes on to the skin, at the verge of the anus.

Dr. Thweatt, of Virginia, has successfully treated hemorrhoids by this means, and so have several others in the United States. Dr. Cooke, of England, has also related[2] six cases of hemorrhoids cured under the use of the nitric acid, by applying a dossil of lint dipped in the acid to the pile, and pressing it there for fifteen or twenty minutes; during this time the pain is severe, though the cure is rapid; an abscess close to the sphincter muscle also followed in one case, but ultimately got well.

[1] Dublin Med. Journ., March, 1843, p. 94, *et supra;* also Sept. 1844.

[2] London Med. Times and Gazette, April, 1853.

II. THE LIGATURE.

The hemorrhoidal tumor may be strangulated either by threads passed through its base, and then tied so as to surround it, or by encircling it with a wire ligature drawn tight by means of a double canula (Physick), or by throwing a simple loop of silk over it, so as to constrict its base. (Plate LXIII., Fig. 1.)

As these methods of applying the ligature are often followed by dangerous symptoms, and as its employment is better effected in the following plan, I shall omit a further description of the ligature for the present.

III. EXCISION.

The removal of hemorrhoidal tumors by excision may be effected by seizing them in toothed forceps, and removing them with scissors curved on the side (Dupuytren), or by passing a ligature through the tumor, and excising it with a bistoury.

IV. INCISION AT THE BASE OF THE PILE FOLLOWED BY LIGATURE.

The objection to the use of the wire ligature, as above directed, is the extreme pain induced by the constriction of the nerves of the skin, as well as the suffering and delay consequent upon the sloughing of the tumor. The danger from excision, especially of internal piles, is that it removes the mucous coat and exposes the patient to dangerous hemorrhage. The following plan has, therefore, been suggested in order to obviate all these objections, and effect a speedy, safe, and permanent cure:—

Operation of Dr. Wm. E. Horner, of Philada.[1]—Calm the irritability of the rectum by cold water injections, employing them several days before the operation. Then, at the time of the operation, empty the rectum, direct the patient to force out the tumors by straining in a squatting position, and place him in bed on the side corresponding to the tumors after they are protruded.

[1] Am. Journ. of Med. Sciences, vol. iv. N. S. p. 358.

Then, after a thorough etherization, pass a large needle and strong silk ligature transversely through the upper part of the largest tumor, and, removing the needle, form a loop by tying together the ends of the ligature, directing it to be held by an assistant, so as to prevent the retraction of the hemorrhoids within the rectum. (Plate LXIII., Fig. 2.) A strong awl, or slightly curved tenaculum, being next made to transfix the base of the same tumor in a line transverse to the ligature, the assistant should hold this with his other hand so as to pry or elevate the mucous coat from the subjacent parts, when the surgeon should make a semicircular incision around the base of the tumor of a sufficient depth to detach the anal plexus of veins from the sphincter muscle, cutting rather into the skin than upon the mucous lining of the anus, and keeping sufficiently close to the margin of the anus to prevent a fold of integument being left upon its edge, as this is apt to swell, inflame, and become exceedingly painful. The awl and ligature being then passed through the loop of a wire ligature, the latter should be carried around the base of the tumor, so as to occupy the line of the incision on one side, and the mucous covering of the tumor on the other. The wire should now be drawn perfectly tight, or until the tumor becomes dark brown or black, when its end should be fastened upon the canula, and the venous plexus will be perfectly constricted through the mucous coat of the rectum on the inner face of the tumor, and through the cellular coat of the gut on its outer side. If the hemorrhoid remains large and very tumid, after being constricted, the surgeon may puncture it with a lancet or bistoury, and permit its blood to escape, after which a piece of cerate should be temporarily placed between the tumor and the incision, to guard against adhesions, and an anodyne enema given, the thread ligature being left in the tumor for six or eight hours, when it may be used to elevate it, whilst it is snipped off with a pair of scissors, the wire loop being thus freed from its position without creating any loss of blood.

Remarks.—The dangers that have been incurred in the excision of piles, and the suffering consequent on the ordinary method of applying the ligature, are facts that every experienced surgeon must have frequently noted. When, therefore, it is necessary to select a mode of operating, I would recommend that proposed by Dr. Horner, as it is one that I have repeatedly performed, and the success of which I have now seen in nearly fifty cases. In but one of these has it been necessary to repeat the operation,

whilst many, and some even of the very worst hemorrhoids that I have ever encountered, have been cured in about two weeks; some patients being able to sit up in bed in seven days; and daily experience only tends to increase my confidence in it.

SECTION IV.

FISTULA IN ANO.

PATHOLOGY.—When, from any cause, an abscess is developed about the anus, it may discharge itself by one or more small orifices, either externally upon the buttock, internally into the gut, or by both surfaces. From the constant action of the sphincter and levator ani muscles, the approximation of the sides of this abscess and their union is prevented, the parietes of the cavity become callous, the orifice becomes small, contracted, and indurated, and the condition known as fistula in ano is induced. To facilitate the adhesion of these parts, by exciting proper inflammatory action, and bring the sides of the cavity of the abscess in contact, so that they may be kept at perfect rest, is the object of the operations performed for the relief of this complaint. Two principal means are resorted to: 1. The ligature. 2. Incision.

§ 1.—THE LIGATURE.

The application of a ligature to a fistula, so as to induce the division of the sphincter muscle by ulceration and the formation of healthy granulations, may be effected in various ways; but by the use of the following instruments of Dr. Wm. Gibson, it is rendered a simple and not very painful operation.

OPERATION OF DR. GIBSON, OF PHILADELPHIA.[1]—A silver canula, five inches long and an eighth of an inch wide, slightly curved, so as to convey a watch-spring ten inches long, with a bulb at one end and an eye at the other, and with a steel stylet (Plate LVIII., Figs. 24, 25), being first prepared, the surgeon should gently probe the course of the fistula, and if it is incomplete, pass in the canula, with

[1] Pract. of Surg., vol. ii. p. 164.

PLATE LXIV.

OPERATIONS FOR FISTULA IN ANO.

Fig. 1. A Section of the Rectum and Anus, in order to show the relations of the parts in a Blind Fistula. 1. Rectal orifice of the fistula. 2. Its position in the fat about the anus. 3. The gut. 4. The anus. 5. The structure immediately around the anus. After Bernard and Huette.

Fig. 2. A similar section to show the relations of an Incomplete Fistula. 1. Orifice of the fistula in the buttock. 2. Its termination. 3. Rectum. 4. Anus. 5. Surrounding parts. After Bernard and Huette.

Fig. 3. Section showing the relations of a Complete Fistula. 1. Rectal orifice. 2. External opening. 3. Rectum. 4. Anus. 5. Surrounding structures. After Bernard and Huette.

Fig. 4. Operation for Fistula in Ano by the Knife. The patient being placed upon the affected side, the parts can thus be laid open without exposing the surgeon to the chance of injuring his own finger, as has often happened by the sudden motion of the patient when placed upon his hands and knees. 1. Hand of assistant supporting the buttock. 2. Left forefinger of surgeon passed into the rectum to touch the point of the bistoury. 3. His right hand introducing the bistoury through the anal orifice of the fistula, in order to divide the parts from above downwards, as he withdraws both hands. 4. Fistulous opening. After Nature.

Fig. 5. Section to show the Operation of Probing a Fistula. 1. Rectal orifice of fistula. 2. Its anal orifice. 3. Rectum. 4. Probe passed along the fistula until its point touches the forefinger in the rectum. After Bernard and Huette.

Fig. 6. Division of a superficial Anal Fistula by the Bistoury, as passed along a Director. 1. Rectal orifice of fistula. 2. Its anal opening. 3. The gut. 4, 5. The director. 6. The bistoury passing along it. 7. Portion of the integuments near the anus, which is to be laid open. The drawing represents the patient in the position of Fig. 4. After Bernard and Huette.

Fig. 7. Operation for Fistula in Ano by means of the Ligature. 1. Rectal orifice. 2. Anal opening. 3. Rectum. 4, 4. Ligature *in situ*. 5. Tissue to be divided. After Bernard and Huette.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

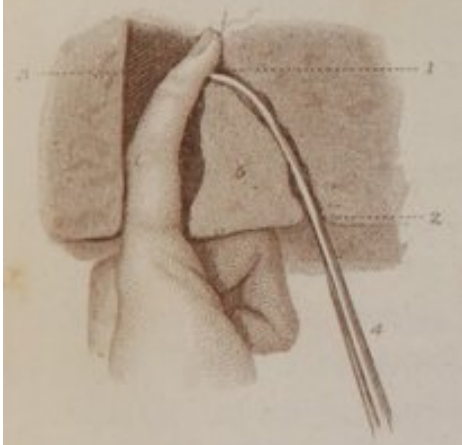


Fig. 6.

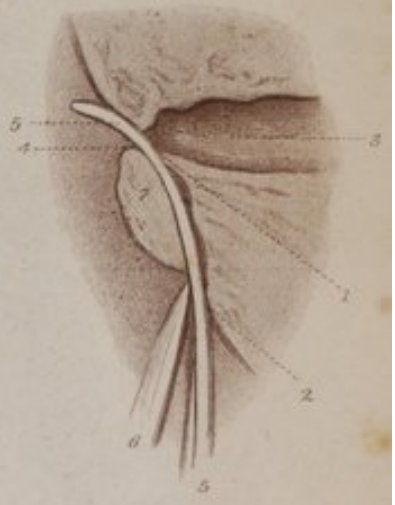
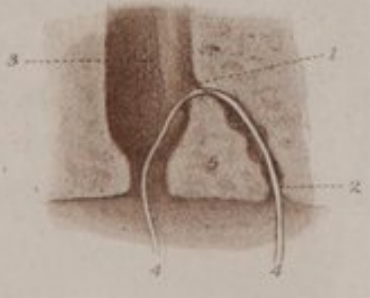


Fig. 7.



its stylet retracted, passing the left forefinger into the rectum, and pressing the point of the canula against the side of the gut, where it is supported by the finger, push forward the stylet, puncture the wall of the rectum, withdraw the stylet, and pass the canula through the opening thus made, until it touches the finger in the rectum. Then passing the watch-spring, armed with a ligature, into the canula, carry the spring into the cavity of the gut, and bring one end out of the anus; when, the canula and watch-spring being removed, the other end of the ligature will be left coming out of the fistulous orifice. (Plate LXIV., Fig. 7.) The two ends being now loosely tied, the patient may walk about until the ligature ulcerates out and escapes, as during this time the formation of granulations will generally have removed the complaint.

§ 2.—OPERATION BY THE KNIFE.

Empty the bowels, and place the patient upon the side next to the fistula; pass the left index finger into the rectum; pass the bistoury into the fistula; bring its point to touch the finger, and, withdrawing the two, lay open the gut and the cavity of the abscess by dividing the levator ani longitudinally, and the sphincters transversely. Then keep the anal orifice of the fistula moderately open by introducing charpie or lint until it heals from its upper end by the formation of new granulations. (Plate LXIV., Fig. 4.)

Remarks.—Among the variety of methods of operating for fistula in ano, recommended by surgeons at various periods, there is no difference in the indications to be accomplished, though individual peculiarity has suggested a variety of instruments. Of all these, but one demands special notice, and that is the sheathed bistoury of Wheatley and Dr. Physick. This instrument resembles the ordinary sharp-pointed bistoury, but has a sheath attached upon the blade, which covers its cutting edge as well as its point, but may be shifted at pleasure. This sheath saves the patient the pain likely to be created by passing the sharp edge and point against the sides of the fistula in introducing the instrument, a matter of some moment where etherization is not practised. The position of the patient upon the side, with the limb of the sound side flexed, and that of the affected side extended (Plate LXIV., Fig. 4), as pursued by the French surgeons, is also better than that upon the

hands and knees, or leaning over a table or bed. In the latter position, the pain caused by the incision is apt to force the patient away from the surgeon, in consequence of which the forefinger of the operator is liable to injury. Such a position is also incompatible with etherization, which, in an operation upon an inflamed and sensitive part, is essential to the comfort of the patient. Where time is not an object, or in scrofulous patients, the ligature is best adapted to the cure; but incision is the most prompt and least troublesome.

When the surrounding parts and the edges of a fistula are indurated, the French surgeons are accustomed to pare them off, and leave the wide wound thus made to heal by granulations. But in the majority of cases, such a proceeding only increases the suffering of the patient, and delays the cure. In very callous cases, a slight paring of the edges of the incision may expedite the treatment, but, in most instances, nature is capable of removing the induration.

PART V.

OPERATIONS ON THE EXTREMITIES.

CHAPTER I.

GENERAL OPERATIONS ON THE EXTREMITIES.

THE upper and lower extremities being composed of several tissues which are analogous to those found in other regions of the body, they are liable to many similar complaints, and sometimes require operations which are the same in principle as some of those that have been already described; thus, the removal of tumors, the relief of deformities arising from the cicatrices of burns, the ligature of arteries, or the resection of bones, is very much the same in all parts of the body, and must be regulated by the same general rules, the operations on these regions only differing in accordance with the anatomical relations of the portion of the body in which they are performed. It will consequently be unnecessary in this portion of the work to do more than describe such modifications of these operations as are required by the position and functions of the extremities, and the reader is therefore referred to the preceding pages for any operative directions not specially required in connection with this region.

Two classes of operations are performed upon the extremities; one including all those of a general kind which are performed upon the superficial tissues, and the other referring to such as are deeper seated.

The class of operations of a general character which may be assigned to the first of these limits embraces such as are required for the relief of diseases of the nails and skin, of the superficial nerves, of the veins, and of the tendons.

SECTION I.

ULCERATION AT THE TOE-NAIL, OR "INVERTED TOE-NAIL."

PATHOLOGY.—The suffering caused by inflammation and ulceration of the skin, at the external side of the nail of the great toe, is sometimes so great as to induce patients to desire amputation, in order to be free from the constant annoyance of this complaint. Under these circumstances, it is not surprising that the disorder has frequently attracted the attention of surgeons in relation to its pathology and mode of treatment. Authors have, however, differed considerably in their views of the cause of the symptoms, some asserting them to be due to a deviation or ingrowing of the nail itself, whence the name of "Inverted Toe-Nail;" and others contending that they were owing to the uprising of the flesh in consequence of the pressure of the boot. As in many other vexed questions, both opinions are perhaps correct, or rather the trouble is often due to both causes; but whether the original source is in the flesh or in the nail, the latter soon becomes the cause of its continuance.

To relieve the trouble thus created, it was proposed by Dionis to elevate the nail by scraping it thin, and packing fine lint beneath its edge; by Dessault, to recurve the nail, and elevate its point by means of a curved piece of tin; by Dupuytren, to slit it up in the middle, and turn out each half, whilst Larrey suggested the same process combined with excision of the matrix and the application of the actual cautery or caustic. The latter I have found to be the most effectual, and I am accustomed to accomplish it in the following manner:—

§ 1.—REMOVAL OF THE NAIL AND ITS MATRIX.

OPERATION.—Place the patient in a perfect state of anæsthesia by the use of ether, and then, with a small sharp spatula or scalpel handle passed around the root of the nail, and inserted beneath the fold of the skin at its base to the extent of one-fifth of the length of the nail, free the latter entirely from its matrix, when it may be easily removed entire, by seizing it on its free edge with a pair of strong dissecting forceps, and drawing it upwards and then for-

wards from its root, or by slitting it down the middle from before backwards, and then everting each half; after which the matrix should be thoroughly cauterized with anhydrous potassa in order to prevent the growth of a new nail.

DRESSING.—Apply over the surface a pledget of dry lint; allow it to remain until suppuration is induced, and then favor the cicatrization by the treatment appropriate to ulcers elsewhere.

REMARKS.—Simple as this complaint apparently is, it is yet not uncommon to find cases in which an attempt to cure it has proved a failure. All partial eversions of the nail, or any other operation in which the matrix is allowed to remain to reproduce the nail, must prove but a temporary cure; and even when the entire nail is removed, unless the reflected edge of the skin forming the matrix is thoroughly cauterized, the reproduction of the nail, and perhaps of the complaint, will often be noticed. If the inflammation has caused thickening of the skin over the matrix, so as to render the introduction of the caustic difficult, I would advise the operator to make a slight vertical incision in its middle, and thus facilitate the application of the potash. When the patient is well etherized, this mode of operation will be unattended by pain, and prove very thorough. Without ether, the suffering will be intense. When the caustic is applied, the part should be well and promptly washed with sweet-oil, in order to prevent the extension of its action to the bone, as there is very little tissue between the nail and the upper surface of the phalanx. As the wound heals, it will contract very much, and be covered with so dense a structure that it will be thoroughly protected from the subsequent pressure of a shoe.

SECTION II.

CURE OF PARONYCHIA, OR WHITLOW.

PATHOLOGY.—Four kinds of whitlow have been described by authors: to wit, that wherein pus is found immediately beneath the cuticle, at the root of the nail after trivial inflammation; that in which it is seated in the cellular substance at the end of the finger; that in which the disease is in the sheath of the tendons; and that arising from inflammation of the periosteum.

To relieve the sufferings of the patient, and check the progress of

the disease in the first two varieties, Dr. Perkins has proposed the free application of caustic;[1] and such a treatment may answer for the mild forms. But in the more severe kind (third and fourth varieties) nothing but an early and free incision will prove effectual, and in the cases involving the periosteum prevent the necrosis of the phalanx which is so apt to ensue when the disease is not promptly arrested.

Operation of Incision.—Etherize the patient, place the finger well supported upon a table, and with a sharp-pointed straight bistoury puncture the soft parts at the upper end of the affected phalanx, and then by a rapid motion slit them down to the lower end of the same phalanx, making the incision in the middle of the finger, so as to avoid serious injury to the tendon, or the division of the digital arteries or nerves which course along its sides. The case should then be subsequently treated as an ordinary abscess.

SECTION III.

ENLARGED BURSA.

Pathology.—The enlargement of the bursæ mucosæ, which are seated in the course of the tendons near certain joints, is generally the result of an acute or more frequently subacute inflammation consequent upon over-action of the tendon, or upon long-continued pressure on the part. The increased secretion of bursal synovia thus induced leads to the formation of a tumor in the course of the tendon, which is more or less elastic, and caused by the bursal sac being distended with the natural secretion of the part. When seated at the wrist, the term Ganglion is generally employed to designate it, though this is equally applicable to the swellings found near other joints.

The principles of the treatment are the evacuation of the contents of the bursa, and the production of such action in its cavity as will prevent the reaccumulation of the fluid. These principles have been carried out in various ways; sometimes the cyst has been ruptured by a blow, and the liquid, after being effused into the surrounding cellular tissue, left to be absorbed by nature; or the tumor

[1] Am. Med. Record., vol. ii. p. 490, 1819.

has been treated as an abscess by laying it open with a bistoury, or by introducing a seton, or by a subcutaneous puncture; or by exciting adhesive inflammation in it by injections of iodine; or the sac has been entirely removed by dissecting it out. The close proximity of the joint must necessarily be an objection to any means of treatment that is liable to excite severe inflammation, and the least dangerous methods should therefore be first tried.

§ 1.—SUBCUTANEOUS PUNCTURE.

OPERATION.—Puncture the tumor by a tenotome or cataract needle, so that the opening in the cyst and that in the skin shall not correspond; squeeze its contents into the adjoining cellular tissue, and leave it to be absorbed, whilst pressure is employed to prevent its reaccumulation.

§ 2.—PUNCTURE AND INJECTION OF IODINE.

OPERATION.—Puncture the cyst directly through the skin with a narrow bistoury, or, if the tumor is large, by a trocar and canula. Evacuate its contents, and then with a syringe throw in a small portion of tincture of iodine, regulating the subsequent inflammation by appropriate treatment.

§ 3.—INCISION.

OPERATION OF DR. GEO. HAYWARD, OF BOSTON.[1]—In enlarged bursæ over the patella, or housemaid's knee, Dr. Hayward operates as follows:—

Puncture the tumor, and evacuate its contents, and if it fills again, as is usually the case, lay it open by a free incision, inserting a piece of lint between the lips of the wound, so as to bring on the proper degree of inflammation, and regulate this by poultices and appropriate treatment.

Dr. Hayward has never found it necessary to excise the cyst.

[1] Am. Journ. Med. Sciences, vol. iv. N. S. p. 513.

§ 4.—MOVABLE CARTILAGES IN THE KNEE-JOINT.

The existence of a foreign body within the capsule of the knee-joint gives rise to a train of symptoms which have induced surgeons to attempt their removal. As it is of great consequence to prevent the entrance of air into the joint, and as the foreign body is so movable as to render it difficult to extract it without its escaping once or twice from the orifice made for its removal, any suggestion that will enable the surgeon to fix it firmly in position must facilitate its removal. The proposition Dr. E. Bartlett,[1] of New England, is one, therefore, which deserves attention.

Operation of Dr. Bartlett.—Having forced the loose body to the upper part of the synovial cavity, direct an assistant to grasp the lower end of the femur firmly with both hands, placing one thumb on the right, and the other on the left of the foreign body, with their extremities in contact below it, and thus confine it in a triangular space, two sides of which are formed by the thumbs, and the other (the upper side) bounded by the capsular ligament. Due pressure being now made, the surgeon makes the incision upon the foreign cartilage in the direction of the limb, and prevents either the escape of synovia or the admission of air or blood into the joint, by promptly closing the wound whilst its compression is continued.

Operation of Dr. May, of Washington.[2]—After a strict antiphlogistic preparatory treatment, Dr. May removed two large cartilages, one of which was two inches long, one inch and one-eighth wide, three-fourths of an inch thick, and weighed three hundred and one grains, while the other weighed one hundred and seventy-five grains, in the following manner. Both of the cartilages being first brought to the inner side of the articulation, and held there by the fingers of the left hand, an assistant drew the integuments forcibly upward, and an incision one inch and a half long was made down to the capsule. The opening in this being made rather less than the external cut, the largest cartilage was instantly slipped through, and immediately followed by the smaller one, not more than a teaspoonful of synovial fluid escaping with them. The

[1] Boston Med. and Surg. Journ., 1852.

[2] Am. Journ. Med. Sciences, vol. xxiii. N. S. p. 415.

upward traction of the integuments being now removed, the correspondence or parallelism of the wounds was destroyed, and the further escape of the fluid or the entrance of air thus guarded against. The wound was then closed by adhesive strips, a cold, wet compress placed around the joint, the limb placed in splints, and low diet enjoined. No bad symptoms followed, and at the end of two weeks the patient was allowed gently to use the limb, and gradually recovered the entire use of the joint. Similar success was obtained by Dr. J. Washington Smith, of New York.[1]

SECTION IV.

PAINFUL CONDITION OF THE NERVES.

The nerves of the extremities are sometimes pricked in bleeding, or so accidentally injured as to induce a neuralgic condition, to relieve which an operation is demanded. The operation requisite for its relief is varied, and may consist either in a simple transverse division of the main trunk, or in the excision of a portion of it. For the neuralgia and other evils resulting from the injury of a cutaneous filament in venesection, little more is requisite than a simple incision across the nerve so as to divide it entirely; but in other cases it may be requisite to lay bare the main trunk of the nerve by a regular dissection of its course, and to excise a small portion in order to prevent the reunion of the divided parts, and the restoration of the function of the part. For several interesting papers on affections of the nerves, the reader is referred to the operations of Dr. Warren, of Boston, Bayard, of New Brunswick, and Moses Sweat, of Maine, as quoted in the Bibliographical Index.[2]

SECTION V.

VARICOSE VEINS.

PATHOLOGY.—The morbid enlargement or dilatation of any of the veins of the body has long been regarded as constituting a

[1] Med. Examiner, vol. viii. N. S. p. 578.

[2] Pages 137, 138.

varix, and, to relieve this, surgeons have suggested various operations. The failure of many of these plans to effect a cure, as well as the serious loss of life that has in some instances ensued upon their performance, should induce a close examination of the anatomical relations of these vessels, as well as the pathological changes noted in them. I can, however, simply make a brief reference to the peculiar structure of the coats of these veins, without entering upon their surgical anatomy.

The veins of the extremities, in which the varicose condition is most often seen, are, like the arteries, composed of three coats—a cellular, muscular, and serous or arachnoid one—these coats being generally much thinner in these vessels than in the arteries, the tenuity of the veins being so great as to permit the circulation of the blood to be distinctly seen through them, in consequence of which they are more liable to expansion or rupture upon the application of force. All the superficial veins of the extremities communicate with the deep-seated veins by numerous anastomoses.

In an elaborate paper upon the Pathology of Varices, by Dr. Jno. Watson, of New York,[1] may be found many excellent observations connected with their condition. Speaking of the stages in the progress of varices, Dr. Watson refers to the first as being characterized by a simple dilatation of the vessel, which leads to interstitial development or hypertrophy; the second, by an increase in their length, which leads to the formation of folds and serpentine convolutions, these being most common where the vessel is under least restraint; the third, by an increase in the thickness of their elastic or muscular coat; and the last, by a change in the inner coat, which becomes so thickened as to resemble delicate muscular tissue.

Terminations.—Varicose veins may, under favorable circumstances, contract upon themselves, and diminish in caliber so as to contain less blood than is natural to them. Or the inner membrane may inflame, throw out coagulated lymph, and thus close its channel, or it may run on to suppuration, as in suppurative phlebitis, or the disease may terminate in death by loss of blood.

Operations upon the veins, by inducing inflammation, may cause death from phlebitis; or the recession of the blood from the varicose vessels into the course of the general circulation, in persons

[1] Am. Journ. of Med. Sciences, vol. v. N. S. p. 36.

of a plethoric habit, may induce pleurisy and pneumonia; whilst, under the most favorable circumstances, the most that can be obtained is a temporary relief, the return of the circulation through the anastomosis, between the deep and superficial vessels, often re-developing similar evils to those which it had been attempted to relieve. From considerable observation of many of the plans of operating heretofore recommended, I am induced to think that the patient's life is often exposed without obtaining any permanent good, and I shall therefore omit all mention of the operative proceedings usually described as applicable to this complaint. Those desirous of full information on these plans, are referred to the excellent and extended paper of Dr. Watson, to whom I am indebted for much additional information, and to a confirmation of views obtained in Paris in 1840.[1] Coinciding in the correctness of his opinions as to the danger resulting from incisions, and similar means of treatment, the following plan, as pursued by him, is the only one to which I will refer.

Treatment of Varicose Veins, by Dr. Jno. Watson, of New York.[2]—The patient, having the limb bandaged, and having been kept in bed for twenty-four hours, several small pieces of a common wax bougie should be applied over the course of the varices, some being placed longitudinally, and others transversely along the veins, and secured in their position by a roller. Over this apply the starch bandage,[3] and allow it to remain undisturbed as long as it causes no inconvenience, and does not become deranged.

Remarks.—After the references already made to the treatment of this complaint, the reader must be aware that I deem little more requisite in the way of an operation upon varices, than such pressure as can be obtained by pursuing the judicious plan advised by Dr. Watson. It or the laced stocking, or both, are capable of accomplishing quite as much in the treatment of varices of the limbs as either caustic, excision, incision, perforation, or any of the numerous other plans usually referred to; whilst the latter operations will only afford temporary relief, the free anastomoses of the veins soon leading to a reproduction of the disease, even though the main channel is closed.

[1] Philada. Med. Exam., vol. ii. p. 821, 1839.

[2] Am. Journ. Med. Sci., vol. v. N. S. p. 36, 1843.

[3] Smith's Minor Surgery, p. 282, 3d edit.

SECTION VI.

TENOTOMY, OR DIVISION OF THE TENDONS.

Under the heading of "contracted tendons," surgeons have sometimes placed a class of deformities which are due to a contraction of the muscle, instead of the tendon, to which it belongs; though in the cases of burns or ulcers, an actual loss of the substance of the tendon does sometimes ensue upon the injury. From muscular contraction, the tendons in the neighborhood of different joints are, however, sometimes rendered so prominent and distinct, that they appear to be contracted, as they can be felt like tense bands or cords immediately beneath the skin, interfere with the motion of the part, and retain the limb in a deformed position. To obviate this, the division of the tendon has been practised with considerable success, especially when seconded by such mechanical contrivances as will restore and preserve the limb in its ordinary position.

Operation.—The subcutaneous division of a tendon may be readily accomplished in any case by means of a tenotome (Plate XXXV., Fig. 13), passed beneath the skin, and made to act on the tendon as directed in torticollis;[1] or by making a slight puncture in the skin, introducing the tenotome flatwise upon the tendon, and then, turning its edge downwards, cause the tendon to press against the knife until its fibres are divided, by flexing or extending the foot so as to place the tendon on the stretch. So tense is the tendon in some instances, and especially in the form of club-foot known as "Pes Equinus," that very slight extension of the foot will cause it to press so firmly against the tenotome that its division is accompanied by a sensation that is almost equivalent to a "snap."

Remarks.—As an operation, the division of a tendon by subcutaneous tenotomy is sufficiently simple; but, unless the consequences are well understood, much evil may result from its performance, or from the too early application of mechanical means to remedy the contraction. In studying the results of this division, it should therefore be recollected that when a tendon has been divided without contact with the air, as is accomplished in its subcutaneous section, or in its laceration, the following changes may be anticipated: 1. A

[1] Part III. p. 501.

slight effusion of blood at the seat of injury between the divided ends. 2. The exudation of soft, gelatinous, plastic matter. 3. Its conversion into a sort of lamellated or fibrous tissue, which, in its early condition, is susceptible of a certain amount of elongation.

Perfect rest for a day or two is therefore essential to success in operating for tenotomy, the mechanical means being gradually applied and persevered in until the elongation of the part is sufficient. In deformities of the foot (club-foot), and of the hand, or in false anchylosis, the operation of tenotomy may prove serviceable, care being taken, by reference to the surgical relations of the part, to prevent injury to the adjacent nerves and bloodvessels. For the mechanical treatment of these complaints, the reader is referred to my volume on minor surgery;[1] whilst a reference to the Bibliographical Index[2] will furnish an account of the operations of Drs. Detmold and Dickson, of New York, Norris, of Philadelphia, N. R. Smith, of Baltimore, Walton, of Pennsylvania, Gardner, of Virginia, as well as of those by myself. As it has fallen to my lot to treat many of the deformities in which tenotomy or myotomy has been highly lauded, and as I carefully observed the practice of M. Guerin, of Paris, several years since, I have had fair opportunities of judging of the value of these operations. My experience has, however, induced me to rely much more on the mechanical treatment of deformities than on either tenotomy or myotomy. At best, these operations are only useful in facilitating the adjustment of the position required by the application of the apparatus. Except in the tendo-Achillis, I have, therefore, found few tendons that required division in children under five years of age, whilst beyond this age the employment of both tenotomy and the apparatus offers much less chance of success.

CHAPTER II.

LIGATURE OF THE ARTERIES OF THE EXTREMITIES.

THE arteries of the upper extremity may be ligated at any point from the shoulder to the fingers, and are to be operated on by the same rules as have been already stated in the chapter on Aneu-

[1] P. 435, edit. 1850.

[2] See Bibliography, p. 139.

PLATE LXV.

LIGATURE OF THE ARTERIES OF THE ARM.

Fig. 1. A View of the Anatomical Relations of the parts about the Axilla and upper portion of the Arm. 1. Brachial artery. 2. Director beneath it. 3. Median nerve. 4. Internal cutaneous nerve. 5. Ulnar nerve. 6. Brachial vein. 7. Axillary lymphatics. 8. Branches of axillary artery. 9. Pectoralis minor muscle. 10. Pectoralis major. 11. Anterior margin of axilla drawn back by a hook. 12. Cut edge of brachial fascia. 13. Biceps muscle. 14. Coraco-brachialis. 15. Lymphatic.

After Bernard and Huette.

Fig. 2. Ligature of the Axillary Artery in the Axilla. 1, 2. Incision in the skin and fat. 3. That in the fascia. 4. Axillary artery raised on a director. 5. Axillary vein drawn back by a blunt hook forceps. 6. The Median nerve. 7. Internal cutaneous nerve. After Bernard and Huette.

Fig. 3. Anatomical Relations of the Brachial Artery. 1. Brachial artery. 2. Radial artery. 3. Coraco-brachialis muscle. 4. Biceps muscle. 5. Median nerve. 6. Brachial vein. 7. Profunda minor artery. 8. Ulnar nerve. 9. Fascia formed over artery at the elbow by expansion from biceps tendon. 10. Median Basilic vein. 11. Cephalic vein.

After Bernard and Huette.

Fig. 4. Anatomical Relation of the superficial parts about the bend of the Arm. 1, 3. Cephalic vein. 2. Median Cephalic. 4. Median vein. 5. Median Basilic vein. 6. Brachial artery. 7. Biceps tendon. 8. Median nerve. 9. Ulnar nerve. 10. Radial nerve. 11. Branch of external cutaneous nerve. 12. Main trunk of external cutaneous. 13. Branch of median nerve. 14. Branch of internal cutaneous. 15. Its main trunk.

After Bernard and Huette.

Fig. 5. Anatomical Relations of parts about the Wrist. 1. Posterior annular ligament. 2. Tendon extensor primi internodii. 3. Tendon extensor secundi internodii. 4. Radialis indicis artery.

After Bernard and Huette.

Fig. 6. Ligature of Radialis Indicis Artery. 1. The skin. 2. The fascia. 3. The artery with the ligature beneath it.

After Bernard and Huette.

Fig. 1

Fig. 3

Fig. 5

Fig. 4

Fig. 6

Fig. 2

risms in general.[1] The present account will, therefore, be limited to the operative steps required in the special application of the ligature to the arteries of this member, the anatomical relations of each vessel being given in connection with the operation practised upon it. Compression as a means of curing aneurism is especially applicable to the bloodvessels of the extremities, and is to be accomplished in accordance with the views before given in the general treatment of aneurisms.[2]

In the description of these operations, I shall chiefly follow the directions of the French surgeons, as their fondness for practising the ligature of arteries in the dissecting-room makes them excellent authorities. I shall, therefore, freely resort to their opinions, as I have in every instance tested their accuracy, and am able to furnish my personal experience of the value of those hereafter given.

SECTION I.

LIGATURE OF THE AXILLARY ARTERY IN THE AXILLA.

§ 1.—ANATOMICAL RELATIONS OF THE AXILLARY ARTERY.

The region of the axilla has been differently described by authors; the French surgeons, including in it nearly all the parts found between the arm and clavicle, and others, among whom is Dr. E. Geddings, of Charleston,[3] limiting it to the triangular depression included between the upper part of the arm, shoulder, and side of the chest, which is formed by the edge of the pectoralis major in front, the latissimus dorsi and teres major muscles behind, as they tend to their insertion into the humerus, and by the ribs covered by the serratus magnus at the sides. As the parts about the clavicle have been already referred to,[4] I shall adopt the latter limits.

The depth of the axilla depends very much upon the position of the arm and the obesity of the patient. When the arm is elevated perpendicularly, the head of the humerus is forced down, and nearly effaces it, or sometimes renders it convex, and when the patient is

[1] Vol. i. Part III. p. 538.
[2] Vol. i. p. 534.
[3] Amer. Cyclop. of Med. and Surg., vol. i. p. 559.
[4] Vol. i. Part III. p. 555, and vol. ii. p. 17.

fat, a deposit of adipose matter so fills up this space as barely to leave a depression.

In the region thus bounded by the pectoralis major muscle in front, and the latissimus dorsi behind, and which, in the adult, contains a luxuriant growth of hair, are to be found the axillary artery and vein, with their branches, as well as the nerves of the brachial plexus, together with the lymphatic glands; all these parts being united together by a loose cellular tissue, and surrounded by fat.

The vessels and nerves of the axilla are so arranged as to form a plaited cord, or thong, the vein being generally anterior and internal, whilst the artery which was between the vein and the nerves near the clavicle is here so interlaced by the latter as to be difficult of access. The whole bundle of vessels and nerves traverses the axilla diagonally from above downwards, and from within outwards. The lymphatic ganglia occupy the course of the vessels, and are abundantly developed. (Plate LXV., Fig. 1.)

§ 2.—LIGATURE OF THE AXILLARY ARTERY.

The ligature of the axillary artery may be performed by various methods, some surgeons preferring one and some another. The two hereafter stated are amply sufficient, and as I have frequently tested their correctness, I recommend them to special consideration.

OPERATION OF LISFRANC.—The patient being placed upon the back, and the arm forcibly extended, the distance between the latissimus and pectoralis major should be divided by imaginary lines into three equal parts, and a longitudinal incision three inches long made through the skin and cellular tissue in a line corresponding with the union of the anterior and middle third of the axilla. (Plate LXV., Fig. 2.) The fascia, being then seized in the forceps, should be nicked and slit up on a director in the same direction, or, if this does not expose the parts sufficiently, it may also be divided to a slight extent transversely. The nerves and vessels being now reached, the arm should be lowered, and the cellular tissue around the vessels lacerated by the point of the director sufficiently to distinguish each part. The vein being then pushed to one side, seek on the anterior side of the axilla for the median nerve, underneath and inside of which is found the artery, which may now be secured

by passing the aneurism-needle from behind forwards, care being taken to avoid the axillary vein.

REMARKS.—As it is often difficult to find the artery at this point, the operator, when he experiences a difficulty, should bear in mind the relations of the nerves to each other, as well as to the surrounding parts, and, counting from the coraco-brachialis muscle backwards and inwards, find: 1st. The median nerve. 2d. The artery on the inner side and beneath this nerve. 3d. The internal cutaneous nerve. 4th. The ulnar nerve. 5th. The radial nerve.

OPERATION OF MALGAIGNE.[1]—By a similar incision in the skin, or by one three-fourths of an inch from the anterior border of the axilla (as advised by Manec), the fascia is exposed, opened as before, and the internal border of the coraco-brachialis muscle sought for as the first indication. Division of the sheath of this muscle, on a level with its internal border, leads directly to the median nerve, which is the second indication; and inside and beneath it is the artery, which should be ligated as before directed.

REMARKS.—The ligature of the axillary artery in the axilla may be demanded in cases of aneurism or wound of the brachial artery high up; the primary hemorrhage in the case of wounds being restrained by pressure of the subclavian artery upon the first rib, whilst, if the wounded vessel can be drawn out at the lower part of the wound, the ligature may be more readily applied than it can be higher up where it is surrounded by nerves. In aneurism the same rule holds good, and the difficulty of ligating the vessel high in the axilla, without injuring either the nerves or the vein, has therefore generally prevented its being attempted. As the application of the ligature in the axilla does not make so unfavorable a wound for suppuration as the operation below the clavicle, I should prefer ligating the vessel at this point when permissible. Occasionally, fainting from loss of blood will deprive the operator of the aid to be obtained from noting the pulsation of the vessel in its full force, whilst the interlacing of the numerous nerves will add to his embarrassment. The directions just given can alone show him where he is; thus he should cease to search for the artery, and begin to trace the parts methodically, when he will find, as before stated, the median nerve next to the coraco-brachialis muscle; inside of it the internal cutaneous nerve, and behind this the ulnar and

[1] Méd. Opératoire.

radial nerves. If, then, he follows the directions before given, he will find that even the ordinary amount of anatomical knowledge, possessed by those long absent from the dissecting-rooms, may suffice for the operation.

SECTION II.

LIGATURE OF THE BRACHIAL ARTERY.

The brachial artery, in its ordinary course down the limb, may require to be ligated at any point, close attention being paid to the relations of the superficial and deep-seated veins and nerves of the arm.

§ 1.—ANATOMICAL RELATIONS OF THE BRACHIAL ARTERY.

At the lower border of the latissimus dorsi, and upon the anterior face of its insertion, the axillary artery takes the name of Brachial, and keeps it as far as the bend of the elbow. Throughout its length, the course of this artery is down the arm on its inner side, winding gradually forwards to reach the middle of the anterior face of the bend of the elbow. At first, it runs along the inner edge of the coraco-brachialis muscle; then from its insertion it lies upon the brachialis internus, following the inner edge of the biceps. (Plate LXV., Fig. 3.) In the upper three-fourths of its course, it is only covered by the integuments and fascia, but at the bend of the elbow it perforates the fascia, and passes beneath the expansion from the tendon of the biceps. Passing under this, it sinks deep into the middle of the bend of the arm, and divides into the radial and ulnar arteries about a finger's breadth below the joint.[1] Two venæ satellites accompany it; the basilic vein is superficial, but runs parallel with it; and the median nerve courses along its outer side, at its upper part, between it and the coraco-brachialis. Sometimes this nerve crosses the artery obliquely in front of this point, and sometimes lower down, till it gets on the ulnar side of the vessel. As a general rule, therefore, it may be said that the median nerve is at the outer side of the brachial artery, above; in front of it, at the middle; and on its inner side at the lower third of the arm. The

[1] E. Geddings, Amer. Cyclop. Med. and Surg., p. 346.

radial, ulnar, and internal cutaneous nerves are also upon its inner side, high up the arm, but lower down they advance towards the posterior and internal face of the limb and recede from the artery. The brachial artery is, however, liable to great varieties, sometimes giving off the radial and ulnar arteries as high up as the axilla.

§ 2.—LIGATURE OF THE BRACHIAL ARTERY AT THE MIDDLE OF THE ARM.

Lying on the inner side of the coraco-brachialis muscle high up, and on the inner edge of the biceps muscle lower down, the median nerve is external or more frequently directly over or anterior to the course of the artery. Four indications point out the line of the incision: 1, the external edge of the biceps, and, higher up, the coraco-brachialis (Hodgson); 2, a line drawn from the middle of the axilla to a point a little inside the middle of the bend of the elbow (Sabatier); 3, the ends of four fingers, placed upon the median nerve, which is here on the outside of the artery, and can often be felt beneath the skin as a tense cord, the incision being made parallel with, and inside of the fingers (Lisfranc); 4, the pulsation of the vessel.

Ordinary Operation.—Carry the limb a little off from the body, flex the forearm, and lay it over upon its back; feel for the bicipital fossa, and incise the skin for three inches in the line of the artery. On coming to the fascia, feel for the pulsation of the artery, and, carefully picking up the fascia in the forceps, lay the blade of the scalpel flat upon its side, nick the fascia, insert the director, and slit it up to the extent of two and a half inches, so as to expose the inner edge of the biceps muscle, when the thick yellow sheath of the vessel will be readily seen. Incise this cautiously on its inner edge, when the median nerve, which is the first white cord on the inside of the muscle, being found, the artery may be readily exposed beneath it, by tearing the cellular tissue with the point of the director, when the vessel may be easily ligated from without inwards, by drawing the nerve a little to the outside. (Plate LXVI., Fig. 2.) The internal cutaneous nerve is internal to, and the ulnar nerve half an inch behind the artery.

If by the division of the axillary artery high up the brachial is deficient, the radial and ulnar arteries will be found in very much

the same position as that above assigned to the brachial, the ulnar being, however, a little more to the inner and posterior side of the arm than the radial.

§ 3.—LIGATURE OF THE BRACHIAL ARTERY NEAR THE ELBOW.

ORDINARY OPERATION.—Make an incision through the skin on the inner edge of the biceps muscle, or in the line from the axilla to the elbow, before mentioned. Open the fascia and sheath as before directed, and the median nerve will be found about a quarter or half an inch on the *inner side* of the vessel. Separate the artery a little from its sheath with the point of the director, and apply the aneurismal needle, so that the ligature may be carried around the vessel from within outwards. (Plate LXVI., Fig. 2.) As the median nerve passes underneath the artery, two inches above the epitrochlea, it should be remembered that, though it is on its anterior and external side at the upper part of the arm, it is here posterior and internal to it.

REMARKS.—The ligature of the brachial artery at any point is not a difficult operation to one familiar with the general relations of the median nerve to the artery, and though these vary a little, as mentioned above, the nerve is never far from the artery. The most troublesome cases are those in which the radial and ulnar arteries are given off near the axilla; but these anomalies are not very common. After the ligature is applied upon the vessel, one end should be cut off, the wound closed by adhesive strips, and the arm kept moderately warm for a few hours, until the circulation is established through the muscular and anastomosing branches. When, in ligating the artery, the arm is much swelled, the line described by Sabatier will furnish the best direction for the incision; but, when it is not, the course of the biceps or coraco-brachialis muscles will suffice. The rapid enlargement of the anastomosing arteries, though soon advantageously restoring the circulation, sometimes creates trouble in cases of aneurism at the bend of the elbow, and occasionally necessitates the application of two ligatures, one above, and the other below the tumor.

SECTION III.

LIGATURE OF THE RADIAL ARTERY.

The Radial artery is seldom ligated, except at the points hereafter mentioned, owing to its muscular relations.

§ 1.—ANATOMICAL RELATIONS OF THE RADIAL ARTERY.

At the upper third of the forearm, the radial artery is placed in the groove that separates the supinator radii longus from the pronator radii teres and flexor carpi radialis muscles, where it is covered by the inner edge of the supinator muscle by the fascia and by the skin. The radial nerve is on its outside, and the venæ satellites accompanying it as usual. (Plate LXVI., Fig. 1.)

At the lower third of the forearm, the artery is only covered by the skin and fascia, has the tendon of the flexor carpi radialis on its inner side, and the radial nerve far outside of it.[1]

When the limb is too much swollen to permit the distinguishing of these marks of reference, a line drawn from a point half an inch outside of the middle of the front of the elbow to a point on the outer side of the forearm two inches and a half below, would indicate its course above (Lisfranc), or from a similar point at the elbow to the middle of the space which separates the styloid process of the radius from the tendon of the flexor carpi radialis (Malgaigne), would show its position below.

§ 2.—LIGATURE OF THE RADIAL ARTERY.

The Radial artery may be tied either at its middle or its lower third.

I. MALGAIGNE'S OPERATION AT THE UPPER THIRD OF THE FOREARM.

The ligature of this artery may be readily accomplished by any incision in the line which it takes from the elbow to the hand. The great accuracy of the details furnished by Malgaigne induces me, however, to prefer his description of it to any other.

By an incision in the line just mentioned, the skin is divided

PLATE LXVI.

LIGATURE OF THE ARTERIES OF THE UPPER EXTREMITY.

Fig. 1. Surgical Anatomy of the Bloodvessels of the Forearm and Hand. 1. Brachial artery. 2. Radial artery. 3. Ulnar artery. 4. Position of radial artery at wrist. 5. Position of ulnar at wrist. 6. Palmar arch. 7. Radialis indicis. 8. Basilic vein. 9. Cephalic vein. 10. Venæ satellites of radial artery. 11. Venæ satellites of ulnar artery. 12. Median nerve. 13. Radial nerve. 14. Ulnar nerve. 15. Biceps tendon. 16. Supinator radii longus. 17. Flexor carpi radialis. 18. Flexor carpi ulnaris tendon.

After Bernard and Huette.

Fig. 2. Ligature of the Brachial Artery. *Upper Incision.*—1. Skin. 2. Fascia. 3. Brachial vein. 4. Median nerve. 5. Artery raised on a director.

Second Incision near the Elbow.—1. Skin. 2. Fascia. 3. Inner edge of biceps. 4. Median nerve. 5. Artery on director.

After Bernard and Huette.

Fig. 3. Ligature of the Radial and Ulnar Arteries. *Upper Third.*—1. Skin. 2. Fascia. 3. Radial artery. 4. Radial nerve. 5. Director under artery. 6. Inner edge supinator radii longus. *At Wrist.*—1. Skin. 2. Fascia. 3. Artery on director. 4. Radial nerve. *Ligature of the Ulnar Artery at the Middle of the Forearm.*—1. Skin. 2. Fascia. 3. Artery. 4. Vein. *Ligature of the Ulnar Artery at Wrist.*—1. Skin. 2. Fascia. 3. Artery on director. 4. Nerve.

After Bernard and Huette.

Fig. 4. Anatomical Relations of the Arteria Dorsalis Pedis. 1. Anterior tibial artery. 2. Anterior tibial nerve. 3. Anterior annular ligament. 4. Tendon extensor proprius pollicis. 5. Extensor brevis digitor pedis.

After Bernard and Huette.

Fig. 5. Ligature of the Anterior Tibial Artery on the Foot. 1. Skin. 2. Fascia. 3. Director. 4. Artery raised on it.

After Bernard and Huette.

Fig. 2.

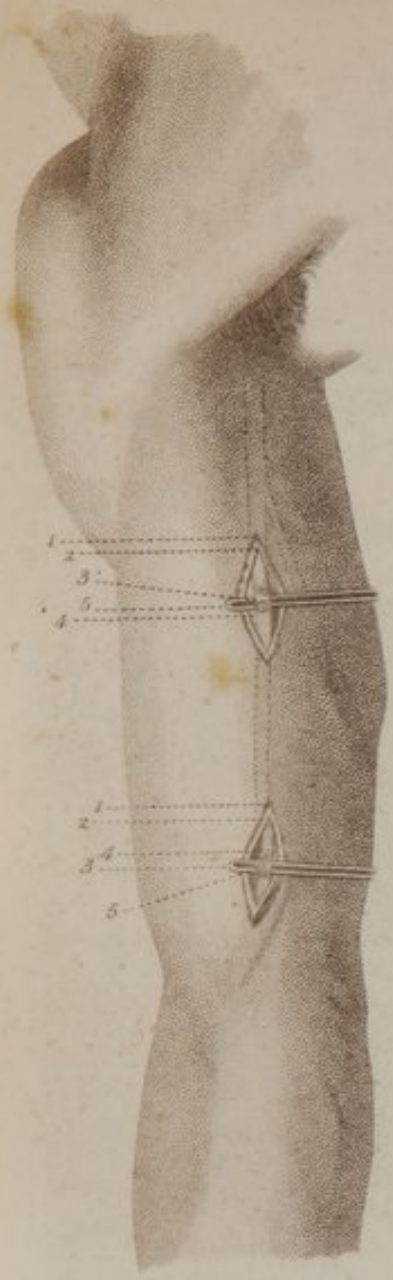


Fig. 1.

Fig. 3

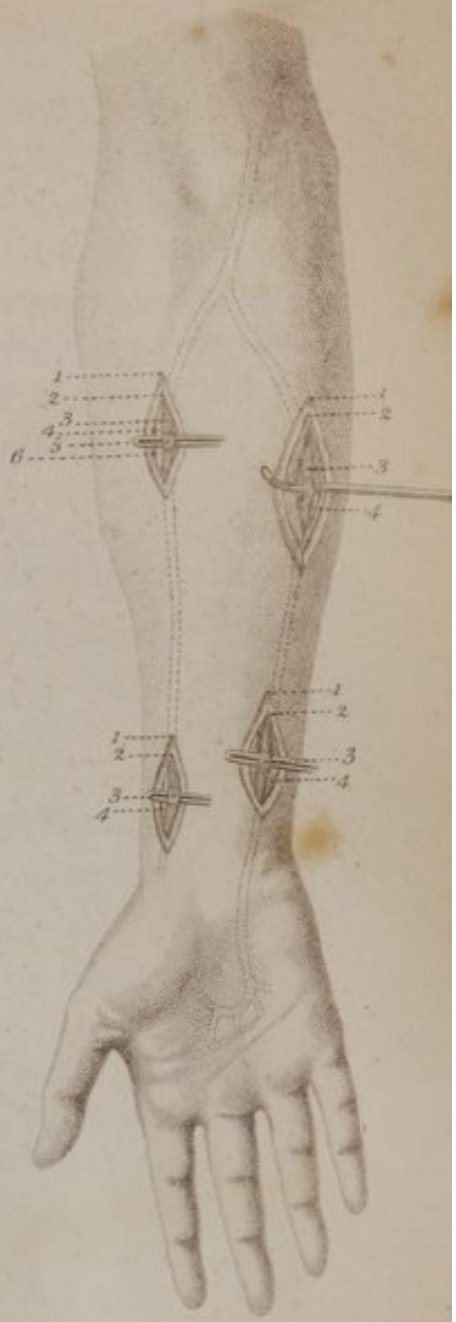


Fig. 4

Fig. 5.

to the extent of two and a half or three inches, the median vein pushed to one side, the supinator muscle exposed by laying open the fascia, and then its internal border raised with the finger or director, when the sheath of the vessels may be seen and opened. (Plate LXVI., Fig. 3.) If the artery is not met with, draw the muscle outwards until the radial nerve is seen, which is never absent; and seeking between this nerve and the median line of the arm, the artery will be found unless there is an anomaly.[1]

II. LIGATURE OF THE RADIAL AT THE WRIST.

Make an incision two inches long, parallel with and on the radial side of the tendon of the flexor carpi radialis about half an inch from the wrist; pick up the fascia in the forceps, nick it cautiously, and open it upon a director; when the artery will be found on the outer or radial side of the tendon.[2] (Plate LXVI., Fig. 3.)

REMARKS.—The ligature of the radial at the points mentioned may be required in cases of wounds of the palmar arch or at the wrist, and may be surely accomplished under the directions just given.

The constant practice furnished in superintending the daily operations of the members of my operating classes, enables me constantly to verify these rules, and, in the interval that has elapsed since the last edition of this work, I have found no reason to change them.

III. LIGATURE OF THE RADIAL ARTERY AT THE THUMB.

The ligature of the magna pollicis, or of the radialis indicis, at the root of the thumb, can seldom be required in practice; compression, or the ligature of the radial at the wrist, answering a better purpose. The operation, as an exercise, is shown in Plate LXV., Fig. 6, the incision being made in the line of the tendons of the extensor ossis, metacarpi pollicis, and extensor secundi internodii pollicis. The tendon being made prominent by forcibly extending the thumb, a little depression is created into which the French students drop their snuff, when desirous of taking a pinch with dirty hands, hence it has with them the name of the "Tobacco-box," "*La Tabattiere.*" The incision should be made in its middle.

[1] Malgaigne. [2] *Ibid.*

SECTION IV.

LIGATURE OF THE ULNAR ARTERY.

As the Ulnar artery lies more deeply than the radial, its relations require a little more attention.

§ 1.—ANATOMICAL RELATIONS OF THE ULNAR ARTERY.

The thickness of the flexor muscles near the elbow placing the Ulnar artery very deep at this point, no operation is usually attempted here, and it is therefore unnecessary to study its relations at its upper third. In the middle and lower third of the forearm, it lies upon the flexor profundus muscle, between the flexor sublimis and the flexor carpi ulnaris. (Plate LXVI., Fig. 1.) The ulnar nerve is on its ulnar or inner side, and the vein upon its outside, but this artery is subject to many anomalies, in some of which it is quite superficially placed.

§ 2.—LIGATURE OF THE ULNAR ARTERY.

The Ulnar artery may be tied in its middle and lower third as follows.

I. LIGATURE OF THE ULNAR ARTERY AT THE MIDDLE THIRD OF THE FOREARM.

ORDINARY OPERATION.—A line drawn from the internal condyle to the radial side of the pisiform bone, will indicate the usual course of the vessel; or a line may be drawn from the inner edge of the tendon of the biceps muscle, at the bend of the elbow, to the ulna at the junction of the upper and middle thirds of the forearm, and from this point to the pisiform bone, should the first fail to point out its pulsations. Upon either of these lines make an incision three inches long, and not extending higher than three fingers' breadth from the internal condyle; pick up the fascia, open it upon a director; carry the inner lip of the wound inwards with the fore-

finger until the internal edge of the ulnar can be felt, and then the first yellowish line, which indicates a muscular interspace met with on the median or radial side, will point out the junction of the flexor carpi ulnaris and flexor sublimis. Separate this interstice with the finger or knife-handle, and at the bottom of the space there will be seen a large yellow or whitish cord (ulnar nerve), with the artery and its two venæ satellites on its radial side, when the ligature may be passed from within outwards, the hand being strongly flexed to relax the muscles. (Plate LXVI., Fig. 3.)

II. LIGATURE OF THE ULNAR ARTERY ABOVE THE WRIST.

ORDINARY OPERATION.—Make an incision two inches long, and one inch above the joint parallel with the tendon of the flexor carpi ulnaris; pick up the fascia, divide it, draw the tendon a little inwards, and the artery will be found on its external side beneath the deep fascia, the ulnar nerve being on its inside and posteriorly. Open the deep fascia, and pass the ligature from within outwards. (Plate LXVI., Fig. 3.)

REMARKS.—The ligature of the ulnar artery at its upper third is now never attempted, on account of the difficulty of finding the vessel, as well as on account of the subsequent suppuration of the wound. It is also better to avoid, if possible, ligating this vessel in its middle third, for the same reason; the ligature near the wrist being sufficient for wounds of the palmar arch, in the palm of the hand, these being the cases which most frequently demand the operation.

CHAPTER III.

LIGATURE OF THE ARTERIES OF THE LOWER EXTREMITY.

THE main artery supplying the lower extremity being the continuation of the External Iliac, it is at different points named Femoral and Popliteal, according to its position, and may be ligated at any portion of its course.

PLATE LXVII.

LIGATURE OF THE ARTERIES OF THE LOWER EXTREMITY.

Fig. 1. Anatomy of the Femoral Vessels. 1, 1. Femoral artery. 2, 2. Femoral vein. 3. Internal saphena vein. 4. Muscular branch of artery. 5. Long saphenous nerve. 6. Branch in front of sheath of vessels. 7. Arteria profunda. 8. Opening in adductor muscle. 9. Musculo-cutaneous nerves. 10. Anterior crural nerve. 11, 11. Hooks holding aside sartorius muscle. After Bernard and Huette.

Fig. 2. Ligature of the Femoral Artery. *At its Upper Third.*—1. Skin. 2. Fascia. 3. Sheath of vessels. 4. Artery raised on the director. 5. Femoral vein. 6. Long saphenous nerve. 7. Inner edge of sartorius muscle. *At its Lower Third.*—1. Skin. 2. Fascia. 3. External edge of sartorius muscle. 4. Femoral vein. 5. Long saphenous nerve. 6. Artery exposed in its sheath. After Bernard and Huette.

Fig. 3. Anatomy of the Popliteal Artery. 1. Artery. 2. Vein. 3. Semi-membranosus muscle. 4. Gastrocnemius. 5, 5. Hooks holding aside the muscles. After Bernard and Huette.

Fig. 4. Course and Relations of the Popliteal Artery to the Joint. 1, 1. Artery. 2. Femur. 3. Tibia. 4, 4. Posterior face of knee-joint. 5, 6, 7. Articulating arteries. After Bernard and Huette.

Fig. 5. Ligature of the Popliteal Artery in its *Upper Half.* 1. Skin. 2. Fascia. 3. Fat. 4. Peroneal nerve. 5. External saphena vein. 6. Popliteal vein. 7. Artery as shown by 8, the hook holding aside the veins. After Bernard and Huette.

Fig. 6. Ligature of the Posterior Tibial Artery. *At its Upper Third.*—1. Skin. 2. Fascia. 3, 3. Gastrocnemius muscle held aside by a blunt hook. 4. Artery on the needle. 5. Soleus muscle. *At its Middle Third.*—1. Skin. 2. Fascia. 3. External edge of soleus. 4. Artery. 5. Needle under it. 6. Posterior tibial nerve. *At the Ankle.*—1. Skin. 2. Director under artery. 3. Posterior tibial nerve.

After Bernard and Huette.

Plate 67

Fig. 1.

Fig. 2.

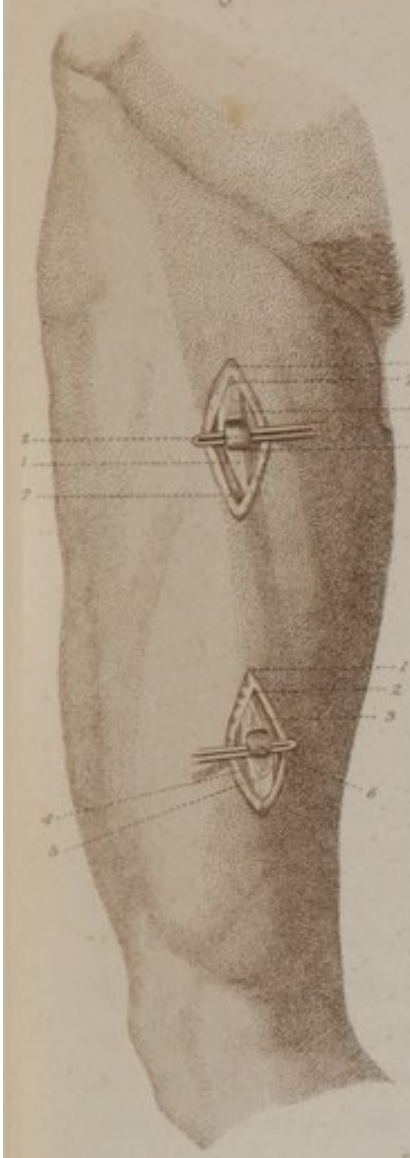


Fig. 6.

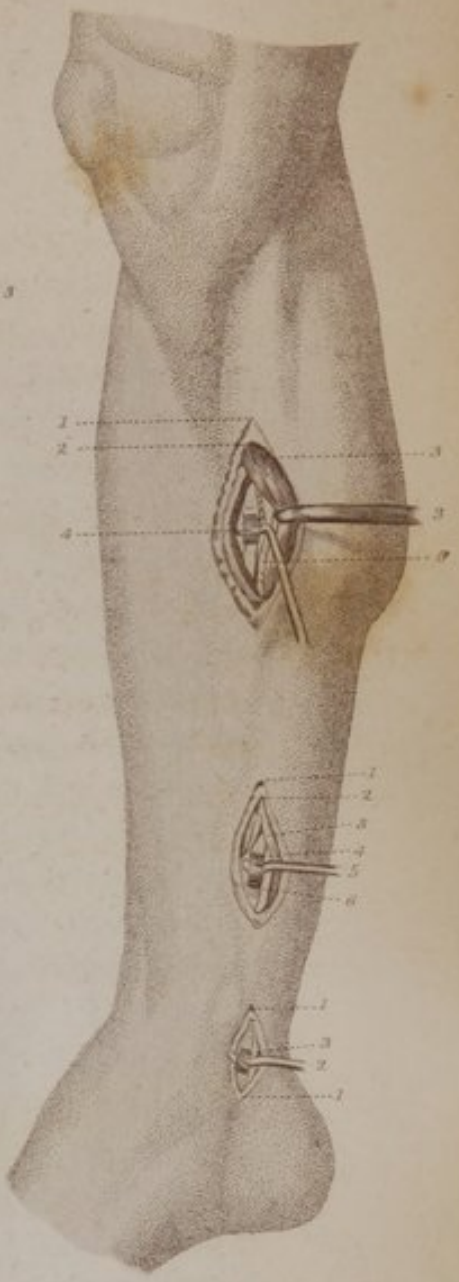
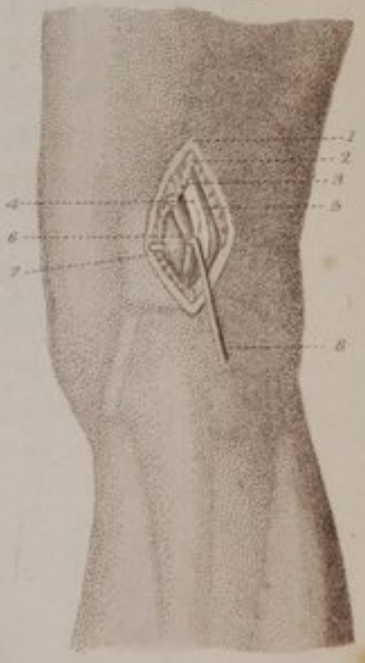


Fig. 4.

Fig. 3.

Fig. 5.



SECTION I.

LIGATURE OF THE FEMORAL ARTERY.

§ 1.—ANATOMICAL RELATIONS OF THE FEMORAL ARTERY.

The line of the groin, or that caused by the attachment of Poupart's ligament to the bones of the pelvis, constituting the upper boundary of the Femoral artery, continues under this name throughout its entire course, until it passes through the insertion of the adductor muscle, at a point which is about one-third of the whole length of the os femoris, above the knee-joint, when it takes the name of Popliteal artery. In the space thus described, the femoral artery runs a winding course, being first on the anterior, then on the inner side, and lastly, near the posterior face of the thigh, following the direction of a line drawn from the middle of the crural arch to the posterior and internal part of the condyle of the femur, or the course of the sartorius muscle, and being inclosed in a common sheath with the femoral vein, the latter being on its inner or pubic side near the groin, behind it in the middle of the thigh, and a little to its outer side below. (Plate LXVII., Fig. 1.)

The anterior crural nerve lies upon the external side of the artery outside the sheath of the vessels, whilst the long saphenous nerve enters the upper fourth of the sheath, and lies upon the outer side of the artery (Plate LXVII., Fig. 1). At its upper fourth, the artery is only covered by the skin and fascia, and may be easily compressed against the bones of the pelvis; but below it is crossed obliquely by the sartorius muscle, so that, at the upper part of the thigh, this muscle is on the outer side of the artery, covers it in its middle, and leaves the artery again to its outer side low down the thigh. The regular course of the muscle makes it a most useful point of reference when attention is given to its relations at the different points of the limb.

Dr. Mott, of New York, whose experience in the ligature of this artery has been very great, thinks it advisable to study the relations of the vessel at the three points in which it may be ligated, thus: 1st, at Scarpa's triangle, or the space bounded above by Poupart's

ligament, outside by the sartorius, and inside by the adductor longus; 2d, where it is covered by the sartorius muscle; and 3d, near the opening made for its passage through the adductor magnus muscle.[1]

§ 2.—LIGATURE OF THE FEMORAL ARTERY.

The Femoral artery may be tied either at its inferior, middle, or superior portions, the first two points being those most commonly resorted to, though it has been occasionally tied at its upper end. In all cases it is important to preserve the warmth of the limb by artificial heat until the circulation is restored.

I. LIGATURE OF THE FEMORAL ARTERY AT THE UPPER PART OF THE THIGH.

SCARPA'S OPERATION.—At this point, the artery is quite superficial, and may be readily felt pulsating in the triangular space (Scarpa's triangle) formed by the junction of the sartorius, adductor brevis, and Poupart's ligament, the base of the triangle being above or at the groin, and its apex below. The most favorable point, according to Hodgson, for the application of a ligature, is about four or five inches below the crural arch, because it gives room for the formation of a coagulum above the origin of the profunda. The operation should be performed as follows:—

Feel for the pulsation of the artery, and note the spot where it is faintest, which will indicate the point where it is crossed by the sartorius muscle, and commencing at this part incise the skin obliquely downwards to the extent of three inches, taking care to push the saphena vein inwards. On exposing the fascia lata, pick up a fold at the lower point of the incision; nick it, introduce a director, and slit it up to the same extent as the skin; open the sheath in the same manner, and expose the artery with the point of the director, the nerve being on its outside, and the vein still at its inner side, and tie it by passing the needle from within outwards so as to avoid the vein.

[1] New York Register, vol. i. p. 185.

II. LIGATURE OF THE FEMORAL ARTERY IN THE MIDDLE OF THE THIGH.

OPERATION OF HUNTER.—Flex the thigh on the pelvis, and the leg on the thigh, and lay the latter upon its outer face, so as to relax the muscles. Then, feeling for the inner edge of the sartorius muscle, make an incision three inches long, so that its lower end shall be about two lines from the inner edge of the muscle, and its upper about four, but without dividing the saphena vein. After incising the skin and fat, pick up the fascia in the forceps, nick it, introduce a director, and slit it up to the extent of the incision in the skin, so as to expose the internal border of the sartorius muscle, which may be recognized by the course of its fibres. Then carefully opening the sheath of the vessels, which here appears as a thick yellowish structure, incise it slightly upon a director, separate the vein from the inner side of the artery with the point of the director, and pass the aneurismal needle from *within outwards* (Plate LXVII., Fig. 2). If the needle is passed in the opposite direction, its point may wound the vein, and the escape of even a little blood will materially interfere with the sight of the surgeon and delay the operation.

OPERATION OF DR. MOTT.[1]—In the operations upon the Femoral artery, Dr. Mott advises the surgeon always to open the sheath of the vessels in front, and never to use the edge of the knife near the sides of the artery, or within its sheath, lest he wound some of the branches which generally are given off from its sides.

REMARKS.—The œdematous condition of the thigh, sometimes seen in cases demanding the ligature of the femoral artery, adds materially to the difficulties attending its ligation when required upon the patient, and the recent cure of a bad case of elephantiasis arabicum, consequent on the application of a ligature to the Femoral artery, reported[2] by Dr. J. M. Carnochan, of New York, presents us with another disease which may call for the performance of this operation, under circumstances which will render it difficult to recognize the ordinary guiding points outside the skin. As a means of cutting off the vascular supply of a hypertrophied tissue, and

[1] New York Register, vol. i. p. 186.

[2] N. Y. Journ. Med., vol. ix. N. S. p. 161, 1852.

enabling the patient to retain a limb which might otherwise have been amputated, this mode of treatment is eminently worthy of consideration in similar cases, and creditable to the surgical skill of the operator. As above described, these operations are chiefly adapted to the dissecting-room, or to the natural condition of the parts. When, therefore, any difficulty is experienced in recognizing the muscular spaces in the middle of the thigh, a line drawn from the middle of the groin, as directed, will prove of great service. Occasionally, the Femoral artery has been tied close to the crural arch, where its position can be readily recognized as being half way between the spine of the pubis and the anterior superior spinous process of the ilium in man, though a little nearer to the pubis in woman; but this operation is not so favorable as that lower down, as it exposes the patient to greater risks from the occurrence of gangrene, the origin of the profunda favoring the course of the circulation when the ligature is applied in the middle of the thigh. The ligature of the femoral artery, as practised in the lower third of the thigh, is shown (Plate LXVII., Fig. 2); but, as it requires the division of the arterial canal through the adductor magnus, and also makes a deep wound, it is seldom resorted to on the patient.

SECTION II.

LIGATURE OF THE POPLITEAL ARTERY.

§ 1.—ANATOMICAL RELATIONS OF THE POPLITEAL ARTERY.

The Popliteal artery being a continuation of the femoral, extends from the adductor magnus tendon to the inferior margin of the popliteus muscle, being covered by the vein which is between it and the skin, and somewhat internal to it above, but external below. The belly of the semi-membranosus, and the two heads of the gastrocnemius muscles, also cover it. The artery is first on the inner side of the femur, then approaches its posterior face, and, passing between the condyles, is in contact with the back of the knee-joint.

§ 2.—LIGATURE OF THE POPLITEAL ARTERY.

When the application of a ligature to this artery is deemed advisable, it may be accomplished by the method hereafter mentioned. But in aneurisms of this vessel its ligation would be very difficult, if not impossible, and compression had better be applied to the Femoral artery in the thigh, in accordance with the principles before stated,[1] or the ligature applied in the middle of the thigh.

LISFRANC'S OPERATION.—The patient being laid upon his face, with the limb extended, feel for the interval between the two heads of the gastrocnemius muscle, and make in this line a longitudinal incision three inches long, commencing at one-third of an inch below the joint and a little outside of the median line. Then, pushing aside the external saphena vein, pick up the fascia, nick it, introduce a director, and incise it to the extent of the opening in the skin; flex the leg on the thigh, and feel for the space between the two heads of the gastrocnemius, at the bottom of which the vessels and nerves will be found. Of these, the popliteal nerve is first seen, and on the inside of it is the vein, the artery being on the outside in the majority of cases, when it only remains to draw the nerve and vein inwards, and pass the needle under the artery from within outwards.[2] (Plate LXVII., Fig. 5.)

REMARKS.—The ligature of the popliteal, as above described, is an operation that is seldom or never undertaken, the depth at which the artery is placed, its proximity to the joint, and the liability of the latter to inflame, as well as the risk arising from the suppuration travelling beneath the fascia of the leg, inducing surgeons to avoid it. In all cases of aneurism, or wounds of the tibial arteries high up, it is easier and safer to tie the femoral at the middle of the thigh; and in the case of aneurism of the popliteal itself, the position of the tumor, as just stated, would render it absolutely necessary to place the ligature higher up. This operation is one, therefore, which is seldom practised except in the dissecting-room.

[1] Vol. i. p. 535.

[2] Malgaigne.

PLATE LXVIII.

LIGATURE OF THE ARTERIES OF THE LEG.

Fig. 1. Anatomical Relations of the Popliteal Region, as shown after removal of the integuments. 1. External saphena vein. 2. Popliteal nerve. 3. Peroneal nerve. 4. External saphenous nerve. 5. Superficial branch of peroneal nerve. 6. Superficial nerves outside the fascia of the leg. 7. Semi-membranosus muscle. 9. Internal saphena vein. 8, 8, 10. Cutaneous veins. After Bernard and Huette.

Fig. 2. Anterior view of the Knee-Joint. 1. Femur. 2. Patella. 3. Tibia. 4. Fibula. 5. Tendon of patella. 6. External and internal lateral ligament. After Bernard and Huette.

Fig. 3. Antero-Posterior Section of the Knee-Joint, showing the Relation of the Artery and Internal Parts of the Joint. 1. Section of the femur. 2. The Tibia. 3. The Patella. 4. The Crucial ligament. 5. The Popliteal artery. After Bernard and Huette.

Fig. 4. Anatomical Relations of the Posterior Tibial Artery. 1. The posterior tibial artery. 2, 3. Its two venæ comites. 4, 4. Section of the internal saphena vein. 5. Fascia of the leg. 6, 6. Hook holding back the fascia anteriorly, and the soleus muscle posteriorly, so as to expose the deep-seated parts. 7. Tibialis posticus muscle. 8. Flexor longus digitorum. 9. Internal malleolus. 10. Tendo-Achillis. After Bernard and Huette.

Fig. 5. Anatomical Relations of the Anterior Tibial Artery. 1, 1, 1. The anterior tibial artery in its entire course. 2, 2. Anterior tibial veins. 3. Anterior tibial nerve. 4. Peroneal artery and vein raised on a director. 5. Flexor longus pollicis. 6. Fibula. 7. Peroneus longus and brevis cut across. 8. Tibialis anticus, held back by the hook. 9. Extensor proprius pollicis. 10. External malleolus, covered by the fascia. After Bernard and Huette.

Fig. 6. Ligature of the Antero-Tibial and Peroneal Arteries. *Upper Incision.*—Ligature of the Anterior Tibial, near its Upper Third. 1. Skin. 2. Fascia. 3. Tibialis anticus muscle. 4. Extensor proprius pollicis. 5. The vein. 6. The artery raised on the needle. *Middle or Posterior Incision.*—Ligature of Peroneal Artery below its Middle. 1. Skin. 2. Fascia. 3. Peroneus longus. 4. External border of soleus. 5. Needle under. 6. The Peroneal Artery. *Lower Incision.*—Ligature of the Anterior Tibial at its Lower Third. 1. Artery. 2. Anterior tibial nerve. After Bernard and Huette.

Plate 68.

Fig. 1.

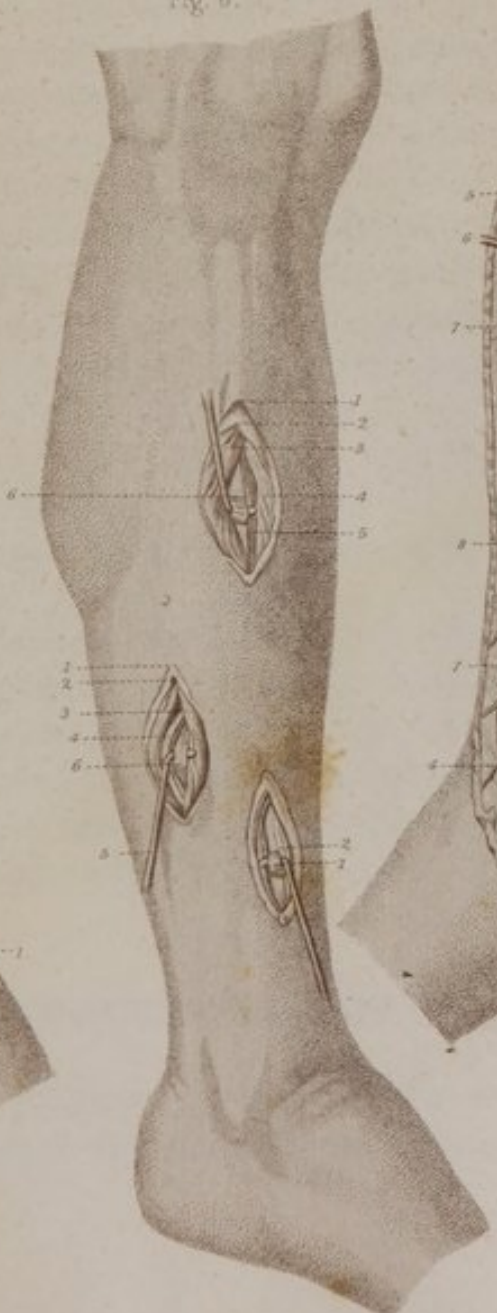
Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.



SECTION III.

LIGATURE OF THE POSTERIOR TIBIAL ARTERY.

§ 1.—ANATOMICAL RELATIONS OF THE POSTERIOR TIBIAL ARTERY.

The Posterior Tibial artery arises from the popliteal, and terminates beneath the internal annular ligament of the ankle, where it gives off the two plantar arteries. Its course is indicated by a line drawn from the middle of the ham to a point half way between the internal malleolus and tendo-Achillis. At its upper third, it lies very deep, being beneath the tibialis posticus, and being also covered by the deep fascia and the muscles of the calf. In its middle third, it is more superficial, and passes along parallel with the inner side of the tibia, from which it is separated by the flexor longus digitorum pedis, though it is also covered by the deep fascia and internal margin of the soleus. (Plate LXVIII., Fig. 4.)

At its lower third, it is immediately beneath the fascia, passes beneath the tendons of the tibialis posticus and flexor longus digitorum pedis, and is almost parallel to the posterior margin of the malleolus internus. It may be ligated at its upper, middle, or lower third.

§ 2.—LIGATURE OF THE POSTERIOR TIBIAL ARTERY.

The ligature of the Posterior Tibial artery may be accomplished, as stated, at any part of its course, but is seldom attempted except in its middle and lower third. Should it be desired to tie it above, the surgeon should be careful not to lose sight of its muscular relations, as an error in separating the proper muscles, as hereafter detailed, will probably cause the failure of the operation.

I. OPERATION AT ITS UPPER THIRD.

MALGAIGNE'S OPERATION.—Make an incision at least four inches long, entirely through the skin, cellular tissue, and fascia, com-

mencing about half an inch from the inner margin of the tibia; introduce the forefinger, and detach and carry outwards the internal head of the gastrocnemius as well as the soleus. Then, whilst an assistant holds these muscles backward and outwards, open the deep fascia upon a director, and look for the artery; on finding it, separate it from its accompanying veins, and ligate it. (Plate LXVII., Fig. 6.)

REMARKS.—This operation is an exceedingly troublesome one, in consequence of the depth of the incision and the contraction of the muscles. A trial upon the subject will soon satisfy any one of the difficulties to be encountered in the patient. It is, therefore, rarely resorted to.

II. LIGATURE OF THE POSTERIOR TIBIAL ARTERY AT ITS MIDDLE THIRD.

ORDINARY OPERATION.—Make an incision two and a half inches long and three-quarters of an inch from the internal edge of the tibia, as advised by Manec, and, cutting through the skin and fat, pick up the superficial fascia, nick it, introduce the director, and slit it up. Then push the soleus muscle upwards and outwards, so as to expose the deep fascia, or that which forms the posterior sheath of the muscle, divide it on the director, and separating the artery from its venæ satellites, carry the ligature around it either from without inwards, or the reverse. The posterior tibial nerve lies upon the outer side of the artery at this part of the leg, and is a good point of reference.

VELPEAU'S[1] OPERATION.—Make a straight incision, about three inches long, at an equal distance between the inner margin of the tibia and the tendo-Achillis, so as to divide the skin and fat; pick up the fascia, nick it, introduce a director, and slit it up to the same distance. Denude the deep fascia by separating the fibres of the muscle with the point of the director; incise it to the same extent as the skin; separate the artery, and tie it. (Plate LXVII., Fig. 6.)

[1] Operat. Surgery, by Mott and Townsend, vol. ii. p. 127.

III. LIGATURE OF THE POSTERIOR TIBIAL ARTERY BEHIND THE MALLEOLUS INTERNUS.

LISFRANC'S OPERATION.—Make a longitudinal or a semicircular incision in the skin parallel to the internal malleolus, but two lines posterior to it, extending half an inch below and one inch and a quarter above it. Pick up the fascia, and divide it carefully upon a director, when the artery will be fully exposed, accompanied by its venæ satellites. The posterior tibial nerve lies posteriorly and externally to the artery. (Plate LXVII., Fig. 6.)

REMARKS.—The ligation of the posterior tibial artery near the malleolus, is a simple operation, and one that is well adapted to the treatment of wounds of the plantar arteries. Velpeau prefers that the incision should be made at least half an inch behind the internal malleolus, and Manec that it should be half way between the tendo-Achillis and the malleolus. Of these methods I prefer the incision of Lisfranc, as its line will enable the operator to search to either side of it if he fails to fall upon the artery. As the vessel lies beneath the deep fascia, two layers must be divided after the skin, in order to expose it. The nerve, which is of some size, lies upon its outer or posterior side. The artery may also be found by seeking first the tendons of the tibialis posticus and flexor longus pollicis pedis, on their groove behind the sinuosity of the os calcis, and, finding them, the artery will be seen between and posterior to them, or between these tendons and the tendo-Achillis.

The operation in the middle of the leg is somewhat more difficult, owing to the depth at which the artery is placed.

SECTION IV.

LIGATURE OF THE ANTERIOR TIBIAL ARTERY.

§ 1.—ANATOMICAL RELATIONS OF THE ANTERIOR TIBIAL ARTERY.

The anterior tibial artery, after passing through the interosseous ligament in the upper part of the leg, lies upon the interosseous ligament in the upper two-thirds of the leg, but is upon the anterior face of the tibia below, till it gets upon the dorsum of the foot,

where it terminates by dipping into the first metatarsal interosseous space to anastomose with the branches of the plantar arch. (Plate LXVIII., Fig. 5.) In this course on the leg, it follows a line which is drawn from the middle of the space between the head of the fibula and spine of the tibia to the middle of the intermalleolar space, and from this space to the middle of the first metatarsal interosseous space of the foot. The anterior tibial nerve is successively seen on the outer side of the artery above; in front of it in the middle of the leg, and inside of it below, though throughout its entire course, it is very close to the artery. Owing to its depth, the anterior tibial artery is seldom tied high up, though it may be accomplished, and, in consequence of the proximity of the ankle-joint, it is seldom tied near the joint. The most common points are, therefore, its middle third, and that on the dorsum of the foot.

§ 2.—OPERATIONS FOR THE LIGATION OF THE ANTERIOR TIBIAL ARTERY.

I. LIGATURE OF THE ANTERIOR TIBIAL AT ITS MIDDLE THIRD.

ORDINARY OPERATION.[1]—The patient lying, or sitting with the leg extended, move the foot, so as to cause the tendon of the tibialis posticus to become prominent, and, following the course of the tendon when it can be felt, or the line above described when it cannot, make an incision three inches long through the skin and foot; open the fascia freely, and seek for the first tendon, or the first intermuscular space from the spine of the tibia. Separate the muscles at this point with the finger or director; flex the foot; hold back the muscles at the side of the wound with blunt-hooks, and the artery will be seen at the bottom of the space, with the anterior tibial nerve crossing it at this point of the limb, though it is on the inner side of the artery lower down. Pass the needle from the fibula towards the tibia, and from below upwards, and apply the ligature. (Plate LXVIII., Fig. 6.) Should the operator carry the incision too far outwards, the second intermuscular space may be found, and mislead him; to remedy which it is better, in case of doubt, to feel from the spine of the tibia outwards, and the error will soon be indicated.

[1] Malgaigne, Philad. edit. p. 157.

II. LIGATURE OF THE ANTERIOR TIBIAL ON THE DORSUM OF THE FOOT, SOMETIMES CALLED THE PEDAL ARTERY.

ORDINARY OPERATION.—Draw a line from the middle of the space between the two malleoli to the first metatarsal interosseous space, and make an incision through the skin along the *external* border of the tendon of the extensor proprius pollicis pedis, but parallel to it, or between it and the first fasciculus of the tendons of the extensor communis, which may be made prominent by causing the patient to extend his toes. After which, the sheath of the extensor communis, or the deep fascia, should be incised and opened upon a director, when the artery, with its two veins, will be clearly seen. The branch of the nerve lies to its inner side. (Plate LXVI., Fig. 4.)

REMARKS.—This operation is very simple, and may be performed in less time than it takes to describe it, as a little practice upon the subject will soon prove the most common mistake being the disposition to look for the vessel on the inner instead of the outer side of the tendon of the extensor proprius pollicis. The first fasciculus of the extensor communis tendons is, therefore, a better point of reference. The operation on this vessel may be required in the treatment of aneurism, as once happened to myself, or for wounds, though most frequently pressure suffices for the latter. The spica bandage of the instep[1] will be the proper dressing after the operation.

CHAPTER IV.

OPERATIONS ON THE BONES OF THE UPPER EXTREMITY.

THE operations performed for the relief of the affections of the bones of the upper extremity do not differ from those practised in the lower limbs, except in the slight modifications rendered necessary by their relations to surrounding parts. Certain general rules are, therefore, applicable to both extremities, and such additional

[1] Smith's Minor Surgery, p. 101.

remarks as are required beyond what were made in connection with the resection of the clavicle,[1] will be referred to below, the special operative proceedings being detailed in connection with the extremity to which they belong.

SECTION I.

RESECTIONS IN GENERAL.

By resection of the bones of the extremities, as has been before stated,[2] is usually meant such an operation as removes a sufficient portion of their structure to create a void or solution of continuity, but yet retains the limb, and subsequently permits a considerable degree of motion in it. In many instances, though resection of these bones results in more or less shortening, yet even then the member will prove to be much more serviceable than an artificial limb; and the operation is, therefore, one which enables the surgeon to remove the disease, and yet not destroy the usefulness of the extremity. The advantages of resection over amputation in disorders limited to the articulations, is, therefore, very apparent. In amputation, the entire member is often removed in consequence of a disorder which is comparatively limited, as in caries of the shoulder, or of the hip or knee-joint; whereas by a resection the diseased part is alone extirpated, the other and sound portions of the limb being left to perform their functions. For these reasons, the experience of surgeons is now gradually establishing the superiority of this operation over amputation, and the propriety of attempting the relief of diseases of the joints by its means should, therefore, be always thought of before resorting to any other. A looseness of expression has, however, led some surgeons to describe as resections operations which are really amputations. When, therefore, in any case, a bone is removed with the limb, the operation can only be regarded as an amputation, and not as a resection, the utility and chief characteristics of the latter class of operations consisting in the preservation of the motion of the extremity.

The general conditions which are essential for the proper performance of a resection may be divided into such as concern the patient, and such as pertain to the surgeon.

[1] See vol. ii. page 19.

[2] *Ibid.*

On the part of the patient, it is essential that the disorder, whether caries, necrosis, exostosis, or other bony tumor, should be limited in its extent, so that the surgeon may be certain of removing the entire complaint. The surrounding soft parts should also be in a condition favorable to the healing of the wound, without being liable to such contraction, suppuration, or ulceration as might subsequently impair the motion of the limb, the function of which should always be preserved after the operation, if only in a modified form.

The surgeon, in addition to the ordinary attributes of an operator, such as coolness and dexterity, should have an accurate knowledge of the relations of the adjoining structures, as the various muscles, tendons, nerves, and bloodvessels in the neighborhood must all be left untouched, if possible. Especially is it important to avoid unnecessary injury to the periosteum, as, through this membrane, the new structure will often be replaced in such a manner as to add much to the usefulness of the limb.

As the resection of the bones of the extremities is also very liable to induce severe constitutional disturbance, and to give rise to fever, erysipelas, or long-continued suppuration, much medical skill will be necessary to conduct the case to a favorable termination; it being essential to success that the after-treatment of the case be judiciously directed, the diet, and internal as well as local remedies, being carefully superintended by the operator.

For the performance of any resection, various saws, chisels, gouges, bone-nippers, &c., will be required, together with proper means for accomplishing the division of the soft parts, arresting hemorrhage, and dressing the wound. As the number of instruments resorted to in operations upon the bones is nearly indefinite, the reader is simply referred to Plate V. for a view of such as are most frequently wanted.

SECTION II.

RESECTION OF THE BONES OF THE UPPER EXTREMITIES.

The resection of the bones of the upper extremities may be practised either upon their diaphyses or upon their articulating extremities. In operating upon the diaphysis, a free external incision is necessary in order that the entire removal of the diseased structure

by saws, chisels, and gouges may be accomplished without creating a fracture.

As resection of the scapula and clavicle has been before referred to, in connection with the operations on the chest,[1] it only remains to describe the operations practised on the upper limb, from the glenoid cavity down to the fingers.

§ 1.—RESECTION OF THE SHOULDER JOINT.

The head of the humerus and the articulating surfaces of the scapula may, from caries, necrosis, or other complaints, demand resection, so as to free the patient from a source of irritation which might otherwise exhaust the powers of life. It may be accomplished by exposing the articulation, and removing the diseased portion by means of the saw or gouge.

OPERATION OF WHITE, OF ENGLAND.—Make an incision down to the bone parallel with the fibres of the deltoid muscle, and extending from the apex of the acromion four or five inches downwards, so as to open the capsule on the outer side of the joint; then carry the elbow in towards the body; luxate the head of the bone through the muscle, and saw it off.

SYME'S OPERATION.—Whilst an assistant compresses the subclavian artery, make a longitudinal incision, three and a half inches long, in the middle of the deltoid muscle, and a shorter one from its inferior extremity upwards and backwards, towards the posterior border of the axilla, so as to form a triangular flap. Raise it up, and whilst it is held by the assistant, carry the elbow in towards the side of the body, so as to render the capsular ligament tense. Open it by a circular incision around the head of the bone, luxate it, slip a piece of binders' board under it, and saw it off with the amputating saw. Then cleanse the wound (Plate LXIX., Fig. 1), bring down the flap, and attach its point to the skin of the arm by a single stitch of the interrupted suture, taking care to insure a vent for any pus that may accumulate; after which it only remains to apply the starch bandage and spica of the shoulder,[2] so as to leave the wound open.

LISFRANC'S OPERATION.—In this operation, a posterior flap is

[1] Vol. ii. p. 19 to 29.

[2] Smith's Minor Surgery, p. 39.

formed as in his amputation of the shoulder, the head of the bone being luxated, sawed off, and treated as above directed.

REMARKS.—Resection of the head of the humerus is an operation that has been repeatedly performed with success in cases of caries of the head of the bone, as well as of the glenoid cavity, the removal of the latter being readily accomplished by the bone-nippers, after the articulation is exposed. As a means of saving the patient the partial use of an important member, which in former times would have been amputated, this operation must be regarded as one of the most useful of those suggested within the last century. Although the scapula and end of the humerus are no longer in contact after the performance of this resection, a considerable amount of motion will yet be preserved at the shoulder, and in a case reported by Mr. Syme the use of the arm was almost completely established.

Resection of the head of the humerus has not, I think, been often performed by surgeons in the United States, the only cases that I have found being that reported by Dr. Hunt, of Washington;[1] and one of a partial character by Dr. Pinkney, U. S. Navy.[2] Amputation of the shoulder for disease of the bone has, however, often been resorted to, and it is to be hoped that more attention will be bestowed on this mode of treating caries of the head of the bone, as its resection is an operation well worthy of trial. In selecting a method, that of White should be preferred, if the induration and other changes in the soft parts do not forbid it, as it preserves the more perfect action of the deltoid, and thus facilitates the subsequent motion of the shoulder; but the section of the deltoid, as advised by Syme and Lisfranc, exposes the joint more freely, and is better adapted to such cases as may also require resection of the glenoid cavity of the scapula.

§ 2.—RESECTION FOR FALSE JOINT IN THE HUMERUS.

Resection of the ends of a false joint in the Humerus has been attempted in several instances, but as the complaint has frequently been cured by the introduction of a seton, as suggested by Dr.

[1] Med. Record., vol. i. p. 365, 1818.

[2] Am. Journ. of Med. Sciences, vol. xii. N. S. p. 330, 1846.

PLATE LXIX.

RESECTION OF THE BONES OF THE UPPER EXTREMITY.

Fig. 1. Syme's Operation for Resection of the Head of the Humerus. The patient being seated, an assistant compresses the subclavian artery with 1, his right forefinger, whilst with 2, the fingers of his left hand, he holds up the triangular flap. As the operation is just completed, 4 shows the glenoid cavity, and 5 the section of the humerus.

After Bourgery and Jacob.

Fig. 2. Bourgery's Operation for Resection of the Head of the Humerus. The arm being carried off from the body by 2, the left hand of the surgeon, the subclavian artery is compressed by one assistant, whilst the surgeon transfixes the soft parts near the end of the bone by a catlin, and cuts downwards, parallel with the humerus, to the length of three inches. Another assistant then passes 1, 1, a piece of bandage, through the wound and around the bone above and below, so as to protect the soft parts. The head of the bone being now isolated, it is sawed off by the chain-saw.

After Bourgery and Jacob.

Fig. 3. Moreau's Operation for Resection of the Elbow-Joint. 1. Hand of assistant reverting the quadrilateral flap. 2. Condyles of humerus. 3. Strip beneath the bone to protect the soft parts from the action of 4, the saw. After Bernard and Huette.

Fig. 4. The same Operation concluded. 1, 2, 3, 4. The quadrilateral flap replaced and held in position by the sutures. After Bernard and Huette.

Fig. 5. Resection of the Radius. 1, 2. Incision. 3. Hand of surgeon, disarticulating the bone. 4. The knife. 5. The inferior end of the radius. 6. Its superior portion. This operation should have been represented as the extirpation of the ulna, which has been accomplished by Dr. Butt, of Virginia, in a similar manner. After Bernard and Huette.

Fig. 6. Resection of the Lower End of the Ulna. 1. Triangular flap turned back. 2. The articulating surface of the bone. 3. A strip passed beneath the bone, to protect the soft parts from 4, the saw.

After Bernard and Huette.

Fig. 7. Velpeau's Operation for Resection of the Carpal Surface of the Radius and Ulna. 1, 1. Vertical incision. 2, 3. The transverse cut. This transverse incision is wrongly represented, as it should have been carried across from 1, 1, so as to revert the flap downwards.

After Bernard and Huette.

Plate 69

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

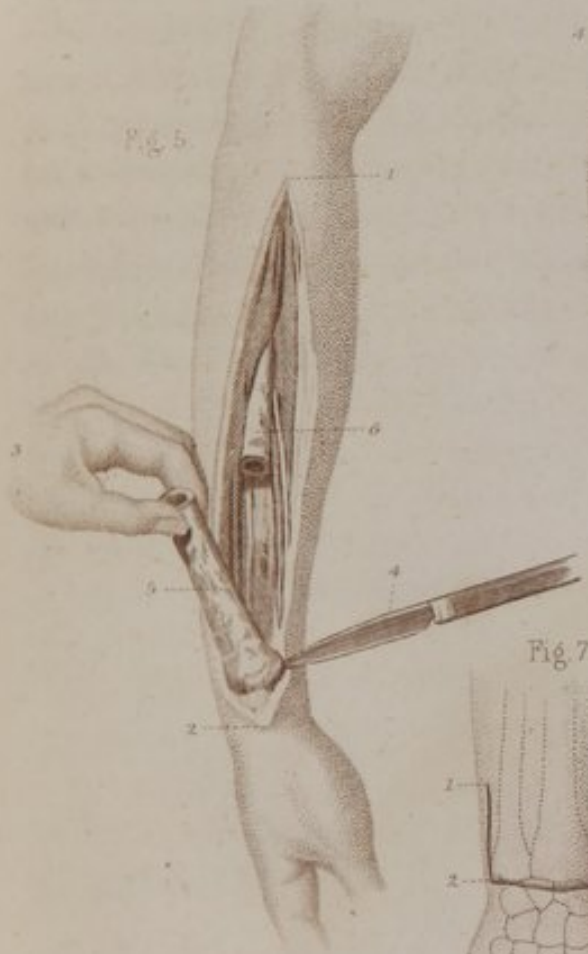
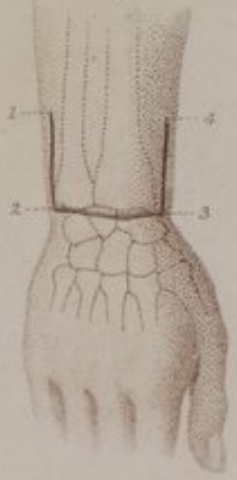


Fig. 6.

Fig. 7.



Physick;[1] and by the application of caustic by Dr. Rhea Barton, of Philadelphia;[2] the resection of the bones has not often been necessary. It has, however, been accomplished in the United States, by Dr. J. Kearny Rodgers, of New York,[3] and many others, by making an incision over the seat of the joint, exposing the ends of the bones, turning them out, sawing them off, and then treating the case as a recent compound fracture of the arm.

As a means of curing false joint, this operation, or any other which creates a wound, is liable to very serious objections. In a recent paper on the treatment of false joint, I suggested[4] the use of an apparatus which kept the ends of the bone in contact, and yet allowed free motion of the limb, and since this publication I have had such experience of its results as induces me to think it will do away with the treatment of false joint as heretofore pursued. In a future paper, I shall lay these results before the profession.

The treatment of a false joint by the use of the seton may be accomplished in accordance with the original plan of Dr. Physick.

Operation of Dr. Physick, of Philadelphia.—In the year 1802, a patient afflicted with a false joint in the middle of the humerus was cured in the following manner:—

A long seton-needle, armed with a skein of silk, being prepared, extension and counter-extension of the limb were made by two assistants, and the seton passed between the fractured ends of the bone in such a manner as to avoid the course of the artery. A pledget being then applied on each orifice made by the needle, the silk was left in the wound, the arm in a few days placed in the splints, and the dressing renewed daily. For *twelve weeks* no amendment was perceptible; but, soon after, the patient complained of pain, the bending at the seat of fracture became less apparent, and in about *five months* the arm was as strong as ever. Several other surgeons in the United States have since been equally successful.[5]

[1] Med. Repository, vol. vii. p. 122, 1804.
[2] Med. Record., vol. ix. p. 275, 1826.
[3] N. York Med. and Phys. Journ., vol. vi. p. 521, 1827.
[4] Am. Journ. Med. Sciences, vol. xxi. N. S. p. 106, 1851.
[5] Bibliographical Index, p. 144.

§ 3.—RESECTION OF THE ELBOW-JOINT.

Resection of the bones of the elbow-joint, like that of the shoulder, is also among the more recent operations of surgery, having been suggested by Park, of England, in 1781, and performed in 1782 by Moreau.[1] The process of Moreau is that which has been most generally approved, and it has been selected with occasional modification as the plan of most of the operations performed in the United States.

Operation of Dr. Thomas Harris, of Philadelphia.[2]—In the case of a woman, twenty-six years of age, laboring under hectic fever with suppuration in the elbow-joint, the following operation was performed:—

The operating table being covered by a mattress, the patient was placed on it with her face downwards, and with the posterior internal portion of the elbow presenting to the surgeon, whilst the point of a strong bistoury was passed transversely so as to divide the skin, cellular tissue, and tendon of the triceps, above and close to the olecranon process, and extend from the radial side of one condyle of the humerus to near the inner condyle, avoiding the position of the ulnar nerve. Two longitudinal incisions, three inches long, were then made on each side of the transverse one, so as to form a letter H, and make two quadrilateral flaps, which, on being dissected off, fully exposed the joint. The soft parts at each side, including the ulnar nerve, being now drawn to one side, by means of curved spatulæ, the olecranon process was removed by the common amputating saw. (Plate LXIX., Fig. 3.) The condition of the joint was then carefully examined, and all the articulating surfaces being found in a carious condition, the head of the radius and the diseased surfaces of the ulna and humerus were perfectly removed with the bone-nippers, two branches of the articulating arteries tied, the joint carefully cleaned, and the parts closed by sutures, and dressed with angular splints. The patient ultimately recovered with considerable motion in the joint.

Remarks.—Since the introduction of anæsthetics, the pain and shock from this operation have been materially reduced, and the

[1] Velpeau, Op. Surg.

[2] Am. Journ. Med. Sciences, vol. xix. p. 341.

chances of success thereby increased. One of the chief difficulties attendant on its performance is the risk of wounding the ulnar nerve, and in the patient operated on by Dr. Harris this was increased by the thickening and adhesion of the soft parts. To obviate this, Dupuytren proposed to open the sheath of the nerve cautiously behind the internal condyle, as soon as the upper flap was dissected, and have it held inwards and forwards by an assistant during the operation. A reference to the Bibliographical Index will show the reports of the operations performed by Drs. Gurdon Buck, Jr., and Stone, of New York,[1] and by Dr. J. Pancoast, of Philadelphia. In the operation of Dr. Buck (for the removal of the olecranon process), two longitudinal incisions were substituted for that of the H, the horizontal cut being omitted, and the sides dissected up so as to expose the bone without dividing the attachment of the triceps tendon. This is a valuable improvement on the H incision, and should be employed wherever it is admissible.

§ 4.—RESECTION OF THE BONES OF THE FOREARM AND HAND.

The bones of the forearm may be resected at any portion of their length; the removal of the upper articulating surfaces, and especially of the olecranon process, belongs, however, to the operation just detailed as resection of the elbow-joint, whilst the removal of the lower, constitutes resection of the wrist.

I. RESECTION OF BOTH RADIUS AND ULNA.

Operation of Dr. Compton,[2] of New Orleans.—A boy, æt. 15, having received a compound comminuted fracture of both the radius and ulna, as well as other injuries, on board ship, remained some days without proper treatment, the arm being in a sloughing condition and the bones protruding several inches out of the mass of muscles. About two months subsequently, having otherwise recovered, Dr. Compton made a straight incision the whole length of the inner side of the radius, and a counter opening opposite the

[1] Am. Journ. Med. Sciences, vol. v. N. S. p. 299.

[2] New York Journ. of Med., vol. x. N. S. p. 135, 1853, from New Orleans Med. Register.

olecranon process; dissected out both bones carefully; disarticulated them at the elbow, and removed them entire with the exception of the lower end of the radius, a great portion of the periosteum being, however, detached by nature and left in the wound.

This patient subsequently recovered; had entire use of the hand, so as to open and shut it; could grasp objects firmly; and had a firm forearm, although it was shortened about three inches. The forearm remained at a right angle with the humerus, but it could be flexed and extended so that the hand moved through eight or ten degrees of an arc of a circle. The pulse was readily perceptible in the boneless forearm.

II. RESECTION OF THE BODY OF THE ULNA.

The ulna or radius, when diseased to a considerable extent, may be removed from the arm without necessarily destroying the usefulness of the limb.

Operation of Dr. Butt, of Virginia.[1]—This operation, which was performed in 1825, has generally been referred to by European surgeons as extirpation of the *radius*, instead of the ulna, which was the bone resected by Dr. Butt in consequence of a long-continued necrosis.

Operation.—The patient being seated in a chair, and the tourniquet applied as usual, a transverse incision was made down to the bone, about four inches and a half below the olecranon, and extending to a little more than half the diameter of the arm. A longitudinal one intersecting the lower part of this cut being then made in the line of the most superficial part of the bone, and extended to the wrist-joint, the dissection of the soft parts around the bone was commenced at the transverse incision, and carried down three inches, until a spatula could be insinuated beneath the bone, so as to protect the soft parts from the action of the saw. The ulna being now divided transversely, the dissection was continued along the whole course of the bone down to the wrist-joint, a piece of twine being passed around the denuded end of the bone, so as to enable an assistant to elevate it, after which the bone was disarticulated from the wrist and removed. (Plate LXIX., Fig. 5.) The

[1] Philad. Journ. Med. and Phys. Science, vol. i. N. S. p. 115, 1825.

wound being cleansed, the tourniquet was loosened, the ulnar and interosseous arteries tied, and the edges of the longitudinal wound closed by adhesive strips, and that of the transverse by sutures. In three months, the patient was enabled to pursue his usual avocation as a carpenter; flexion, extension, and rotation of the wrist being as free and uninterrupted as ever, declaring subsequently that he had as much strength in this hand (the left) as most people had in the right.

III. RESECTION OF THE INFERIOR EXTREMITY OF THE ULNA.

OPERATION.—"The hand being carried outwards, make a longitudinal incision along the internal border of the ulna, and terminate it inferiorly by a transverse cut across the back of the joint. The triangular flap thus made being now raised and carefully dissected back, the tendons should be drawn aside, the artery avoided, and the bone disarticulated. A small piece of wood being then passed beneath the end of the bone, it may be readily sawed through."[1] (Plate LXIX., Fig. 6.)

REMARKS.—The success attending resection of the ulna has certainly been such as may induce others to repeat the operation in similar cases rather than amputate the limb, and in the variety of diseases of this bone which are met with from time to time, the surgeon should hesitate a long time before consenting to such a mutilation, as is caused by amputation, especially if the arm is the right one. Resection of the ulna, like resection of the head of the humerus, is an operation that has hardly been fairly developed by American surgeons, though a case of resection of the middle two-thirds of the bone, which resulted most fortunately, has lately been reported[2] by Dr. Carter Johnston, of Richmond, Virginia.

In quoting the case of Dr. Butt, which is, I believe, unique in its character (though smaller portions have frequently been extirpated), the French surgeons have been misinformed, both Malgaigne and Velpeau referring to it as a resection of the radius, whereas it was the removal of the lower two-thirds of the ulna. Dr. Pancoast, of Philadelphia, seems also to have fallen into the same error.[3]

[1] Bernard and Huette.

[2] Philadelphia Med. Examiner, vol. vii. N. S. p. 644, 1851.

[3] Operative Surgery, by Joseph Pancoast, M. D., Philad., p. 125.

In operating upon the radius, the same steps would be required as are described for the resection of the ulna, but the subsequent usefulness of the limb would be necessarily much more impaired, as the hand would be thrown out of its line with the arm, and pronation and supination destroyed.

IV. RESECTION OF THE WRIST-JOINT.

In the case of a dislocation of the bones of the forearm upon those of the carpus, in such a manner as to forbid their reduction, the resection of the inferior extremities of the radius and ulna has been advised and successfully practised. It has also been recommended to apply this resection to cases of caries of the wrist; but any one at all familiar with the structure of this joint must readily see that such an operation could offer but little prospect of success, except at the expense of a stiff wrist, as, under such circumstances, the bones of the carpus would probably participate in the complaint. Many cases will, however, be found in which even with a stiff wrist there may be considerable motion in the fingers, especially if the surgeon is careful throughout the treatment to flex them frequently, so as to prevent the tendons from becoming adherent to the front of the capsule of the inflamed joint.

Operation of Velpeau.[1]—By an incision on each side of the forearm, reaching from the root of the thumb, and from the last metacarpal bone upwards, for two inches above the level of the styloid process of the radius, and united by a transverse incision, a flap is formed and turned from above downwards over the back of the hand. The articulation being now carefully opened, and the ends of the bones turned out, the tissues on the front of the arm are to be dissected off, so as not to injure the radial and ulnar arteries, when a thin piece of board or lead being passed beneath, the bones may be readily sawed off with the amputating saw. The flap being replaced and united by sutures (Plate LXIX., Fig. 7), gentle pressure will unite it to the anterior surface, and the hand be ultimately useful to some extent.

[1] Velpeau, Op. Surg.

V. RESECTION OF THE METACARPUS.

One or more of the last four metacarpal bones may, occasionally, require resection in their middle, in consequence of a limited caries, or badly-treated fracture. When needed, the bone should be carefully exposed from the back of the hand by an incision parallel with its length, the tendon and other soft parts being protected from the knife, and then the bone either disarticulated at its extremities, or else a portion excised by the bone-nippers.

Resection of the metacarpal bone of the thumb is to be accomplished by a longitudinal incision, similar to that referred to under Amputations, and shown in Plate LXXIV., Fig. 7.

The operation presents, however, but an uncertain prospect of success, as regards the ultimate usefulness of the remaining portion of the thumb.

VI. RESECTION OF THE BONES OF THE HAND.

The phalangeal articulations may require resection in consequence of their becoming anchylosed in a straight position, and causing the patient the inconvenience of a straight and stiff finger. Under such circumstances, the bone should be exposed on the back of the finger, a V-shaped piece sawed out with a fine watch-spring saw, the finger kept flexed like a hook, and the parts allowed to heal in this position.

CHAPTER V.

OPERATIONS ON THE BONES OF THE LOWER EXTREMITY.

THE success attending the resection of the bones of the lower extremity has been much more brilliant than that ensuing upon the operations performed on the thoracic limbs, and it is to the surgeons of the United States, and especially to Dr. J. Rhea Barton, of Philadelphia, that the world is indebted for a most happy illustration of the advantages to be gained from a scientific application of mechanical principles, especially when aided by the efforts of nature in the formation of a new joint.

SECTION I.

RESECTION OF THE FEMUR.

The femur has been resected at its head, trochanters, shaft, and condyles, either for the removal of such portions as were diseased, or to restore the usefulness of the limb.

§ 1.—RESECTION OF THE HEAD OF THE FEMUR.

The head of the femur has been removed in cases of compound fracture, coxalgia, and caries, especially the latter; but though some few patients have ultimately recovered, it has only been after a long-continued and dangerous illness arising from the free suppuration and hectic fever which supervened, and these few were children about fourteen years of age, who were afflicted with caries. This operation should, therefore, be considered as a most dangerous one, and as especially unjustifiable in *coxalgia*, as the natural tendency of the complaint is to a cure, and anchylosis is as apt to follow the resection as it is to ensue on the progress of the disease. A reference to Plate LXX., Fig. 2, will sufficiently explain the steps to be pursued should any surgeon feel justified in attempting it.

§ 2.—RESECTION OF THE FEMUR FOR ANCHYLOSIS, AND FORMATION OF A NEW JOINT AT THE HIP.

Operation of Dr. Jno. Rhea Barton, of Philadelphia.[1]—A young man, 21 years of age, having his thigh immovably fixed at a right angle with his pelvis, and carried across the opposite thigh, whilst the foot rotated inwards, was operated on as follows:—

The patient being laid partially on the opposite side, a crucial incision, seven inches long, was made over the prominence of the trochanter major, and a transverse cut of five inches made to cross it at the same point. The four flaps thus formed being dissected back, the fascia was freely opened, and the muscular fibres over the

[1] North Amer. Med. and Surg. Journ., vol. iii. pp. 279, 400, 1827.

trochanter incised and detached from around the bone, so as to permit the two index fingers to be passed around the neck of the femur, until they met on the opposite side. With the strong narrow saw (Plate LXXI., Fig. 12), the bone was then nearly divided through the upper part of the great trochanter; and the neck—when the limb had been adducted—was drawn into its proper line, and the remaining portion snapped. No artery was cut; the wound was closed by a few sutures, and then dressed in Physick's modification of Dessault's splints.[1] The patient subsequently recovered, and by the formation of a false joint, produced at the resected portion, had during six years a limb upon which he could walk without apparent lameness. Dr. J. Kearny Rodgers, of New York, about four years afterwards, successfully performed a similar operation.[2]

SECTION II.

INTRODUCTION OF A SETON FOR FALSE JOINT IN THE FEMUR.

PHYSICK'S OPERATION for false joint in this bone was similar to that reported under false joint in the humerus, but was not successful. The operation has also failed in other cases in the femur, and was not thought by Dr. Physick to be adapted to the treatment of the disease in this bone.[3]

I therefore invite special attention to the account of the treatment of false joint in the humerus, as before given, and to the plan of treating all false joints by an artificial support, which I suggested in 1851.[4] Having been pursuing this plan, since this period I have succeeded in obtaining the histories of four cases of false joint of the femur, which, in my own hands, and that of professional friends, have resulted in a cure in three instances, and, in the fourth, enabled the patient to walk with only a cane, though union did not occur, the patient being in advanced life. Eight or ten cases of false joint in both bones of the leg have also been cured in a few weeks under this plan of treatment, whilst the patients were able to walk about. As the treatment consists in the application of an apparatus, and

[1] Smith's Minor Surgery, p. 252, 3d edit.

[2] Am. Journ. Med. Sciences, vol. i. N. S. p. 507, 1840. Reference to this paper has been overlooked in the Bibliographical Index.

[3] Dorsey's Surgery, vol. i. p. 135.

[4] Am. Journ. Med. Sci., vol. xxi. N. S. p. 106, 1851.

PLATE LXX.

RESECTION OF THE BONES OF THE LOWER EXTREMITY.

Fig. 1. Barton's Operation for Resection of the Neck of the Femur, and the Formation of a False Joint in a case of Anchylosis of the Hip. 1, 1. Flaps of integument formed by a crucial incision, and turned back. 2. Incision of muscles over trochanter major. 3. The retractor passed around the bone, to protect the soft parts from 4, the narrow saw.

After Nature.

Fig. 2. Sedillot's Operation for Resection of the Head of the Femur in Caries. 1, 1, 1. Semilunar incision through the soft parts, convex above, and exposing the joint. 2. A strip slipped beneath the bone. 3, 4. The chain-saw in the act of excising the head of the bone.

After Bernard and Huette.

Fig. 3. Barton's Resection of the Femur by the removal of a V-shaped piece, in order to straighten a limb which was anchylosed at the knee nearly to a right angle. The flap has been reverted to show the section of the bone. After Nature.

Fig. 4. Resection of the Lower Extremity of the Femur. 1, 1. Retractor applied to the soft part. 2. Strips beneath the bone. 3. Portion of the femur to be excised. 4. The amputating saw.

After Bernard and Huette.

Fig. 5. Resection of the External Malleolus. 1. Left hand of the surgeon. 2. The chisel. 3. A steel hammer. After Bernard and Huette.

Fig. 6. Roux's Operation for Resection of the Lower Extremity of the Tibia. The soft parts being freed by a vertical incision, a retractor, 1, has been passed beneath the anterior flap to elevate it. 2. A strip beneath the posterior edge of the bone. 8. A small saw, dividing the bone before it is reverted and disarticulated. After Bernard and Huette.

Plate 70.

Fig. 1.

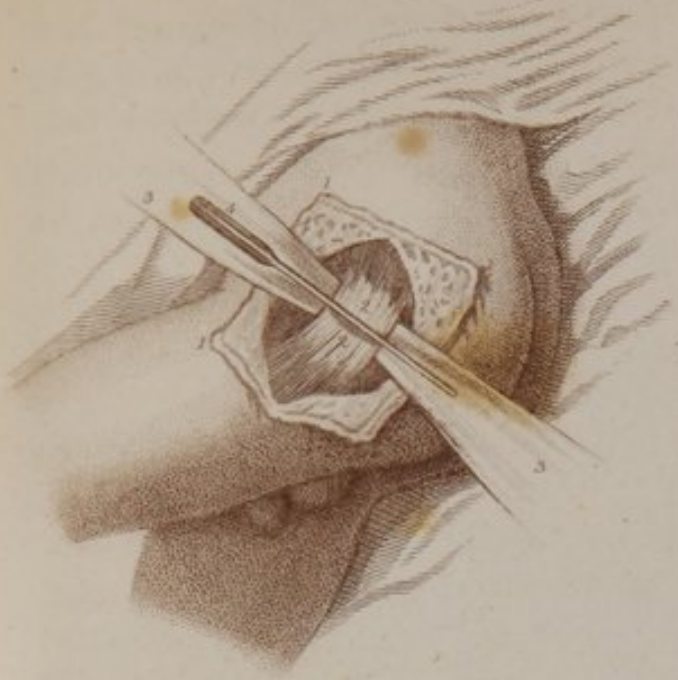


Fig. 2.

Fig. 3.

Fig. 4.

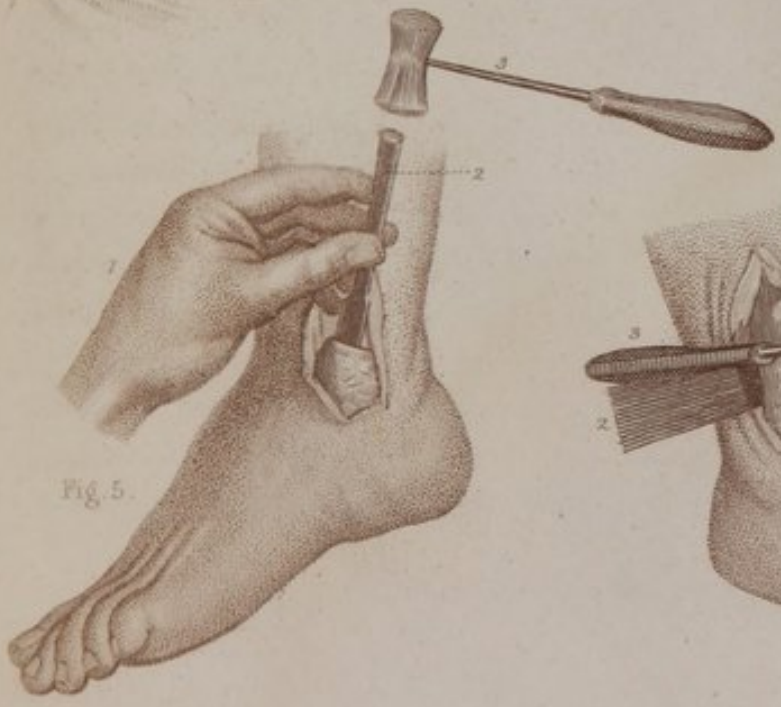
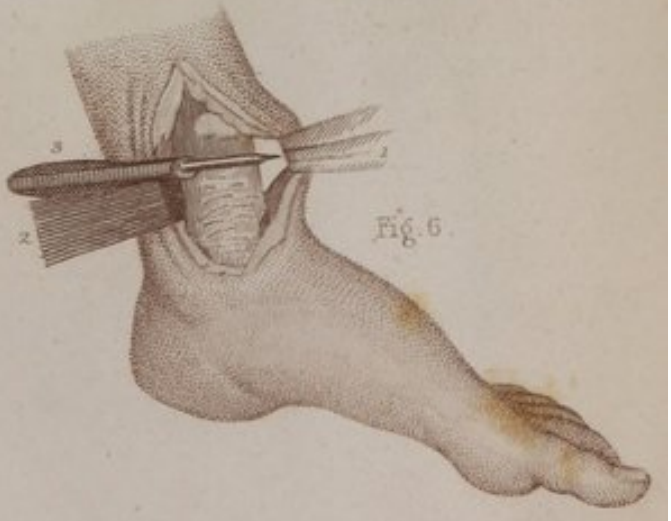


Fig. 5.

Fig. 6.



does not require an operation, its description would here be out of place, and I shall therefore present it in a short time through the medium of the medical journals. Its principles are to be found in the first paper which I published in the *American Journal of Medical Sciences*, referred to in the account of false joint in the humerus.

SECTION III.

RESECTION OF THE KNEE-JOINT.

In cases of anchylosis of the knee-joint, the resection of a V-shaped piece of the femur was suggested by Dr. Barton as a means of furnishing a useful limb, especially when the joint is flexed. As this operation has since been successfully performed, and repeated by various surgeons in the United States, it is now justly regarded as a standard one in cases of true anchylosis resulting in permanent flexion of the knee.

Operation of Dr. Jno. Rhea Barton, of Philadelphia.[1]—A physician, having his leg permanently flexed and anchylosed upon the thigh, to a degree somewhat less than a right angle, as the result of inflammation which had existed in childhood, determined to obtain relief, and underwent the following operation in the hands and at the suggestion of Dr. Barton, on the 27th of May, 1835:—

Operation.—By an incision which commenced at a point opposite the upper and anterior margin of the external condyle of the femur, and passed obliquely across the front of the thigh to terminate on the inner side, the soft tissues were incised. A second, which commenced also on the outer side, about two and a half inches above the first, and also passed obliquely across the thigh to join the other in an acute angle, being now made, the tendon of the quadriceps femoris, and some of the fibres of the muscles, were divided, the flap turned back, the bone freely exposed, and a triangular, or wedge, or V-shaped piece of bone (Plate LXX., Fig. 3) easily removed by means of a small narrow-bladed saw. This wedge of bone not including the entire diameter of the femur at this point, a portion of the shaft of the bone was left undivided posteriorly, that it might at first protect the artery from the saw, and, by subse-

[1] Am. Journ. Med. Sciences, vol. xxi. p. 332, 1837.

quently interlocking the fragments, prevent the sharp edges of the bone from injuring the soft parts. By slightly bending the leg backwards, these fibres were now gently broken, and the operation, which lasted about five minutes, entirely completed.

No bloodvessels being injured, the flap was restored to its place, the wound lightly dressed, the patient placed in bed upon his back, and the limb supported upon a splint *of an angle corresponding to that of the knee before the operation*: This position being retained until it was supposed that the asperities of the bone were removed, a splint, with a more obtuse angle, was applied, and changed from time to time until the limb had attained a position almost straight, when it was kept permanently in that line until the bones united. During the treatment, special care was taken to protect the popliteal vessels from pressure by employing long hair bags at the sides of the splint, so as to leave a vacancy in the course of the artery, the interspace being filled with lightly-carded cotton. The constitutional symptoms, though somewhat severe, resembled those usually seen in a compound fracture, but, in four months, the patient stood erect, with the feet in their natural position, and both heels touching the floor, although a slight angle had been designedly left at the knee in order to obviate the necessity of throwing out the limb in the act of walking, which would have been the case if the knee had been kept perfectly straight. The patient ultimately recovered perfectly. A reference to the Bibliographical Index[1] will show that this operation has been repeated in the United States by Dr. Wm. Gibson, Pancoast, and T. D. Mütter, of Philadelphia; by Dr. Burr, of Louisiana, and in a modified form by Drs. Buck, of New York, and Wedderburn, of New Orleans.

Remarks.—In the observations of Dr. Barton, connected with the history of this case, there may be found some most valuable remarks on the advantages of the plan which he pursued, and especially on the value of the section of the bone at a proper angle. To obtain this, and it is essential to the cure, it will be found advantageous to resort to the rule proposed by Dr. Goddard, of Philadelphia,[2] and practised by Dr. Mütter, which is as follows: "Take the angle of deformity, and then remove from the bone the complement of the angle." The use of Stromeyer's splint, as employed

[1] Bibliographical Index, p. 145.

[2] Philad. Med. Examiner, vol. vii. N. S. p. 39, 1851.

by Dr. Mütter in his case, would also be an improvement on the original dressing, as the popliteal space will thus be left entirely free from pressure, and the limb may be readily and gradually extended, as required.

§ 1.—REMOVAL OF A PORTION OF THE PATELLA, CONDYLES, AND ARTICULATING SURFACES OF THE TIBIA.

OPERATION OF DR. GURDON BUCK, JR., OF NEW YORK.[1]—A patient, twenty-two years of age, had his right knee anchylosed at a right angle, in consequence of traumatic inflammation, seven years previous. The condyles of the femur were prominent, and stood in advance of the tuberosity of the tibia, with the patella deeply and immovably imbedded between them; the tendons in the ham stood out in bold relief from the limb, but the surrounding soft tissues were healthy, though the deformed limb was shortened and less developed in every respect than its fellow. By modifying the operation of Dr. Barton, it was supposed that it would be feasible to obtain greater strength of limb, and less remaining deformity.

OPERATION.—The hamstring tendons having been divided, some days before, by a subcutaneous section in which the peroneal nerve was cut across, the patient was placed in a proper position, the tourniquet applied, and an incision made from the outer to the inner condyle, across the middle of the patella, and a second incision from the middle of this, perpendicularly, downwards to the tuberosity of the tibia. The integuments being dissected as low down as a finger's breadth below and parallel with the margin of the articulating surface of the tibia, the ligament of the patella and the fibro-ligamentous tissues on either side were cut through on the same level, to nearly the extent of two-thirds of the circumference of the bone. A section of the tibia was then made, three-fourths of an inch below the joint anteriorly, and directed obliquely upwards so as to terminate at the margin of the articulating surface posteriorly, two-thirds of this section being accomplished by the amputating saw. Another section was then made with the same saw through the upper part of the patella, parallel with the first, and on a plane forming an

[1] Am. Journ. Med. Sciences, vol. x. N. S. p. 277.

angle with it less than a right angle, and continued to about the same extent, the remainder of the section through the tibia and condyles being completed with a metacarpal saw. This wedge-shaped piece being now removed, it was found that the section had not divided the posterior portion of the condyles, which still remained consolidated with the tibia. A new section was therefore undertaken, commencing upon the cut surface of the femur three-fourths of an inch anterior to the angle at which the previous sections met, and directed more obliquely upwards and backwards. The remaining points of connection being then cautiously ruptured by flexing the leg, the rough prominences were pared away with the bone nippers. On attempting to extend the leg, it was found that the bony surfaces could only be brought to within a finger's breadth anteriorly, as the soft parts in the ham offered great resistance. These were therefore dissected up, and a further section, five-eighths of an inch thick, removed from the anterior two-thirds of the femur, which enabled the surgeon to extend the leg and bring the bony surfaces in contact. The section of the condyles now exceeding that of the tibia in its antero-posterior diameter, there was an overlapping in front of about half an inch. But two ligatures were required; and the soft parts posterior to the joint, and separating it from the artery, were very little disturbed, but the angular flaps of integument being redundant were pared away to the requisite extent, and secured in contact by seven sutures. The limb being then placed on an inclined plane, adhesive strips were applied between the sutures, and dry lint laid over the whole. The operation lasted forty minutes, and the patient left his bed in about three months with an apparatus, but shortly recovered, and was able to walk on a sort of stirrup-iron beneath the foot, the leg on this side being about five inches shorter than the other at the heel, though half of this might be ascribed to the defective development of the limb subsequent to the inflammation of the joint.

Remarks.—The selection of this plan of operating having probably been caused by the peculiar difficulties of the case, it is difficult to make a just comparison between these two methods. The opinion of a want of strength in the support afforded by the operation of Dr. Barton, which seems to have originated the plan pursued by Dr. Buck, is, however, an erroneous one, as has been proved in several instances, while the section above the condyles,

as practised by Dr. Barton, can be made to remove the difficulties connected with contractions about the ham. Except under peculiar circumstances, I think, therefore, that the operation above the knee would be the best, as it causes little deformity from shortening, and is much more simple.

§ 2.—RESECTION OF THE BONES OF THE LEG.

Resection of the bones of the leg, in order to cure a false joint, has been repeatedly performed, but requires no special description, being effected usually by incising the soft parts, turning out the ends of the bones, sawing them off, and then treating the case as a compound fracture. In the leg, this operation is much more serious in its results than it is in the humerus, and it is also one that exposes the patient's life unnecessarily, especially as a cure may be accomplished, or a useful limb obtained with less risk, by means of an artificial limb or splints applied so as to enable the patient to walk about during the progress of the cure, as I have succeeded in doing in two instances,[1] in one of which an ununited fracture of several months' standing recovered in a few weeks, simply in consequence of the stimulus of motion. In several instances since this period, cures of false joint have been accomplished by my method of treatment; and in no case would I, therefore, attempt any operation in false joint until these or similar splints had been worn for a twelvemonth.

A partial resection of the tibia, or a perforation of its shaft, is sometimes required in order to give vent to accumulations of pus within its cancellated structure, when the diagnosis is positive, as may be learned by studying the symptoms of the complaint, as detailed in the various articles that have been written on it. An instructive case has also been reported[2] by Dr. Strong, of Boston, showing the practice of Dr. Nathan Smith, of New Haven, in the complaint, but as the operation consisted solely in a simple perforation of the bone, my limits forbid its republication.

[1] On the Treatment of Pseudarthrosis by an apparatus which permits the use of the limb, and obviates the necessity of the amputation. (Am. Journ. of Med. Sciences, vol. xxi. p. 106, 1851.)

[2] Am. Journ. Med. Sciences, vol. xxv. N. S. p. 83, 1853.

§ 3.—EXTRACTION OF THE FIBULA.

Make an incision down to the bone at its central portion, denude it of the soft parts, pass the chain-saw around, saw it across, and then disarticulate it at each extremity. But in removing the upper portion, the surgeon will probably be compelled to divide the anterior tibial nerve, where it winds round the neck of the bone.[1]

As this bone is seldom diseased without the tibia being similarly affected, its separate resection is a rare operation.

SECTION IV.

RESECTION OF THE ANKLE.

One or both bones of the leg may be resected at the ankle-joint, in the manner described in the ensuing cases.

§ 1.—RESECTION OF THE INFERIOR EXTREMITY OF THE TIBIA AND FIBULA.

Resection of the inferior extremity of the bones of the leg has been performed in cases of severe wounds of the ankle-joint complicated with dislocation, as well as in those of compound fracture. These operations have, in a few instances, been attended with more success than might have been anticipated from a knowledge of the structure concerned; a French surgeon, named Josse, "having removed, in one instance, two inches of the right tibia, and in another more than an inch from the left tibia and fibula of a patient, who yet, at the end of three months, walked with the aid of a cane."[2] Such cases must, however, be regarded as wonderful instances rather than as ordinary examples of success. More frequently, the patient will suffer from severe constitutional disturbance, and, if he recovers, will have a limb considerably shortened, as well as a stiff ankle. It becomes, therefore, questionable whether, under such circumstances, an artificial foot and leg would not answer better than the natural one. When, however, it is desired to perform this resection, it may be accomplished in several ways.

[1] Malgaigne.

[2] Velpeau, Op. Surgery, by Mott and Townsend, vol. ii. p. 822.

ROUX'S OPERATION.—Make a longitudinal incision, three inches long, on the outer side of the fibula, commencing over the external malleolus. From the inferior extremity of this, carry a transverse incision as far as the tendon of the peroneus tertius. Dissect up the flap, and open the sheath of the two other peronei tendons, push them back, expose the fibula from behind, avoiding the vessels and nerves; insinuate a chain-saw between the tibia and fibula from within outwards, divide the bone, raise up its lower extremity and disarticulate it. Then place the leg on its external side, and make a longitudinal incision on the tibia from the internal malleolus, about three and a half inches upwards, and from its extremity make a transverse cut as far as the tendon of the tibialis anticus. Dissect up the flap, and isolate the surrounding parts by passing a piece of pasteboard beneath the bone, drawing the vessels and tendon to one side, and then cut across the bone with a narrow saw. The tibia being thus divided, it is to be disarticulated in the same manner as the fibula[1] (Plate LXX., Fig. 6).

§ 2.—RESECTION OF THE ASTRAGALUS.

The removal of any of the bones of the tarsus must be the result of circumstances, and the only directions which can be given in relation to them is to open the integuments freely at the most prominent point of the bone, and then free its attachments. It is, however, desirable that the wound should be so contrived as to place the cicatrix at such a point as will not expose it to pressure or friction in the act of walking, in order to prevent the constant recurrence of ulcers in this part.

The astragalus has been successfully removed in cases of compound dislocation, by Drs. Alexander H. Stevens, of New York;[2] Wm. A. Gillespie, of Virginia;[3] Barton, of Philadelphia, in 1831;[4] Dr. Geo. W. Norris, of Philadelphia, and by a few other surgeons. There is, therefore, sufficient evidence to show that, in compound dislocations of this bone, it is desirable to attempt its resection or extirpation before resorting to amputation of the leg.

[1] Bernard and Huette, Med. Operat., p. 103.

[2] N. Y. Med. and Phys. Journal, vol. v. p. 560, 1826.

[3] Am. Journ. Med. Sciences, vol. xii. p. 552, 1833.

[4] Liston's Pract. Surgery, Philad. edit. p. 141, 1842.

§ 3.—RESECTION OF THE OS CALCIS.

Within the last six years, the progress of conservative surgery has led several surgeons to attempt the resection of bones which it was formerly thought could not be removed without destroying the utility of the limb. Among the most marked of these has been the resection of the entire os calcis, which, in the hands of Messrs. Hancock, Wakley, Greenhow, Potter, Page, Gay, Simon, Lowe, Field, and others in England, has resulted favorably. In a report on this operation by Mr. H. Martineau Greenhow, of New Castle, England,[1] twelve cases are mentioned, of which ten were successful, the caries or necrosis having, in several instances, involved the other bones of the tarsus to some extent. The disease had lasted from eight weeks to ten years, and in some of Mr. Greenhow's cases the bone was so carious "as to resemble a very porous sponge." The experience of the surgeons above named, has shown that the preconceived objections to this operation are invalid; "the incisions healed readily, in some instances even by the first intention, the joint was generally very movable, the tendo-Achillis attached itself perfectly to the soft parts (muscles and integuments of the heel), adapted itself to the new condition of the ankle, the foot was at once put in a comfortable state, and the patient at last had a limb which was almost as serviceable to him as its fellow." The mode of operating has necessarily been varied, owing to the peculiarities of each case, some of the surgeons preserving the sole of the foot entire, and others forming a flap or flaps from it.

Mr. Hancock's Operation.[2]—A single flap was formed in the sole of the foot with its convexity looking forwards, by an incision which commenced at one malleolus and ended at the other.

Mr. Greenhow's Operation.[3]—In four cases, this surgeon operated as follows: In three cases, the incisions were made first from the inner and outer malleoli to meet at the apex of the heel, and then others extended along the side of the foot, the flaps being dissected back so as to freely expose the bone and its connections. In the fourth case, the incision commenced at the point of the heel, was carried slightly upwards towards the inner malleolus, and then

[1] Brit. and Foreign Med.-Chirug. Rev., No. xxiii. p. 233, July, 1853.

[2] *Opus citat.* [3] *Ibid.*

slightly downwards and forwards. This being repeated on the external side, two curved flaps were formed and dissected upwards and downwards.

§ 4.—RESECTION OF THE METATARSAL BONES AND PHALANGES.

The resection of these bones is to be conducted on the same principles as those of other parts, and the incisions to expose the bone will be similar to those described hereafter under Amputations of the Foot.

CHAPTER VI.

GENERAL REMARKS ON AMPUTATIONS.

As the amputation of a large limb necessarily destroys the equilibrium which had previously existed in the forces of the economy, it should always be regarded as a serious operation, and liable to involve the life of the patient. As it also removes a part which is often essential to the daily maintenance of the individual, and, in too many instances among the laboring classes, renders them paupers for life, it is an operation which should be resorted to as seldom as possible, and only when a careful review of the moral and physical condition of the patient establishes the fact that the mutilation of the body is better than the loss of life. Possessed of a very moderate amount of mechanical skill, and with a little resolution, any one may be able to perform an amputation; and the renown sometimes supposed by young surgeons to be attached to the performance of this operation, may well be deemed of a doubtful character, as it tacitly implies that, by a more judicious and skilful treatment, they might perhaps have avoided such a mutilation. As such an operation is also liable to affect injuriously the reputation of a young surgeon, it will prove to be a good rule never to amputate a limb without having a consultation with two or more other practitioners, if it is at all possible to obtain their opinion, as the most serious cases have occasionally recovered without losing the limb, even when the surgeon has openly declared such an event

to be impossible; whilst, on the other hand, legal proceedings on a charge of mal-practice have been subsequently instituted against the surgeon when a patient has been disposed either to escape the payment of a bill or gratify a malicious disposition. Too much caution can then hardly be shown by the young surgeon in resorting to this operation, especially when it is not sanctioned by the opinion of his seniors.

SECTION I.

CASES FOR AMPUTATION.

The propriety of performing amputation in cases of gunshot wounds and compound fractures, in gangrene, or for the removal of malignant growths, is a question on which there has been much diversity of sentiment, and if my present limits permitted, this subject might advantageously be allowed to occupy several pages. I shall, however, be compelled to confine its consideration to a condensed statement of the opinions of distinguished authorities in a few of the more serious cases, and to the general statement that amputation is proper in any case, only, when the disease or injury which appears to demand it is otherwise incurable, or when the patient is so circumstanced that the omission of the amputation would increase the chances of death.

§ 1.—GUNSHOT WOUNDS.

The necessity of amputating in these injuries, it has been generally admitted, should be regulated by the fact of their producing a compound fracture opening into a large joint, or the mutilation of the principal bloodvessels and nerves; but, in all these cases, the position and circumstances of the patient should not be overlooked, as injuries may demand amputation in the field, which, in private life, would recover without it.

The views of surgeons in regard to the indications for amputation in gunshot fractures differ somewhat, according to the position of the injury. In the femur, it is nearly universally admitted to be imperative. Thus, Ravaton thinks such a fracture is nearly always fatal; Ribes mentions that, in an aggregate of four thousand cases

at the Hôtel des Invalides, in Paris, there was not a single cure; De Claubry, surgeon of the Imperial Guard, was of the same opinion, most of the soldiers in Spain dying unless the limb was promptly amputated; whilst Percy, Thompson, Larrey, Guthrie, and Hennen express nearly the same views.[1]

Mr. Guthrie, however, states that in the upper extremity it is very different, and that "this limb should not be amputated for almost any accident that can be produced in this way."[2]

In gunshot wounds of large joints, which produce fracture, the necessity for amputation is generally very decided, as gangrene or tetanus are very apt to follow; but in simple punctured wounds, even of joints like that of the knee, amputation in civil practice may be delayed until the symptoms render it urgent. When tetanus is developed or threatening, especially if the symptoms are well marked, it is useless to amputate, as it is only possible to remove the wound, but not the tetanic symptoms.

The advantages of secondary over primary amputations in these, as well as in other cases, will be referred to hereafter.

§ 2.—RAILROAD ACCIDENTS.

A class of injuries unknown to the older surgeons are now so common as to furnish those of the present day with many examples of compound fractures and dislocations of the most serious kind. These injuries, together with those resulting from the use of thrashing-machines, as well as those created in mills and cotton gins, are the result of the application of force to the limb, in such a manner as to produce extensive contusion of neighboring parts as well as laceration at the seat of injury. It is, therefore, not uncommon, in amputations performed for the relief of such injuries, for the stump to slough, after an attempt has been made to heal it, and this should always be guarded against by amputating sufficiently far from the seat of injury to be sure of a sound circulation in the flaps. This sloughing arises, according to Dr. George Hayward, of Boston,[3] "from a condition of parts resembling that which has been spoken of by military surgeons as a local

[1] Velpeau's Op. Surg., by Mott, vol. ii. p. 454. [2] Velpeau, *loc. cit.*

[3] Paper on Amputations in Massachusetts General Hospital, p. 16, Boston, September, 1850.

PLATE LXXI.

INSTRUMENTS FOR AMPUTATION, ETC.

Fig. 1. Trocar for Tapping the Bladder through the Rectum. Schiveley's pattern.

Fig. 2. Petit's Tourniquet. " "

Fig. 3. A Large round-bellied Scalpel for dissecting back the integuments in the circular amputation. Schiveley's pattern.

Fig. 4. A Small Catlin for the interosseous space. " "

Fig. 5. Large Amputating Knife, for the circular operation. " "

Fig. 6. The Long Ten Inch Catlin, for the flap " " "

Fig. 7. An Eight Inch " " " " "

Fig. 8. Bone-Nippers, for removing any sharp points left by the action of the saw. Schiveley's pattern.

Fig. 9. Dissecting Forceps, to hold the integuments whilst they are dissected from the fascia before they are reverted, as in the circular operation. Schiveley's pattern.

Fig. 10. Spring Forceps of Dr. Nathan R. Smith. " "

Fig. 11. Artery Tenaculum. " "

Fig. 12. Barton's Metacarpal Saw. " "

Fig. 13. Ordinary " " " "

Fig. 14. The Large Amputating Saw. " "

Plate 71.

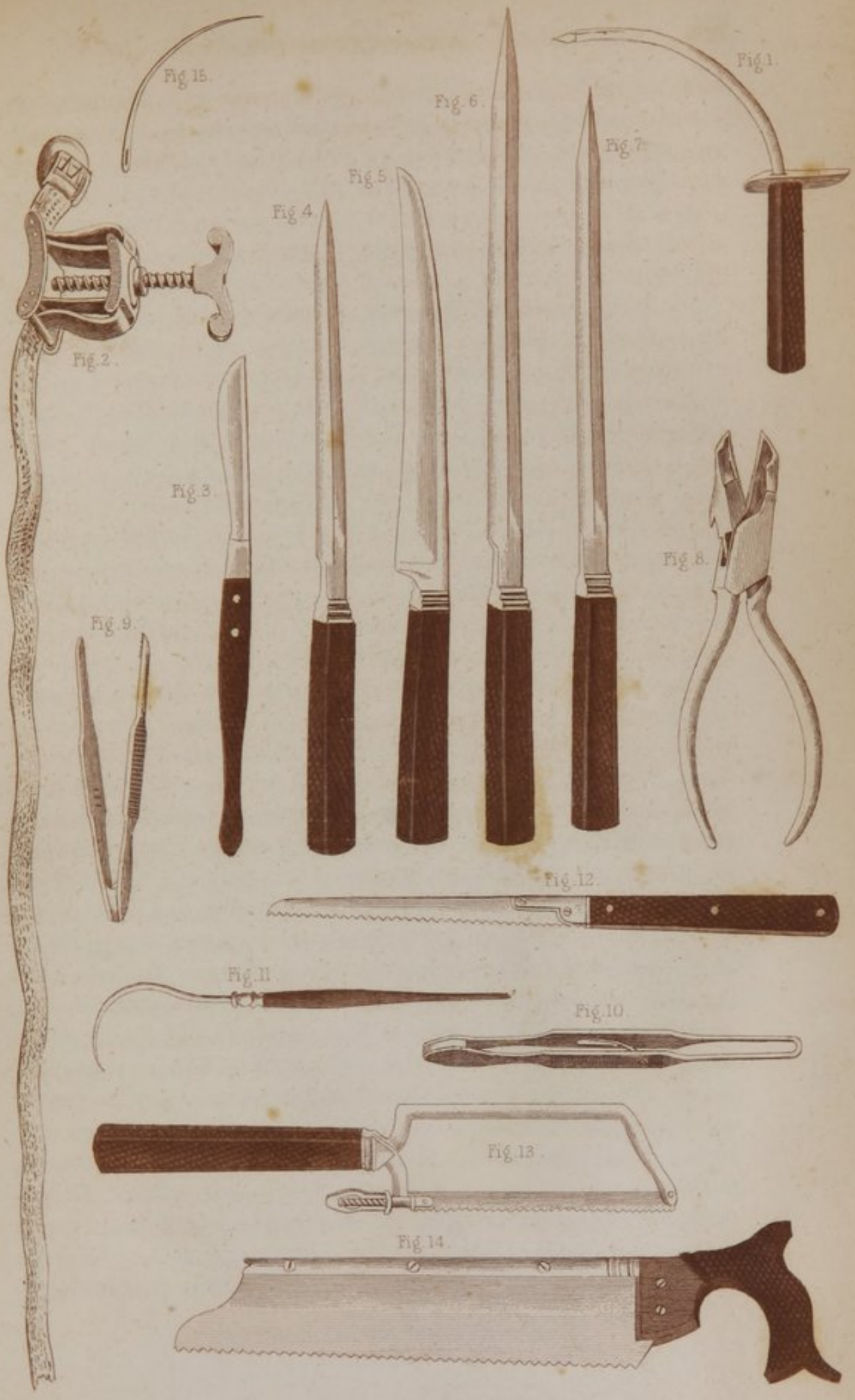


Fig.15.
Fig.6.
Fig.1.
Fig.7.
Fig.5.
Fig.4.
Fig.2.
Fig.3.
Fig.8.
Fig.9.
Fig.12.
Fig.11.
Fig.10.
Fig.13.
Fig.14.

asphyxia, and is a state of suspended animation, differing from death only in the fact that the power of resisting decomposition is retained for a time, though certainly destroyed by the debilitating effects of the operation." The shock created by these accidents usually results in a state of extreme depression, and in such cases I think the amputation should be delayed until the reaction is established, though on this point there is a diversity of sentiment. One reason which has always influenced me in opposing immediate amputations in cases of railroad accidents, is the fact of having repeatedly found them complicated with such internal injury as would result in death, independent of the condition of the limb. In nearly all instances of railroad injuries to the limbs, the patient is either first knocked down by a blow from the cars, or else falls or is thrown with violence upon the ground, the latter being generally uneven, and it is whilst in this position that the limb is injured by being run over. Contusions of the abdominal or thoracic viscera, or concussion of the spinal marrow or brain, with violent muscular inflammation, will therefore often be found to coexist with the compound fracture or luxation. In one instance in my own observation, this contusion resulted in laceration of the spleen, which caused death within twelve hours after the performance of amputation, although no complaint was made by the patient of any other injury than that of the leg; and in another, a rupture of an hepatic vein caused the death, though the amputation seemed likely to do well. By waiting till reaction is fully established, and the sensibility of the entire body restored (say three days), we will be rendered more certain of the patient's true condition; whilst by resorting to anæsthetics, the shock of the amputation can then be fully obviated. Should a bad compound comminuted fracture of the extremities require amputation in order to arrest the hemorrhage, it would be desirable simply to divide the integuments, and remove the limb at the seat of fracture, and subsequently (two or three weeks) perform an amputation for the better formation of a stump. This suggestion,[1] which may be termed a partial or temporary amputation, is due to the late Dr. Wm. E. Horner, who tried it satisfactorily in two cases. Sufficient time has not as yet elapsed to permit a satisfactory test of it on my part, but the subject is worthy the investigation of surgeons in charge of large hospitals in cities where railroad accidents are so numerous.

[1] Philadelphia Med. Examiner, Feb. 1853.

For the consideration of other injuries requiring amputation, the reader must refer to the more general surgical treatises, as the subject is too extended for a work of a purely operative character.

§ 3.—THE PERIOD FOR AMPUTATING.

The advantages of a primary over a secondary amputation is also a serious question, and one with respect to which there is a diversity of sentiment.

Larrey[1] asserts that, in the American war, the French surgeons lost almost all their patients by deferring their amputations, whilst the Americans, by immediate amputation, saved nearly all of theirs.

Velpeau,[2] after a careful and learned examination of this question, states that amputation should in these cases be performed within the first twenty-four hours after the accident.

Sir George Ballingall[3] is, however, "satisfied that in civil hospitals primary amputations do not do so well as in military life, owing to the difference of moral causes in these two conditions, the soldier being robust at the time of the accident, and brought to a purer air in a hospital than he had had in barracks."

Mr. Guthrie, in a lecture published in the London *Lancet*,[4] states that he regards the advantageous results of primary amputations (or those done within forty-eight hours), over all ordinary amputations, or those done at the end of several days or weeks, as being so firmly established as not to admit of dispute.

Sanson agrees with Ballingall in the statement that the striking advantages claimed for primary over secondary amputations, as observed in military practice, do not hold good to the same extent in civil hospitals, and explains it on various grounds, the most important of which is the transfer of a man accustomed to active labor and full diet with fresh air, to the close wards and life of a hospital, this alone being sufficient to excite constitutional disturbance.

Dr. Norris,[5] in a paper published in 1838, furnishes the statistics of the amputations in the Pennsylvania Hospital for the seven preceding years, and shows that, of 24 primary operations, 14 were

[1] Clinique Chirurg., tome 3me, p. 518.
[2] Op. Surg., by Mott, vol. ii. p. 470.
[3] *Ibid.*, 471, note by Dr. Townsend.
[4] Lancet for May, 1853.
[5] Am. Journ. of Med. Sci., vol. xxii. p. 356.

cured and 10 died. In another paper,[1] containing the results of the same hospital from 1838 to 1840, he also shows that of 35 primary operations, 24 were cured and 11 died, and that of 25 secondary amputations, 13 were cured and 11 died. By combining these tables, he therefore concludes "that immediate amputations after injuries are less fatal than secondary, the mortality after the former being 1 in $3\frac{2}{11}$, and in the latter 1 in $2\frac{6}{7}$."

Dr. George Hayward, of the Massachusetts General Hospital at Boston, in some valuable statistics from that Institution,[2] affords the observer an opportunity of learning this fact, by comparing the date of admission with that of the operation, though he does not directly mention the fact of the operation being primary. From an examination of his dates, it appears that of fourteen primary amputations, ten were cured and four died; but he fears that the operation in recent injuries is often resorted to too early.[3]

Dr. Buel,[4] of the New York City Hospital, in an exceedingly well-arranged statistical table of the amputations performed in that hospital from 1839 to 1848, says, "that it is customary, in the New York Hospital, to amputate before the accession of inflammatory action, so that the occasions for secondary amputations are rare." The mortality after primary amputations was 27.77; of others 30.76 per cent. The mortality after amputations for chronic affections was 20.67.

M. Guersent, of the Children's Hospital in Paris, is opposed to hasty operations in the cases of children suffering from chronic diseases, especially white swelling, as the lymphatic habit may often be ameliorated, and a valuable though imperfect limb preserved. As a general rule, M. Guersent has saved eight or nine out of every ten operations. Much of his success is, however, attributed by a writer in the *Bulletin de Therapeutics*, tome xl. p. 81, to his practice of ordering good and nutritious diet as soon as possible after the operation.[5]

The most valuable contribution that has been recently made, to

[1] Am. Journ. of Med. Sci., vol. i. N. S. p. 38, 1840.

[2] *Ibid.*, vol. i. N. S. p. 64, 1840. A reference to this paper, as well as a second one by Dr. Norris, has been accidentally omitted in the Bibliographical Index, owing to an error of the press.

[3] *Opus citat.*, p. 70.

[4] Am. Journ. of Med. Sciences, vol. xvi. p. 39.

[5] South. Med. and Surg. Journ., vol. vii. p. 379, from Med.-Chir. Review.

our knowledge, of the results of primary and secondary amputations in civil practice, is, however, that furnished[1] in a recent paper by Dr. John O. Stone, of New York City, and is among the most satisfactory of all the papers that have been published on this subject; the practice of military surgeons having apparently so settled the views of the civil surgeons on the advantages of primary amputations over secondary, that comparatively few have examined the subject without being previously prejudiced to their opinions. The Astor House riots in New York having presented a large number of gunshot wounds and compound fractures, the advocates of primary amputations were surprised at the results of the practice in these cases, "nearly every case" being stated by Dr. Stone to have terminated unfavorably that was touched by the knife. He therefore collected extended statistics of the civil practice elsewhere, and found that the favorite doctrine of primary amputations was not supported by the result. After presenting several extended statistical tables of amputations in European and American hospitals, as well as in military and civil practice, Dr. Stone arrived at the following conclusions:—[2]

"1st. That primary amputations of the upper extremities are equally successful, and to be preferred both in military and civil surgery.

"2d. That in military surgery primary amputations of the lower extremities are twice as successful as secondary.

"3d. That in civil surgery (that is, in American hospitals), it is immaterial whether primary or secondary amputations of the lower extremities are resorted to.

"4th. That secondary amputations of the upper extremities in civil surgery are 8 per cent. less fatal than in military surgery.

"5th. That secondary amputations in civil surgery are 12 per cent. less fatal than in military surgery.

"By adding together all accessible information in regard to amputations of the lower extremities in civil hospitals, both European and American, and comparing it with the results obtained in military hospitals," Dr. Stone found "that the mortality in primary amputations of the lower extremities in civil practice was 53½ per cent., and of secondary amputations 12½ per cent., or 32 per cent. in favor of primary amputations in military service compared with

[1] New York Journ. of Med., vol. iii. p. 297.

[2] *Ibid.*, p. 305.

civil practice, and 36 per cent. in favor of secondary amputations of the lower extremities over primary in civil surgery. He also found that there was a difference of 41 per cent. in favor of secondary amputations over primary in civil practice, and a difference of 9 per cent. in favor of secondary amputations in civil practice compared with the primary amputations of military surgery.

"He therefore concludes, *that in military surgery primary amputations are to be preferred; that in civil practice secondary amputations are to be preferred, and that the secondary amputations of civil surgery are more successful than the primary of military surgery.*" Dr. Stone then closes his paper with some valuable data to show that, in all compound fractures, it is better to attempt to save the limb, and that very often the attempt will succeed under the most doubtful circumstances. It would afford me much pleasure to extend the circulation of the many valuable facts collected by Dr. Stone's labors, were it compatible with my plan; but, under present circumstances, I can only advise the reader to study his valuable contribution to conservative surgery, being satisfied that he will then attempt to save many limbs that would otherwise have been amputated.

The question of the advantages of secondary over primary amputations has also been discussed in a paper by the late Prof. W. E. Horner,[1] of Philadelphia, where this surgeon advocated the delaying of amputations, founding his opinion upon his own experience with the American army in 1812; and upon those of Drs. Mann and Trowbridge, also surgeons in the army at that period. Dr. Mann states that, after the battles of Little York and Fort Greene, a less number survived primitive than consecutive amputations, three or four dying immediately after the primitive operation, whilst there was not a single case of death occasioned by consecutive amputation during the campaign of 1813. Dr. Trowbridge gives his testimony in favor of immediate amputation only when there is no prospect of saving the limb. Blandin, in France, as late as 1829, was thought to entertain the same sentiments. Mr. Fergusson, in referring[2] to the former opinions of surgeons in relation to the advantages of primary amputations over those which are secondary, thinks that modern practitioners have been too much guided by the opinions of military surgeons, the majority of whom have decided

[1] Ranking's Abstract, No. xvii., 1853.

[2] Pract. Surg., 4th Am. edit. p. 158.

in favor of primary amputations; whereas an inspection of the valuable tables of Dr. Reid, of Manchester, has induced him to think that the balance is greatly in favor of the delayed or secondary operations, the intermediary being more fatal, however, than the primary. He therefore, in revising his personal experience, declares his inclination for delay. Mr. Miller[1] also expresses the opinion that secondary amputations in civil always prove more successful than they do in military practice, and thinks it due to the superior accommodations and conveniences presented in civil cases.

My own experience is decidedly favorable to the performance of secondary amputations in civil practice, particularly railroad accidents, as it gives sufficient time to learn whether the internal injuries which nearly always accompany the necessity for amputation, are not sufficient to destroy life without the performance of the operation. I now, therefore, simply check the hemorrhage by pressure; or, if the limb is mangled, divide the torn tissues and leave the treatment of the wound to subsequent consideration.

Judging from the above statements, as well as from my personal observation, I should therefore advise the reader to delay the performance of amputation in any accident until after reaction is fairly established, that is, until the warmth of the body and a free circulation have returned; and then to etherize the patient fully before the performance of the operation, so as to avoid the shock; but in amputations for gunshot wounds in civil practice, or for diseased joints, or other similar complaints, I would advise him to wait as long as it is possible, or until hectic fever is fairly established, before amputating, believing that the results of secondary amputations under these circumstances will prove to be preferable to the primary, and this opinion is, I think, sustained by the facts cited above.

SECTION II.

POINTS FOR THE PERFORMANCE OF AMPUTATION.

Amputation of an extremity may be performed either at the "place of election" or at "the place of necessity," and by a circular, oval, or flap-like incision of the soft parts which are to cover the bone and form the stump.

[1] Prin. Surg., 4th Am. edit. p. 632.

§ 1.—THE PLACE OF ELECTION.

The selection of a spot in which amputation can be most advantageously performed, is a point which the character of the limb, the occupation of the patient, and the probable substitute for the limb subsequently to be obtained, must chiefly decide, it being performed either through the shaft of the bone (continuity) or through its articulation (contiguity), in accordance with the nature of the accident, the character of the artificial support that is to be subsequently worn, or the views of the surgeon either for or against amputations through joints. The general rule for all amputations, where the pecuniary circumstances of the patient admit of his obtaining an artificial limb, is to leave as long a stump as possible, in order to secure a firmer attachment; but when the amputation is to be performed on the leg of a poor man, whose means will compel the use of the common peg or wooden leg, to make the stump comparatively short, or at least within four fingers' breadth of the tubercle of the tibia, in order to prevent its protrusion behind the thigh, when the knee is bent upon the peg.

Surgeons of all countries yet differ widely in regard to the advantages of amputating through a joint in preference to above it, arguing that as every articulating surface is covered by a synovial membrane, this is liable to keep up a secretion, prevent the healing of the flap, and thus create a fistula, and that, as a general rule, many joints present prominences of bone which often can only be covered by the integuments, and that the latter will subsequently sustain friction very badly. These arguments, though very specious, have not been sustained by facts, and the efforts of Mr. Syme, and also of the younger surgeons in the United States, have had a tendency to create a doubt as to these objections. Where an artificial limb, as an arm or leg, is desired, it will, I think, be found that the increase in the length of the stump, by adding to its motion, more than compensates for any delay in healing the wound, and that it will subsequently have sufficient ability to resist pressure without the creation of ulcers. For the further consideration of this question the reader is, however, referred to the section on Amputation at the Knee-joint.

"The place of necessity knows no law."

SECTION III.

THE DIFFERENT KINDS OF AMPUTATION.

Three principal methods are employed in incising the soft tissues in an amputation, and they are usually designated as the circular, the oval, and the flap operation.

§ 1.—THE CIRCULAR OPERATION.

This ancient method of operating has been described by all surgeons from the earliest periods, especially from the time of Celsus, though it has been modified at different times, in order to guard against a "conical stump," or to prevent such a retraction of the muscles as would diminish the amount of covering to the bone. Without specifying these modifications, it must suffice to state that the plan of operating at present generally pursued by the profession, appears to have been adopted with a full knowledge of the views of surgeons of a preceding period, in respect to the advantages of each, and may therefore be presumed to be the best.

ORDINARY OPERATION.—After applying the tourniquet, or some other means of arresting the circulation, the skin should be divided by a circular sweep of the amputating knife, held so that the incision may commence with the heel of the blade, and terminate with the same point. The attachment of the skin to the fascia being then divided so as to enable the integuments to retract, or to be turned back like the cuff of a coat, the muscles should be incised down to the bone by a second sweep of the knife, and the division of the fibres which adhere directly to the bone thoroughly accomplished by two or three shorter cuts. The soft parts being now forced or drawn back by means of a retractor in the hands of an assistant, the bone should be cut transversely across, and the operation completed by tying the arteries and closing the stump, as will be subsequently described.

The necessary instruments may be seen in Plate LXXI.

REMARKS.—In the formation of a stump by the circular operation, the surgeon usually has to decide whether he will bring the sides of the integuments together vertically or transversely to the

thickness of the limb. This point, though chiefly dependent on the peculiar circumstances of each case, may generally be decided by the position in which the limb is to be placed in bed during the cure, it being desirable always to approximate the integuments in such a manner as to favor the subsequent escape of any purulent collections. In the United States, it is the almost universal practice to attempt union by the first intention, and it is under such circumstances that the line of union in a circular operation may become a matter of importance.

An important point, in the practice of every young operator, is to decide the proper amount of integuments necessary to cover the stump, and I therefore advise him to proceed as follows: Take the circumference of the limb with a piece of tape, fold it into five equal parts, and then incise the integuments at the distance of one of them from the point at which the bone is to be sawed across, or make the flaps equal to one-fifth of the circumference of the stump. This calculation is sufficiently free to permit of the ordinary amount of retraction during the healing of the stump.

§ 2.—THE OVAL METHOD.

The oblique or oval form of the flap is the result of such an incision as is made by carrying the knife a little higher on one side of the limb than on the other, so as to form an oval, instead of a circular wound, and is especially applicable to amputations through the joints. In performing it, the knife should be carried around the limb in a direction which is oblique to its perpendicular diameter, so as to divide all the parts down to the bone and form a wound which is angular at its point of commencement and termination, but rounded in the intermediate part something like the letter U, when its two ends are brought nearly in contact.

REMARKS.—The oval method is seldom applied to amputations of the shaft of the bones, though where there is a large amount of muscle and integument, as in a well-developed thigh or arm, I have found it to form a better stump than the circular method, as it avoids the folds and puckering so generally caused by the approximation of the edges of a circular wound. The selection of the amount of the flaps will be decided as before.

§ 3.—THE FLAP OPERATION.

In incising the integuments for the formation of a flap to cover the end of the bone, two methods have been employed, the difference being chiefly in the formation of one or two flaps, according to circumstances.

When two flaps are desired, they may be formed either by cutting from the skin to the bone, or from the bone outwards.

In operating from without inwards, the soft parts are punctured by the catlin, and the cut made on one side through all the tissues from within outwards, at an angle capable of furnishing a sufficient amount to form a cushion for the end of the bone. This flap being then held back by an assistant, a second one is formed on the side of the vessels of the limb, by commencing at the bone, and cutting outwards, when the latter is to be sawed off, and the flaps approximated.

In the single flap operation, the structures are divided on one side, either with or without other incisions.

The calculation of the amount of integuments requisite to cover the stump in this method of operating, would be about one-fourth instead of a one-fifth, as there is more retraction of the soft parts when they are thus divided.

REMARKS.—The flap operation is the favorite mode of amputating with some surgeons, on account, apparently, of the rapidity with which it may be performed, but it is especially liable to secondary hemorrhage, owing to the oblique division of the vessels of the stump. Sometimes, however, it is the result of necessity, as in cases of laceration, where the integuments are destroyed on one side of the limb.

SECTION IV.

ESTIMATE OF THE DIFFERENT KINDS OF AMPUTATION.

The variety of cases requiring amputation, and the different results obtained under such circumstances, have apparently caused a want of harmony among experienced surgeons in deciding on the merits of either plan, which it is difficult to credit, when it is known

that these opinions are the result of each surgeon's experience. Such a diversity of sentiment is, however, rather apparent than real, and must be ascribed to the predilections consequent on the force of circumstances; thus, an amputation that might be instantly demanded on a field of battle and without assistants, might be performed very differently, when the operator was in a civil hospital, and with every convenience, so that, if two surgeons were similarly situated, they would doubtless coincide perfectly on this, as on most other practical points.

The advocates of the flap operation state that it is more prompt, less painful, exposes less to hemorrhage, obtains a rapid cure, and forms a stump well adapted to an artificial limb.

Its opponents contend that it exposes a greater surface for suppuration; that there is greater difficulty in finding the vessels that are to be tied, owing to their being obliquely divided; and that secondary hemorrhage is, therefore, more common after the flap than after the circular operation.

The advocates of the circular operation claim that it is most likely to form a good "apple-dumpling-like stump;" that the arteries may be easily found and tied; that secondary hemorrhage is rare; and that, by giving the wound a conical shape with the bone in the centre, the flesh is placed in the most favorable condition for properly covering the bone, and sustaining pressure.

Its opponents object to its slowness, to the pain caused by dissecting back the cuff-like portion of the skin, when anæsthetics are not employed, and to the excessive and irregular contraction of the various layers of the muscles when transversely divided.

CHELIUS,[1] from "personal experience, prefers amputation by the circular cut, with the eversion of the skin, believing the advantages ascribed to the flap operation to be groundless."

VELPEAU[2] thinks "too much importance has generally been accorded to the flap operation; that it has many partisans in the dissecting-room, but is seldom resorted to for amputation in the continuity of the limb."

FERGUSSON,[3] although performing the flap operation most frequently, owing to special circumstances, states "that, at the present

[1] System of Surgery, by South, vol. iii. p. 652.

[2] Operat. Surg., by Mott, vol. iii. p. 484.

[3] Practical Surgery, p. 152.

day, more amputations are done by the circular than by the flap operation, and that, fifteen or twenty years back, not one surgeon in fifty ever thought of performing any other," and he therefore doubts whether the flap can present any special advantages.

In the United States, GIBSON[1] advocates the circular operation upon the thigh, and the flap in the leg.

NORRIS[2] states "that, with very few exceptions, the circular amputation is the operation performed in the Pennsylvania Hospital, union being always attempted by the first intention."

HAYWARD[3] says "that, in the Massachusetts General Hospital, a large proportion of the amputations were done by the circular method, the flap being adopted only when it was thought likely to afford a better stump."

BUEL[4] remarks "that, in 49 cases occurring in the New York City Hospital, 24 were performed by the double flap operation, and 25 by the circular method. Of the flap operations, the mortality was 17.66 per cent., and of the circular, only 12 per cent."

Dr. Buel, however, thinks that the greater mortality of the flap operation may have been due to the greater proportion of thighs in which it was performed.

Dr. PORTER, U. S. A., who served in the Mexican war, expresses the opinion[5] that the army surgeons were greatly in favor of the circular operation in Mexico, one of them of extended experience, and who previously advocated the flap operation, changing his opinion and practice on the ground that the stump made by the circular operation was the best, and his own opinion is decidedly in favor of the circular method.

Personal experience has long induced me to think that, in attempting to settle this question, there has been too much ascribed to the defects of each method of operating; that the circular operation is the best in the middle of the limb, but that the flap is best adapted to the articulations; and that the rapidity with which one can be performed instead of the other, is owing rather to the greater practice of such surgeons as confine themselves to one kind of operation than to the superiority of either in respect to time. In some

[1] Practice of Surg., vol. ii. pp. 488, 489.
[2] Am. Journ. Med. Sciences, vol. xxii. p. 359.
[3] *Ibid.*, vol. i. N. S. p. 65, 1840.
[4] *Ibid.*, vol. xvi. N. S. p. 38.
[5] *Ibid.*, vol. xxiv. N. S. p. 24, 1852.

cases (laceration), the flap is the only means of forming a covering to the stump without removing a large amount of the limb. But it should always be remembered that the flap exposes the patient to greater risk of secondary hemorrhage than the other methods, either from the oblique division of the end of the artery, or, as I have sometimes seen, from its being punctured or bruised in the transfixing of the soft parts in the first introduction of the catlin.

SECTION V.

GENERAL MEASURES REQUISITE IN AMPUTATION.

The mere division and removal of the limb being the simplest portion of an amputation, the surgeon should pay special attention to the other measures connected with the operation, as these are mainly conducive to its prompt and fortunate performance. In every important amputation, the duties of the assistants, and the preparatory as well as the secondary steps, should therefore be thoroughly considered.

§ 1.—PREPARATORY MEASURES.

The general preparatory measures, required in an amputation, are very much the same as those demanded in other operations,[1] and do not require any further notice, except the caution that they should be made in accordance with the general health of the patient; thus, one who is to undergo amputation in full health, may be benefited by a moderate loss of blood, whilst one who was enfeebled by disease, would be killed by the loss of a few ounces. The diet also should be regulated accordingly.

The propriety of employing anæsthetic agents in *amputations*, and their effects upon the subsequent condition of the patient, are questions that, since the general introduction of anæsthetics in operative surgery, have excited considerable interest. They are, however, questions that must as yet be regarded as unsettled, the opinions hitherto expressed, and based upon statistics, being com-

[1] Vol. i. Part I. page 180.

PLATE LXXII.

AMPUTATION OF THE ARM.

Fig. 1. View of the Head of the Humerus, showing its Hemispherical Character. 1. Greater tuberosity. After Bernard and Huette.

Fig. 2. Side View of the Bones forming the Shoulder-Joint. 1. Head of the humerus. 2. The clavicle 3. Acromion process of the scapula. 4. Coracoid process. 5. Dorsum of the scapula. 6. Section of the biceps tendon. After Bernard and Huette.

Fig. 3. A Three-quarter View of the Scapula. 1. Glenoid cavity. 2. Spine of the scapula. 3. Coracoid process. After Bernard and Huette.

Fig. 4. Lisfranc's Operation for Amputation at the Shoulder-Joint. 1. The long ten-inch catlin transfixing the deltoid muscle from behind. 2. Its point of exit in front. 2, 3, 4. Shape of the posterior flap.
After Bernard and Huette.

Fig. 5. The same Operation, showing the Formation of the Anterior or Internal Flap. 1. The long catlin. 2. Hand of the surgeon. 3. Anterior angle of flaps, or point of exit of the catlin. 3, 4, 5. Posterior flap raised up, so as to show, 6, the head of the humerus.
After Bernard and Huette.

Fig. 6. Larrey's Operation for Amputation at the Shoulder-Joint. 1, 2. The first, or vertical incision. 3, 4. The posterior incision, commencing near the middle of the first. 5. The anterior incision, starting from the same point. After Bernard and Huette.

Fig. 7. Wound left by the preceding Operation. 1, 2, 3, 4. Shape of the wound. 5. The glenoid cavity. 6, 6. The axillary vessel.
After Bernard and Huette.

Fig. 8. Velpeau's Flap Amputation of the Arm. 1, 2. The flaps and their relation to the bone, which is shown in the dotted lines.
After Bernard and Huette.

Fig. 9. Ordinary Circular Operation for Amputation of the Arm. 1. The knife. 2. The hand of an assistant retracting the soft parts.
After Bernard and Huette.

Fig. 10. Appearance of the Stump after the Operation. 1, 2. The brachial and profunda arteries. After Bernard and Huette.

Plate 72.

Fig. 1.

Fig. 2.

Fig. 4.

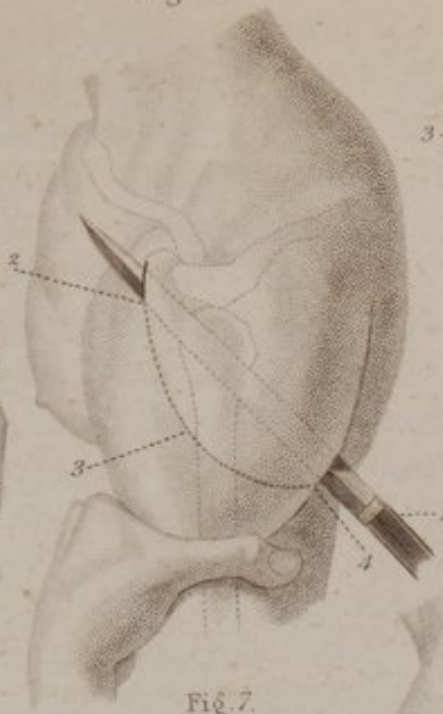


Fig. 3.

Fig. 5.

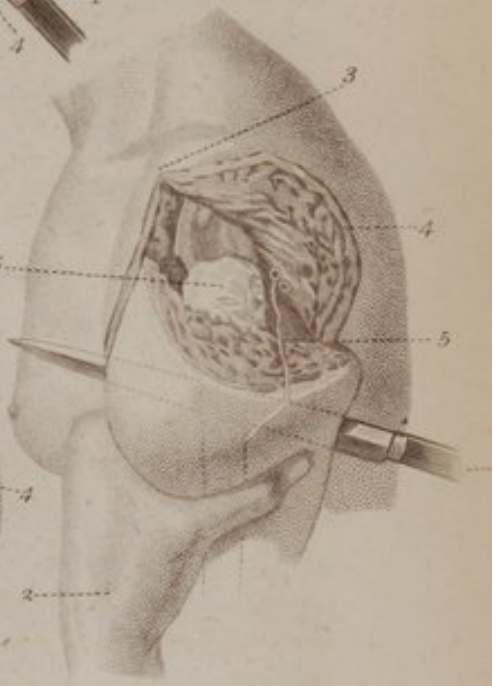


Fig. 6.

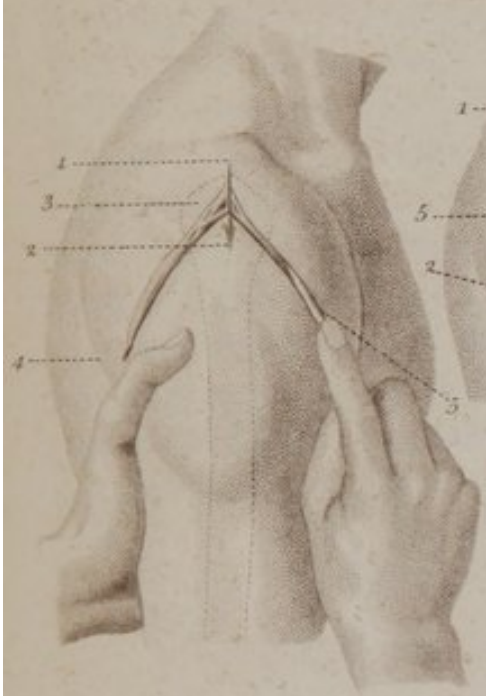


Fig. 7.

Fig. 9.

Fig. 10.

Fig. 8.

paratively limited in number, whilst they have not exhibited the result in such a position as places it beyond all cavil. The causes acting upon a patient are so varied in cases requiring amputation, that it is exceedingly difficult to determine what is the immediate cause of death. I shall therefore reserve the account of the views upon this subject for the next section.

The necessary instruments are shown in Plate LXXI., and should all be kept in perfect order for immediate use. The ligatures should be carefully made; the bandage and compress prepared for the tourniquet, if it is to be employed; the hair shaved off the skin, so as not to interfere with the subsequent dressings; a retractor[1] of muslin or buckskin, cut with one or two tails, so as to protect the soft parts from the saw; and the limb elevated for a few hours previous to the operation, so as to drain it of blood, if the debilitated condition of the patient renders it desirable to prevent the loss of even a moderate amount.

The dressings for an amputation were formerly very varied; but a wiser view of the changes in the condition of parts after an amputation has led to a most judicious change. Instead of the spread cerate, Maltese cross, tow, bandages, &c., which were prepared to envelop the stump, many surgeons now resort to the water dressing, and require, therefore, a few needles and ligatures to make the interrupted suture, a piece of oiled cloth to place under the limb to protect the bed, and sufficient lint or wet cloths to cover the stump and guard it from external irritants.

§ 2.—EMPLOYMENT OF ANÆSTHETICS IN AMPUTATIONS.

As the duty of one of the assistants, as subsequently described, is to attend to the administration of the anæsthetic, it of course becomes necessary to decide the question as to their employment in the operation. On this point, as just stated, there is some diversity of opinion; and the true state of professional sentiment, as hitherto published, may be best understood by presenting a brief analysis of the opinions of those surgeons whose sentiments have been published.

[1] Smith's Minor Surgery, p. 39, 3d edit.

Dr. J. B. Porter, of the U. S. Army,[1] who served in the late Mexican war, and noted the results of the employment of sulphuric ether, regards it as creating a disposition to hemorrhage, by poisoning the blood and depressing the nervous system, and that union by adhesion is, therefore, prevented. Etherization, he states, was much resorted to in capital operations, at Vera Cruz, during a portion of 1847; but before the summer had passed away, its employment was wholly abandoned. He also coincides in the opinion of Jobert, that after the use of ether the local inflammation has been less, and union by the first intention thereby prevented.

Velpeau,[2] in a course of lectures on the treatment of gunshot wounds, in referring to two cases, says that he does not take advantage of anæsthetic agents in the amputations of these patients, "because the chloroform evidently depresses the nervous system; and as great prostration exists in patients who have received gunshot wounds, it is advisable to refrain from any anæsthetic.

In the Massachusetts Hospital,[3] "it does not appear that the fatal results of amputation have been diminished by the introduction of anæsthetics; but Dr. Hayward expressly states that he does not think they had anything to do with the mortality."

Dr. Lent,[4] of New York, in his statistics of amputations, says that he does not deny that anæsthetics may have had some influence upon the mortality in the amputations at the N. Y. Hospital, for three years, or from 1848 to 1851, but he has seen no reason to infer that it has, except, perhaps, the fact that union by adhesion has been much less frequent since the introduction of anæsthetics into the hospital than it was before. But he expresses the opinion, that, as hospital gangrene, erysipelas, and purulent cachexia had been very marked in the hospital during the same period, it is difficult to decide whether the mortality after amputations and the use of ether, are in the relation of effect and cause.

Dr. Norris, of Philadelphia, in a recent paper[5] on the statistics of amputation in the Pennsylvania Hospital, in which there were only 48 deaths out of 200 amputations, mentions that no anæsthetics were employed in any of these cases; from which we may conclude

[1] Am. Journ. Med. Sci., vol. ix. N. S. p. 2.
[2] Ranking's Abst., vol. viii. p. 103.
[3] Trans. Am. Med. Obs., vol. iv. p. 271, 1854.
[4] Pamphlet, reprinted from N. Y. Journ. Med. 1851.
[5] Am. Journ. Med. Sci., vol. xxviii. N. S. p. 19.

that the employment of anæsthetics is regarded by him as injurious. Yet, the results of this hospital, as compared with the New York and Massachusetts General Hospital, do not exhibit such marked evidences in favor of abstinence from anæsthetics, presuming that the injuries and other circumstances were similar; thus, his table exhibited the following account:—

	No. of Amp'ns.	Cured.	Died.
Penna. Hospital, from Jan. 1830 to Jan. 1850,	200	148	48
Mass. Gen. Hospital, " " 1822 to " 1850,	146	109	32
N. Y. City " " " 1839 to April 1851.	154	100	54

That the use of anæsthetics does not always prevent union by adhesion, is apparent from a case reported to the French Academy, by M. Henot,[1] in which is an amputation at the hip-joint, under ether; the wound was ten inches long, and four-fifths of it united by the first intention, the process of the cure being entirely satisfactory.

Mr. Lizars[2] states that, though he commenced the use of anæsthetics with prejudice, he is now a thorough convert to their use in almost every operation in surgery, and mentions his having employed them in amputations.

Mr. Miller, of Edinburgh,[3] furnishes, however, the most decided testimony in favor of anæsthetics in amputations, when he says that, in his experience, the opinion that anæsthetics favor hemorrhage has not been sustained, but the contrary, preventing its flow by quieting the general circulation. Nor does it favor hemorrhage after the stump has been arranged and the patient placed in bed; the occurrence of hemorrhage within twenty-four hours after an amputation performed under anæsthetics being comparatively unknown. He therefore expresses his opinion that, though the question of the result of the employment of anæsthetics in all operations is not positively settled, that is, whether it does not save life as well as prevent pain, there is no doubt that such will ultimately be found to be the fact.

Unwilling as I am to compare my experience with that of the surgeons just quoted, both for and against the use of anæsthetics in amputations, I must say that I have had very fair opportunities of noticing the results in many of my own operations, as well as in those of others, and am at present so well satisfied with the

[1] Ranking, No. viii. p. 126, 1848.
[2] Ranking, No. x. p. 143, 1849.
[3] Principles of Surg., Am. edit. p. 723.

advantages gained by the administration of an anæsthetic (ether five parts, chloroform one part) in amputations, that it would require very strong objections on the part of the patient to induce me to amputate without it. The employment of anæsthetics before an amputation, and the use of the water-dressing subsequently, I regard as the most valuable surgical improvements of the nineteenth century.

§ 3.—DUTIES OF ASSISTANTS.

Before commencing an important amputation, as that of the thigh for example, the surgeon should select four capable assistants, and assign to them their special duties: thus, the first may attend to the etherization, and carefully watch its effects; the second control the hemorrhage, either by pressing on the main artery or by the application of the tourniquet; the third support the lower portion of the limb, and be especially careful in holding it steady during the action of the saw, neither raising it so as to bind the instrument, nor depressing it so as to snap and splinter the bone; whilst the fourth should hand the instruments, attend to retracting the soft parts, so as to protect them from the saw, and tie the arteries as they are picked out by the surgeon. This assistant may also aid in approximating the flaps during the dressing, whilst the third warms the adhesive strips when they are required.

§ 4.—AFTER TREATMENT.

As the general rules for the after-treatment of all operations have been before described,[1] I shall limit the account at present to such special means as are required in amputations.

The dressing of an amputation may be advantageously performed as soon as the hemorrhage is entirely checked, in the following manner: Cleanse the surface of the stump by gently squeezing on it the water from a sponge, but do not brush it roughly with the sponge; gather together the ends of the ligatures, and bring as many as possible out of the lower angle of the wound. If the stump

[1] See vol. i. Part I. p. 193, *et supra*.

presents a large surface, it will also prove useful to introduce a small strip of linen at this angle and between the edges of the skin, as was the practice of Dr. Physick. Then with the needle and ligature make two or three stitches of the interrupted suture, in order to close the stump, placing the first stitch so as to unite the flaps in the centre, adding to these, if deemed useful, two or three strips of adhesive plaster. Place over this a soft linen towel or piece of lint wet with tepid water, and then place the patient in bed, with the limb slightly elevated by means of a pillow doubled under it, and covered by the oil-cloth. The tourniquet may either be left loosely applied around the limb, or kept near the bed ready for use. In order to prevent spasm of the stump, and such muscular contraction as might derange the dressing, a broad bandage should be carried over the limb above the stump, and its ends pinned fast to the bed, after which, a hoop should be so arranged as to keep off the weight of the bedclothes. One assistant should then be left on guard for twenty-four hours, and an anodyne administered, if the patient require it.

During the first forty-eight hours after a primary amputation, in a patient in good health, the diet may consist of light nutritious articles, as broths, &c., and then, if fever or a tendency to active inflammation is not apparent, he may be allowed to eat meat and resume his ordinary diet. But if he has been previously confined to bed by a chronic disease, no change should be made in the diet previously given.[1]

The only attention required by the stump, in many instances, during the first forty-eight or seventy-two hours after the first dressing, is to keep the lint or cloth moist by squeezing upon it water of such a temperature as is most agreeable to the feelings of the patient, some liking it cold and others tepid, the oiled cloth beneath the limb being so arranged as to carry off the surplus water and keep the patient dry. On the fifth day, if ulceration is apparent about the stitches, one or more may be removed, and the flaps supported by long adhesive strips, or by the turns of a bandage. About the sixth or tenth day, one or more of the ligatures will be loosened, and may be quietly drawn away; but, should they adhere too long, and delay the cure, then the means before referred to[2] should be resorted to. As soon as the ligatures have

[1] See vol. i. Part I. p. 194.

[2] Vol. i. Part I. p. 230.

PLATE LXXIII.

AMPUTATION AT THE ELBOW-JOINT IN THE FOREARM.

Fig. 1. A Front View of the Articulating Surfaces of the Bones composing the Elbow-Joint. 1. The humerus. 2. The radius. 3. The ulna. After Bernard and Huette.

Fig. 2. A Side View of the Elbow-Joint. 1. The humerus. 2. Head of the radius. 3. The ulna. After Bernard and Huette.

Fig. 3. A Front View of the Elbow-Joint. 1. The humerus. 2. The radius. 3. The ulna. 4. The external condyle. 5. The internal condyle. 6. Articulating surface of the radius. 7. Articulating surface of the ulna. After Bernard and Huette.

Fig. 4. Amputation at the Elbow-Joint by the Flap Operation. 1, 2, 3. The shape of the anterior flap. After Bernard and Huette.

Fig. 5. Continuation of the same Operation. 1, 2, 3. The anterior flap turned upwards. 4. The knife in the act of completing the division of the anterior ligament of the joint. 5, 6, 7. Shape of the surface from which the flap has been cut. After Bernard and Huette.

Fig. 6. Velpeau's Circular Operation at the Elbow-Joint. 1, 2. Fold of integuments turned up, showing the knife dividing the capsular ligament. After Bernard and Huette.

Fig. 7. The Wound left by the preceding Operation. 1. The epitrochlea of the humerus. A ligature has been placed on the brachial artery. After Bernard and Huette.

Fig. 8. Circular Amputation of the Forearm. 1. Hand of assistant retracting the soft parts. 2. The flap of skin turned back. The hand of the surgeon holding the knife firmly in its grasp, with the point inclined to the surgeon's shoulder, so as to sweep entirely around the arm, is also shown. After Bernard and Huette.

Fig. 9. Sawing the Bones of the Forearm in the same Operation. A retractor has been passed through the interosseous space and around the bones, so as to protect the soft parts from the action of the saw.

Fig. 10. The Appearance of the Wound after a Circular Amputation of the Thigh. 1. The femur. 2, 2. The arteries. After Bernard and Huette.

Plate 73

Fig 1

Fig 3

Fig 2

Fig 4

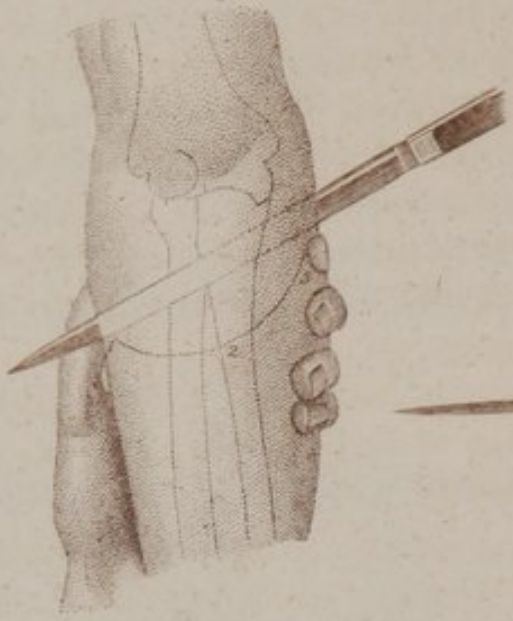


Fig 6

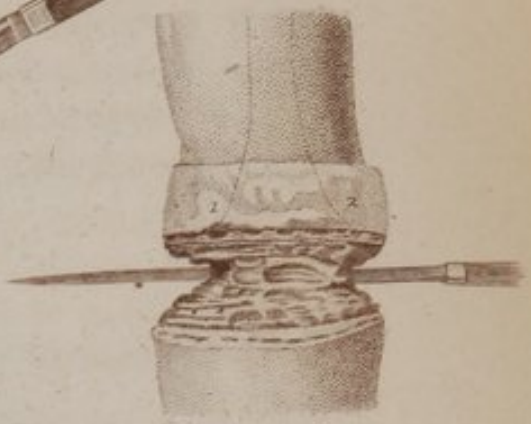


Fig 5

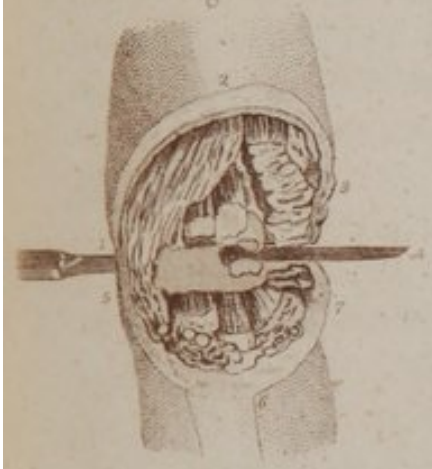


Fig 7

Fig 8

Fig 9

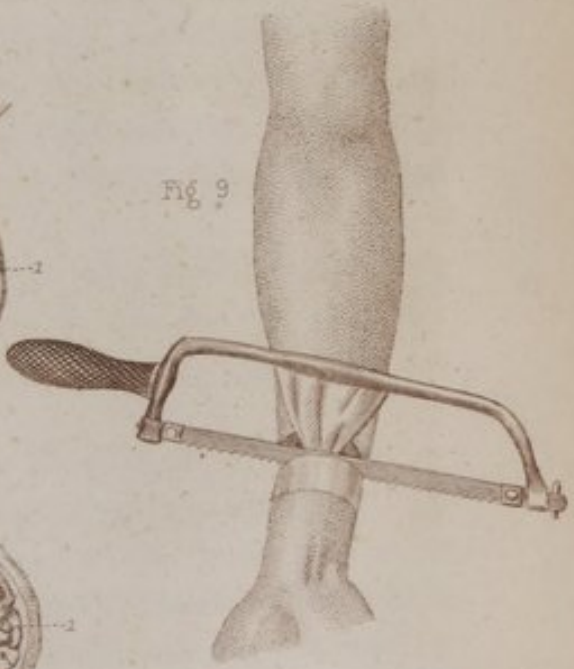


Fig 10

separated, the stump may be advantageously compressed by the gentle traction of a bandage until the newly-formed adhesions have acquired firmness. When, in the course of the treatment, the stump shows a disposition to high inflammation, warm poultices, or rather, *cloths wrung out of hot water*, may be substituted, if suppuration seems likely to relieve it; but whenever the latter is freely established, the stump should be placed horizontally, or slightly inclined downwards, so as to favor the escape of the matter, and prevent its burrowing in the muscular interspaces. Although the water dressing, as usually practised, occasionally presents examples of union by the first intention throughout a considerable portion of the stump, it will not always do so. When, therefore, suppuration is freely established, the wet cloths should be frequently changed and fresh ones substituted, so as to prevent decomposition of the pus and consequent irritation. By these means, the secretions never become offensive, and both patient and surgeon obtain a degree of comfort that was impracticable under the old method of dressing.

§ 5.—ACCIDENTS THAT MAY OCCUR EITHER DURING OR AFTER AMPUTATION.

The occurrence of an accident *during* an amputation is an event which proper foresight will always prevent, and it should, therefore, be regarded, like many other "accidents," as positive evidence of the carelessness of the operator. This carelessness may be shown: 1. In the occurrence of hemorrhage. 2. In cutting openings in the flaps. 3. In splintering the bone.

The occurrence of hemorrhage during an amputation may arise from breaking of the tourniquet, or from failure to compress the artery by the assistant entrusted with it, both of which can be avoided by proper care.

The flaps may be cut or perforated, in the circular operation, by careless dissection of the skin, or by thoughtlessly transfixing one point instead of another; whilst splintering of the bone may arise from want of ability or proper information in the assistant who holds the limb during the act of sawing. Such accidents require merely to be enumerated, in order to be avoided. Fainting is the only event truly accidental that can occur during an amputation, and it may be

readily remedied by lowering the patient's head, and administering stimulants.

After an operation, hemorrhage may occur at any moment. If it shows itself within forty-eight hours, it is evidence of the neglect of the surgeon in ligating the vessels of the stump, and, if not severe, may be checked by compression; but, if more profuse, it may be requisite to open the stump and seek for the bleeding vessels, and then ligate them properly.

Spasm, or twitching of the stump, is not an unfrequent occurrence after an amputation, and is due to the irregular contraction of the muscles, sometimes caused by the pressure against the sharp end of the bone, and sometimes due to nervous irritation. Gentle circular compression of the limb, and the free use of opiates internally, will usually afford relief. Should the recurrent bandage of stumps have been applied, the turns should be examined to see that they do not compress the end of the soft parts of the stump against the freshly sawed edge of the bone.

Inflammation of the stump, abscesses, or exfoliation of a lamina of bone, may also complicate the after-treatment, but they may be relieved on the ordinary principles of the treatment of such affections elsewhere.

When the removal of the ligature is delayed beyond the proper time (three to four weeks), a resort to the means before referred to is all that is necessary.

Neuralgia of the stump may arise, either from the inflammation and enlargement of the end of a nerve, or from its adhesion to the cicatrix. The principles before spoken of, in connection with neuralgia, will here suffice for the relief of this condition of the part.

A tender condition of the stump, or a constant tendency to ulceration, is sometimes the result of the delicacy of the skin until it becomes accustomed to pressure, and at other times is due to the contraction of the soft parts upon the bone. Under either circumstance the patient will be benefited from soaking the stump daily, for half an hour, in a strong decoction of white-oak bark, which, by acting on the gelatin of the skin, will tan or harden it.

CHAPTER VII.

AMPUTATIONS OF THE UPPER EXTREMITY.

In describing the various methods of amputating, I shall have but little to offer that is peculiar to American surgeons, and having learned in the Parisian schools the methods of the French operators, I shall chiefly present them as described by themselves, though, whenever there is occasion, I shall embrace the views of others, and also offer the results of my individual experience, as tested in daily practice, as well as upon the dead body.

SECTION I.

AMPUTATION AT THE SHOULDER-JOINT.

Amputation at the shoulder-joint is an operation that dates back to a very early period of surgery, being stated to have been performed as early as the year 1686. From this time it has been more or less frequently repeated, especially by military surgeons, among the most prominent of whom is Baron Larrey, who amputated at the shoulder-joint sixteen times during Napoleon's campaign in Egypt, only losing two cases, and fourteen times after the battles of Wagram and Essling. Subsequently, as stated in his memoirs, he amputated at the shoulder more than a hundred times, of which ninety cases were cured.

Amputation at the shoulder-joint has also been frequently performed in the United States, having been done by Dr. John Warren, of Boston, as early as 1781; by Dr. Bayley, of New York, in 1782; and subsequently by Drs. Trowbridge, of New York, in 1809; Gibson, of Philadelphia, in 1812; Bowen, of Providence; Whitridge, of South Carolina; G. McClellan, six times successfully; and also by Mussey, of Cincinnati; Horner, Randolph, D. Gilbert, and Page, of Philadelphia; N. Pinkney, U. S. Navy; Eve, of Georgia; May, of Washington; J. Mason Warren, of Boston; Sanburn, of Massachusetts; Howard, of Georgia; Pensler, of New York; and

Freiott, of Troy; as well as by many others, whose cases cannot now be recalled. Of those above mentioned, a large proportion proved successful.

§ 1.—OF THE OPERATION AT THE SHOULDER-JOINT.

The necessity for amputating the arm at its very highest point has in some instances led to its removal above the articulation, though the operation at the shoulder-joint has been much the more common. The latter amputation has been performed by nearly all the known methods of amputating elsewhere, though that of the flap, with its various modifications, has generally been deemed preferable to the circular operation when circumstances permitted it, owing to the importance of covering the prominence caused by the projection of the acromion process, above the glenoid cavity, when the head of the humerus has been removed.

The operation *above* the shoulder-joint may be performed whenever the disorder, for which amputation of this extremity is demanded, involves either the scapula, or clavicle, or both. The following cases illustrate sufficiently such modifications of the ordinary operations at the articulation, as have been specially demanded.

I. AMPUTATION OF THE ARM ABOVE THE SHOULDER-JOINT.

Operation of Dr. Geo. McClellan, of Philadelphia.[1]—A young man having an encephaloid tumor which extended from the lower part of the right arm upwards to the shoulder-joint, and involved the clavicle and scapula entirely within it, the amputation was commenced by securing the subclavian artery just as it emerged from between the scaleni muscles, after which the clavicle was sawn through close to its articulation with the sternum, and the scapula dissected off from the chest so as to permit the removal of the arm with the entire mass, enough sound skin being saved to form a flap front and back. The wound healed readily, and in a few weeks the patient was walking about, but his subsequent condition is not stated.

Operation of Dr. David Gilbert, of Philadelphia.[2]—A

[1] McClellan, Pract. of Surgery, p. 412; note by J. H. B. McClellan, M. D., 1847.

[2] Am. Journ. of Med. Sciences, vol. xiv. N. S. p. 360.

gentleman with a pancreatic sarcomatous tumor of the shoulder, urgently requiring relief, it was decided, in consultation, to amputate the arm above the shoulder-joint, and remove portions of the clavicle and scapula, which was done as follows:—

The subclavian artery being compressed on the first rib, and an anodyne administered, an incision was made with a large scalpel, which, commencing at the posterior border of the axilla, extended upwards one inch above the highest portion of the spine of the scapula. The next incision commenced where the first crossed the spine of the scapula, and extended downwards and forwards to the point of the shoulder, thence upwards and inwards, along the lower edge of the clavicle, to the extent of its outer third, and then upwards above its superior margin, so as to form a triangular flap. This being dissected up, the clavicle, inside of its outer third, was isolated by passing a retractor under it, when the bone was divided by Hey's saw. The skin, posterior to the first incision, being now reflected backwards, the latissimus dorsi and teres major muscles were divided, as well as the infra and supra spinati, beyond the limits of the disease, so as to expose the neck and upper portion of the body of the scapula, after which the spinous process was divided obliquely from behind forwards and inwards to the neck of the scapula, by means of the amputating saw. The neck and part of the body of the scapula being then sawn through with a long narrow saw, and all the bony concretions severed, the skin and pectoralis major muscle were carefully incised from the axilla forwards and upwards, so as to expose the axillary artery, which being promptly secured, all the remaining attachments were severed, and the wound closed. This patient recovered from the immediate effects of the operation, but died five months subsequently, the axillary lymphatics presenting evidence of the reproduction of the disease.[1]

II. AMPUTATION OF THE ARM AT THE SHOULDER-JOINT.

The following methods are those best adapted to this articulation:—

LISFRANC'S OPERATION.—In this method of operating it is of great

[1] Another and similar operation has been performed by Dr. Gilbert, as these sheets are passing through the press.

consequence that there should be sufficient space behind the patient's shoulder to permit the introduction of the catlin. The patient should, therefore, be either seated or propped up in the bed, so near to its edge that the scapula will be exposed, whilst the arm should be placed close to the side, in order that the head of the humerus may be pushed upwards and outwards as much as possible, by carrying the elbow upwards and inwards. Then feeling for the acromion, and coracoid processes, or for the acromio-coracoid triangle, plunge an eight-inch catlin in at the external side of the posterior margin of the axilla above the tendons of the latissimus dorsi and teres major muscles, and carry it across the shoulder with its blade inclined flatwise, till the point touches the under surface of the acromion process. Then raising the handle sufficiently to lower the point beneath this process, bring it out below the clavicle in the triangular space between the clavicle and the coracoid, and acromion processes. Let an assistant now raise the arm from the side, and carry it off from the body, whilst the surgeon, grasping the relaxed deltoid in his left hand, elevates it as much as possible from the bone, and shaves it off so as to form a posterior semicircular flap about three inches long (Plate LXXII., Fig. 4). This incision should divide the external portion of the capsular ligament, and the tendons of the latissimus and teres major and minor muscles, as well as the deltoid; but if the capsule has not been freely divided by the point of the knife passing over it as it was introduced, it may now be effected by incising it with its heel, whilst the assistant holds up the flap.

On again carrying the elbow a little towards the side, the head of the humerus will escape through the opening in the capsule, when the knife should be passed around it to the inside of the bone, and carried downwards and forward, so as to shave off an internal flap of about two and a half inches (Plate LXXII., Fig. 5), the artery which remains in the flap being held by an assistant grasping the flap before it is detached from the arm below.

When operating on the right shoulder, the same steps are taken; but the point of the knife is inserted in front of the axilla at the acromio-coracoid triangle, and made to come out behind at the same point as was above directed for its insertion in the left shoulder.

LARREY'S OPERATION.—Amputation of the shoulder by the formation of an oval flap is the method sanctioned by the experience of

this well-known surgeon, who had frequent occasion to perform it in his campaigns.

OPERATION.[1]—Make a vertical incision on the external side of the shoulder, down to the bone, and carry it from the edge of the acromion process to within about one inch of the level of the surgical neck of the humerus. Then, commencing at the point, make two oblique incisions, one anteriorly and the other posteriorly, so as to divide the integuments and flesh on the anterior and posterior parietes of the axilla, as well as the insertions of the pectoralis and latissimus muscles (Plate LXXII., Fig. 6). Push back the edges of this wound, and open the joint by a single cut of the knife, drawing slightly upon the humerus, so as to put the ligaments on the stretch. Luxate the head of the bone, pass the knife behind it, and terminate the operation by dividing the structure in the axilla, in which are found the arteries and nerves, which should, at the moment, be compressed by an assistant. The wound which is left is perfectly oval, and well adapted to healing. (Plate LXXII., Fig. 7.)

As the injury which demands this amputation is often the result of a lacerated wound which leaves but little choice as to a flap, the following account is cited as illustrative of one course of proceeding under these circumstances:—

OPERATION OF DR. E. R. PEASLEE, OF NEW YORK.[2]—A musket being accidentally discharged into the shoulder, the entire charge passed directly through the arm, entering on the inside just above the insertion of the deltoid; it then passed obliquely backward, upward, and outwards, and emerging directly below the acromion process, after shattering the bone and blowing away several ounces of the deltoid, left a wound capable of receiving an ordinary teacup. Amputation being decided on, and the ordinary methods being impracticable, the operation was performed as follows:—

OPERATION.—A catlin being passed through the inner edge of the deltoid muscle at a point two inches below the joint, was brought out at the edge of the external wound so as to form a very small anterior flap; after which the knife was carried through the joint, and a posterior flap made of the skin and triceps muscle by extending the incision nearly to the elbow.

REMARKS.—This patient subsequently recovered and had a good

[1] Bernard and Huette, Med. Op., p. 70.

[2] New York Journ. of Med., vol. x. N. S. p. 297, 1853.

stump, the greater portion of which was formed by the skin and triceps muscle being turned up so as to meet the lower edge of the anterior flap nearly on a line with the coracoid process.

As all the plans above stated present excellent methods of amputating at this joint, it is unnecessary to enter into a description of the various modifications that have been proposed by others. The circular operation at this joint presents us with nothing peculiar. Sanson, of Paris, who, in connection with Velpeau, recommended it strongly, divided all the structures at one sweep of the knife applied one inch below the acromion, and then disarticulated the bone.

The objection to this mode of amputating, or rather the advantages possessed by either that of Lisfranc or Larrey over the circular operation, is that, as the artery in the flap is not divided until the last moment, it can then be promptly seized and tied, in consequence of the disarticulation placing the arm out of the way. I believe that this operation is generally preferred by surgeons in the United States.

From the account furnished by Dr. Stephen Smith, of New York,[1] in an excellent paper on amputations at large joints, it appears that amputation at the shoulder-joint has generally been more fatal both in hospital and private practice than amputations of the arm or thigh. He, however, regards the primary as more successful than the secondary amputation at this joint, both in military and private practice.

Statistics of Amputations at the Shoulder-Joint.[2]—From the same statistics,[3] including the cases of this amputation previously reported by Drs. Buel and Lente, of the same city, it appears that of 39 operations performed in the United States, 13 were fatal and 1 doubtful, being a mortality of 33 per cent. In 7 cases anæsthetics were used, of which one was fatal. From a careful examination of the tables formed by collecting the operations of many of the European hospitals, as well as those in New York, Dr. Smith therefore concludes that amputation at the shoulder-joint is more fatal than amputations of the arm or thigh in the same hospitals, and that the same rule holds good in private practice.

[1] New York Journ. of Med., vol. x. N. S. p. 15.

[2] Trans. Am. Med. Assoc., and Am. Journ. Med. Sci.

[3] New York Journ. of Med., vol. x. p. 9, 1853.

SECTION II.

AMPUTATION OF THE ARM.

The amputation of the arm may be accomplished at any point of its length, either by the circular or flap operation.

Circular Operation.—The patient being etherized, and then placed in a suitable position, the tourniquet, or manual compression, should be applied to the artery, and the limb carried off from the trunk to nearly a right angle with the body, whilst the surgeon places himself in such a position as will give him perfect freedom in his movements. Then, holding the large amputating-knife firmly in the right hand, let him grasp the upper part of the patient's arm with his left hand, the lower portion being supported by an assistant, and, stooping down, carry the knife so far round the arm that he can commence the incision well on the top of it, the point of the knife presenting to his own shoulder. On applying the blade to the skin, let him now divide it by one steady circular sweep, by bringing his elbow to his side, and turning the knife-handle in his hand so as to cause the heel of the blade to terminate the incision. The looseness of the attachment of the skin to the fascia permitting considerable motion, it is only necessary for the assistant to retract it with his hands (Plate LXXII., Fig. 9) whilst the surgeon again, by one sweep and with firm pressure on the knife, divides all the tissues down to the bone. The double-tailed retractor being now applied, the bone should be carefully sawed off, any spiculæ that remain excised by the bone-nippers, the main artery picked out and tied, and then the tourniquet loosened, or the compression lessened so as to show the smaller vessels.

The hemorrhage being thus carefully arrested, the ligatures should be so arranged that they may be brought out of the angles of the wound, the two sides of which should then be closed and united by one or two sutures, and the stump (Plate LXXII., Fig. 10) dressed with the cold or tepid water-dressing, according to the season.

Should the inflammation of the part, or the effects of disease, have led to thickening and adhesions of the skin to the fascia, the former may be turned back, like the cuff of a coat, before the division of the muscles, as in the circular amputation of the leg.

The Flap Operation in the arm is the same in principle as that

PLATE LXXIV.

AMPUTATION OF THE HAND.

Fig. 1. A View of the Anatomical Relations of the Bones of the Wrist. 1. The lower extremity of radius. 2. The ulna. 3. The first row of the carpal bones. 4. The second row. 5. The bones of the metacarpus.
After Bernard and Huette.

Fig. 2. Circular Amputation at the Wrist-Joint. 1. The radius. 2. The ulna. 3, 3. Flap of skin reverted. 4. The catlin dividing the front of the joint. After Bernard and Huette.

Fig. 3. Denonvillier's Operation at the Wrist. 1. The radius. 2. The ulna. 3. Semicircular incision on the back of the wrist. 4. The knife about to cut a flap from the palm of the hand. After Bernard and Huette.

Fig. 4. The stump after the preceding Operation. " "

Fig. 5. Maingault's Operation for Amputation of all the Metacarpal Bones, except that of the Thumb. 1, 2, 3. Anterior flap. 4. The knife, which, having transfixed the palm, is about to cut the flap.
After Bernard and Huette.

Fig. 6. Completion of the same Operation. 1, 2, 3. The posterior section. 4. The knife incising the joint. After Bernard and Huette.

Fig. 7. Disarticulation of the Thumb. 1, 2, 3. Line of the incision so as to form an oval wound. After Bernard and Huette.

Fig. 8. The Thumb, being carried across the Palm of the Joint, is opened on its External Side. 1. The head of the metacarpal bone. 2. The bistoury. After Bernard and Huette.

Fig. 9. Union of the Wound, showing the Line of the Cicatrix and the Appearance of the Hand after the Amputation. After Bernard and Huette.

Plate 74

Fig 1

Fig 2

Fig 3

Fig 4

Fig 5

Fig 6

Fig 7

Fig 8

Fig 9

spoken of in connection with amputation of the thigh, and is also shown in Plate LXXII., Fig. 8.

REMARKS.—The results of amputations of the arm are among the most favorable of those presented in connection with amputations, death being a rare exception in the success attendant on this operation.

SECTION III.

AMPUTATION AT THE ELBOW-JOINT.

Amputation at the elbow-joint, like amputation at the knee, has long been considered by surgeons as an objectionable operation, from the fact that the condyles and epitrochlea of the humerus, owing to their prominence and irregular form, were thought to be badly adapted for sustaining pressure, whilst the continued secretion of synovia it was supposed would be likely to keep the wound open some time. Although these objections are by no means accurately proved in relation to amputations through the articulations generally, yet, as there is nothing gained in a disarticulation of the elbow over an amputation immediately above the joint, the operation has not been frequently performed. Originally suggested by Ambrose Parè, in 1580, it has been repeated by several European and American surgeons, among the latter of whom were Dr. James Mann, of Connecticut, in 1812, and Dr. J. Kearny Rodgers, of New York, in 1827. Dr. Mann, in his operation, created double flaps, and Dr. Rodgers antero-posterior flaps. The circular operation has also been performed by Velpeau, of France, and the oval method by Textor, of Germany.

I am satisfied, from a careful examination of surgical works and the journals, that, with the exception of the cases above mentioned, this amputation has seldom been repeated in the United States; and in furnishing an account of the methods by which it may be accomplished, I desire rather to complete the enumeration of surgical operations than to be regarded as recommending this one. Velpeau's operation was performed as follows:—

VELPEAU'S OPERATION.—The hand being strongly supinated, and the forearm slightly flexed, a circular cut is to be made through the integuments about three fingers' width below the bend

PLATE LXXV.

AMPUTATION OF THE FINGERS.

Fig. 1. Amputation of all the Fingers at once. 1, 2, 3. Semicircular line of incision over the metacarpo-phalangeal articulations. 4. The catlin about to form flaps from the palmar surfaces of the four fingers.

After Bernard and Huette.

Fig. 2. The Stump after the preceding Operation. 1, 2, 3. The palmar flap.

After Bernard and Huette.

Fig. 3. Circular Amputation through the Metacarpal Bones. 1, 1. Retractors passed between each bone. 2. The saw in the act of dividing them.

After Bernard and Huette.

Fig. 4. Disarticulation of the Metacarpal Bone of the Little Finger by the Oval Method. 1, 2, 3. Line of incision. After Bernard and Huette.

Fig. 5. Amputation through the Fifth Metacarpal Bone. The bone has been sawed through obliquely, whilst a compress protects the soft parts.

After Bernard and Huette.

Fig. 6. Appearance of the Cicatrix after the Operation of Fig. 4.

After Bernard and Huette.

Fig. 7. Disarticulation of a Finger by the Oval and Flap Operations. *Little finger*, 1, 2, 3. Wound left by the oval method. *Middle finger*, 1, 2, 3. Wound left by the flap operation. After Bernard and Huette.

Fig. 8. Anatomical Relations of the Palmar Surface of the Phalanges of a Finger. 1. The metacarpal bone. 2. The first phalanx. 3. Its lower extremity. 4. Second phalanx. 5. The third phalanx.

After Bernard and Huette.

Fig. 9. Relations of the Flexor Tendons to the Bones. 1, 1, 1. The three phalanges. 2. Tendon of the flexor sublimis. 3. Tendon of the flexor profundus. After Bernard and Huette.

Fig. 10. A side View of the Relations of the Bones of a Finger, when flexed, as in Amputation at the Joints. After Bernard and Huette.

Fig. 11. Lisfranc's Amputation of the Phalanx of a Finger at the Joint, showing the position of the finger and the knife in the first incision.

After Bernard and Huette.

Fig. 12. The same Operation. A flap is about to be formed from the palmar surface of the finger. After Bernard and Huette.

Fig. 13. Palmar View of Lisfranc's Operation, when it is commenced on the Front of the Finger. 1, 2, 3. The flap. After Bernard and Huette.

Fig. 14. The Flap turned up to show the Disarticulation.

After Bernard and Huette.

Figs. 15, 16, 17. Different Stumps resulting from the flap, oval, and circular operations. After Bernard and Huette.

Plate 75.

Fig 1

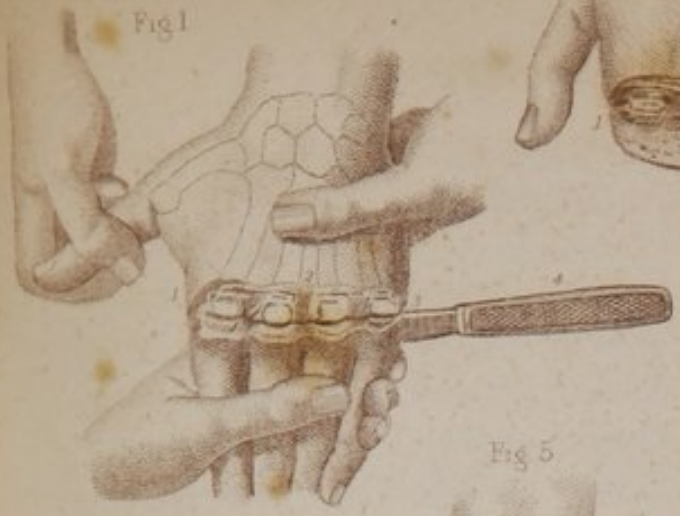


Fig 2

Fig 3

Fig 4

Fig 5

Fig 6

Fig 7

Fig 8

Fig 9

Fig 10

Fig 11

Fig 12

Fig 13

Fig 14

Fig 15

Fig 16

Fig 17

of the elbow; then, dissecting up and reverting this flap (Plate LXXIII., Fig. 6), cut through the muscles at one sweep, divide the lateral ligaments, open the joint in front, and then divide the triceps tendon above the olecranon process. The main trunk of the brachial is the principal artery to be tied, after which the wound can be readily closed by uniting the skin transversely.

FLAP OPERATION.—The circular amputation of this joint is by no means the best method of forming a stump. As the muscles of the forearm are chiefly developed in front of the elbow-joint, I should prefer the flap operation by the following plan:—

OPERATION.—Place the forearm in a semiflexed position, and, grasping the muscles of the forearm in the left hand, raise them and pass an eight-inch catlin through them, so as to shave the bones immediately in front of the coronoid process, and cut an oval flap about four inches long; then passing the catlin rapidly round the back of the elbow, just on a line with the upper edge of the olecranon process, connect this incision with the point of entrance and exit of the catlin. On dividing the back of the capsule and the tendon of the triceps, cut the internal and external lateral ligaments, and, reverting the front flap, divide the front of the capsule of the joint, remove the limb, and unite the flap on the back of the arm, above the line of the condyles, by the interrupted suture.

REMARKS.—I have often amputated in this way upon the subject, and obtained a good covering for the end of the humerus, though I know of no case in which the operation has been thus performed on the patient.

SECTION IV.

AMPUTATION OF THE FOREARM.

In amputating this portion of the upper extremity, every effort should be made to preserve as great an amount of the member as possible, in order to facilitate its subsequent usefulness, whether the patient contemplates using an artificial limb, or merely a hook.

This amputation may be best accomplished by the ordinary circular method, as directed in the amputation of the arm (Plate LXXIII., Fig. 8), a retractor of two tails being prepared in order

to protect the parts more effectually, one tail being passed through the interosseous space (Plate LXXIII., Fig. 9).

The Flap Operation is also applicable to this member, but does not form so good a stump, when the amputation is required at the lower third of the arm. At its upper third, it may be performed by forming a flap anteriorly and posteriorly out of the thickness of the flexor and extensor muscles. The circular operation at the wrist-joint forms a good stump (Plate LXXIV., Fig. 2), and should be performed in preference to the amputation at the upper third of the forearm, whenever the injury is confined to the hand.

REMARKS.—Whatever method is selected for the performance of the amputation of the soft parts in the forearm, it is necessary to avoid sawing the bones, except when they are perfectly parallel. If the hand is either pronated or supinated whilst the saw is employed, one bone or the other will be liable to protrude through the stump, create ulceration, or lead to a conical stump. In this, as in all other amputations of the upper extremities, it is important to leave the stump as long as possible, as every inch of the upper extremity is valuable.

SECTION V.

AMPUTATION OF THE FINGERS.

Amputation of the various phalanges may be accomplished by either the flap, oval, or circular methods, and is sufficiently explained in Plate LXXV.

The flap method, by the plan of Lisfranc (Plate LXXV., Figs. 11, 12), is generally the best for an amputation at the different articulations of the phalanges with each other; the circular is best adapted to the operation through the body of each phalanx, and the oval to the removal of the finger at the metacarpo-phalangeal articulation, as shown in Plate LXXV., Fig. 7. As the plate exhibits these operations very clearly, a detailed description is here unnecessary.

CHAPTER VIII.

AMPUTATIONS OF THE LOWER EXTREMITY.

AMPUTATION of the lower extremity requires the observance of nearly the same general rules as have been detailed under the head of amputations in general. The necessity for the preservation of as great a length of limb as possible is also absolute in this extremity, except when the amputation is to be performed on the leg, and the patient anticipates wearing the common wooden leg or peg. Under these circumstances, the limb should not be taken off *at more* than four fingers' breadth from the tubercle of the tibia, as a greater length of stump would incommode the patient, in consequence of its protruding behind the perpendicular line of the opposite limb in walking about.

Amputation of the lower extremity may be performed either at its different articulations or in the continuity of the bones.

SECTION I.

AMPUTATION AT THE HIP-JOINT.

Amputations of the femur in its contiguity, or by disarticulating the head of the bone, has occasionally been practised, but as it generally leaves a large suppurating surface, and a stump upon which it is exceedingly difficult to apply an artificial limb, it should not be resorted to if it is possible to remove the disease by an amputation high up through the shaft of the bone.

This amputation was first suggested by the elder Moraud, and brought to the notice of the French Academy of Surgery in 1739, though not performed until 1748, when La Croix operated at the Hôtel Dieu of Orleans, in France, in a case of gangrene which had severed the limb, with the exception of the round ligament of the femur.[1]

[1] Chelius, by South.

In the United States, it was first performed by Dr. Walter Brashear, of Kentucky, now of New Orleans, in 1806,[1] and by Dr. Mott, of New York, in October, 1824,[2] by disarticulating the bone after ligating the femoral artery. It has since been performed by Dr. Brainard, of Chicago,[3] in 1837; by Dr. Buel, of New York, in 1847; by Lente, of New York, in 1849; by Van Buren, of New York,[4] in 1850, in a case in which the shaft of the femur had been previously amputated; by May, of Washington;[5] by Drs. Richards and Clagget, of Maryland,[6] in 1851; by Drs. Bradbury[7] and Fuller, each of Connecticut, in 1851; and by Dr. Clark, of Detroit,[8] in 1853. Of these 12 cases, 8 were cured, and 4 died; 7 of the cases were flap operations, 1 circular, and 4 not described.

Of the various methods of operating, the flap and oval are the best, the circular being objectionable on various grounds. When the flap operation can be attempted, the method by the formation of one flap, as shown in Plate LXXVI., Figs. 2, 3, will prove the best. In either case, however, it is essential that the anatomical relations of the articulations should be kept distinctly in view by the operator. Although these are figured in Plate LXXVI., Fig. 1, in connection with the bones, yet the necessity of accurately establishing the position of the head of the femur, before the flaps are formed, is so important that the following measurements, as furnished by Lisfranc, may well be carefully studied. Having tested them a great number of times, I can bear my testimony to the correctness of this, as well as the other excellent data furnished by this well-known surgeon.

§ 1.—SURGICAL ANATOMY OF THE HIP-JOINT.

The following indications of the position of the hip-joint having been furnished by Lisfranc,[9] and repeatedly tested by others, may be relied on as accurate.

[1] Trans. Am. Med. Association, vol. iv. p. 269, 1851.
[2] Phil. Journ. Med. and Phys. Sciences, vol. xiv. or v. N. S. p. 107, 1837.
[3] Am. Journ. of Med. Sciences, vol. xxii. p. 37, 1838.
[4] Trans. of New York Acad. of Medicine, vol. i. p. 123.
[5] Am. Journ. of Med. Sciences, vol. xxii. N. S. p. 313.
[6] Trans. Am. Med. Association, vol. iv. p. 270.
[7] Bost. Med. and Surg. Journ., vol. xlvi. p. 349.
[8] Peninsular Journ. Med., vol. i. p. 59, 1853.
[9] Malgaigne's Op. Surg., Philad. edit. p. 264.

"1st. Let fall from the anterior superior spinous process of the ilium, a perpendicular line, one inch and five lines long, and you will find the external and anterior face of the joint half an inch inside of its extremity.

"2d. Let fall from the anterior inferior spinous process of the ilium a perpendicular line half an inch long, and its extremity will correspond to the upper part of the joint.

"3d. Draw a line transversely outwards for two inches from the spinous process of the pubis, and drop a perpendicular line a quarter of an inch long, from its extremity, and it will fall directly on the joint."

§ 2.—AMPUTATION AT THE HIP-JOINT.

The following cases will illustrate the methods of amputating that may be pursued at this articulation:—

LALOUETTE'S OPERATION.[1]—The patient lying on the sound side, make a semicircular incision from the upper and external part of the great trochanter to the tuberosity of the ischium, so as to divide all the soft parts down to the joint. On recognizing the articulation, direct the assistant to rotate the limb inwards, so as to cause the external surface of the capsular ligament to be put upon the stretch, and then with a strong bistoury or the knife, divide the posterior and external face of the capsule, as well as the round ligament; flex the thigh strongly on the abdomen, so as to disarticulate the head of the bone, traverse the front of the joint with the knife, and, passing along the internal side of the thigh, cut a flap on its inner side, four or five inches long (Plate LXXVI., Fig. 3), the artery being compressed in the flap, or upon the bones of the pelvis by the hand of an assistant. After checking the hemorrhage, bring the flaps together, and let the ligatures come out below, unite the skin by a stitch or two, and then apply adhesive strips, a compress and firm bandage, in order to facilitate the union of the deeper-seated parts.

OPERATION OF DR. VAN BUREN, OF NEW YORK.[2]—Having amputated the thigh two years previously, near its middle, in consequence of the formation of a "true osteo-cartilaginous exostosis," and the disease having subsequently returned, Dr. Van Buren advised amputation at the hip-joint, to which the patient consented.

[1] Malgaigne, Phil. edit. p. 266.

[2] Trans. New York Acad. of Medicine, p. 135.

PLATE LXXVI.

AMPUTATION AT THE HIP-JOINT.

Fig. 1. Anatomical Relations of the Bones forming the Joint, together with the Position of the Artery. 1. Iliac fossa. 2. Shaft of femur. 3. Position of its head in the joint. 4. External iliac artery. 5, 6. Anterior, superior, and inferior spinous processes. 7. Trochanter minor of the femur. 8. Ischium. 9. Pubis. After Bernard and Huette.

Fig. 2. Amputation at the Hip-Joint by the Flap Operation. 1, 2, 3. Anterior flap. 4. The long catlin about to cut the anterior flap. After Bernard and Huette.

Fig. 3. Amputation at the Hip-Joint by Lateral or External and Internal Flaps. 1. The long catlin transfixing the limb directly behind the head and neck of the femur. 2, 3, 4. Line of external flap. 2, 5, 6. Line of internal flap. After Bernard and Huette.

Fig. 4. Continuation of this Operation, when it only remains to Disarticulate the Bone. 1, 2, 3. The external flap. 4. The internal flap. 5. The femur. The position of the vessels is shown by the ligatures. After Bernard and Huette.

Fig. 5. Continuation of the Flap Operation, as shown in Fig. 2. 1. Hand of assistant raising the anterior flap. 2. The head of the femur disarticulated. 3, 4. The arteries as tied. 5. A compress protecting the scrotum and opposite thigh. 6. The long catlin, which, after dividing the capsular ligament, is about to shave the posterior flap from the bone. After Bernard and Huette.

Fig. 6. Appearance of the Wound left in the preceding Operation. 1, 2, 3. Line of the anterior flap as reverted upwards, in order to show the position of the vessels, as well as the acetabulum. 1, 3, 4. Posterior flap. 5. The acetabulum. After Bernard and Huette.

Fig. 7. Van Buren's Operation for Amputation at the Hip-Joint by the formation of an Anterior Flap in front and a Circular Incision behind, so as to diminish the time required in the formation of two flaps by the withdrawal of the catlin. 1. Right hand of surgeon. 2. Position of the catlin in the posterior or circular incision. 3. Left hand of the surgeon abducting the thigh so as to disarticulate the bone. 4. Hands of the first assistant holding up the anterior flap, and compressing the artery in it. 5. Hands of the second assistant. After Van Buren.

Plate 76.

Fig.1.

Fig.2.

Fig.3.

Fig.4.

Fig.5.

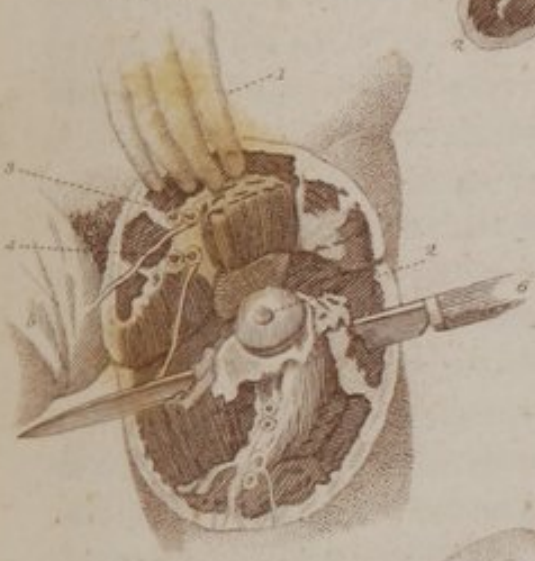


Fig.6

Fig.7.

Operation.—The patient, being in a perfect state of anæsthesia through the influence of chloroform, was placed upon the table, with the buttocks projecting over the edge, the diseased limb held by an assistant previously instructed as to its management, and the other limb and scrotum being held out of the way, the artery was firmly compressed against the pubes.

The surgeon, having now placed himself on the outer side of the limb, seizes it near its middle with his left hand, and with the long ten-inch catlin in his right hand transfixes the hip by entering the knife about one inch above the great trochanter, grazing the head and neck of the femur, if possible, as it passes in front of it, and then pushing its point through the integuments near the anus, at a point diametrically opposite to its point of entrance, so as to cut an anterior flap at least six inches long. The first assistant should now pass one hand into the wound behind the knife, and grasp the flap, and with it the artery, carrying the flap forcibly upwards with both hands over the groin (Plate LXXVI., Fig. 7). The surgeon, then kneeling a little, should carry the knife to the inner side of the thigh, taking care not to injure the neighboring parts with its point, as it is carried round, and, placing the heel of the knife on the integuments at the internal angle of the wound (Plate LXXVI., Fig. 7), carry it across the tissues on the back of the thigh, down to the bone, so as to join the opposite angle of the anterior incision. The catlin being now laid down, the femur should be forcibly abducted, and the capsule of the joint opened by a strong and large scalpel, as near as possible to the acetabulum; the round ligament and the rotator muscles near the trochanter divided, and the limb removed. A large compress or folded towel being then immediately applied to the surface of the posterior flap by the assistant who lays down the amputated limb, the arteries are to be secured in detail, the gluteal and ischiatic being tied before the femoral and profunda if the latter are well controlled in the anterior flap. The wound is then closed, as before directed.

Operation of Dr. May, of Washington.[1]—The patient, being in a state of complete anæsthesia from chloric ether, was laid on a narrow table, so that the nates projected well over its edge, when the artery was compressed upon the pubis by the thumb of an assistant. The limb being then slightly raised and flexed upon the pelvis so as to relax the muscles on the anterior and upper part of the

[1] Am. Journ. of Med. Sciences, vol. xxii. N. S. p. 315.

thigh, the testicles were drawn out of the way, and the sound limb separated as far as possible. The long catlin (twelve inches), being then introduced a little above the tuberosity of the ischium, was carried as near as possible to the neck and brought out one inch and a half below the anterior superior spinous process of the ilium, so as to cut a flap downwards from the front of the thigh, by shaving it from the bone, the femoral vessels not being divided until the lower edge of the flap was being cut, when they were grasped in the flap above the knife by the hand of an assistant. This flap being now raised and drawn forcibly upwards, the femoral artery was still so securely held that scarcely a drop of blood escaped from it. The thigh being then abducted and forcibly depressed by the assistant, the head of the femur was thrown forwards, and as much out of the acetabulum as possible, when the capsular ligament was freely divided, and the round ligament and the head of the femur being thrown out of the acetabulum, the knife was passed behind it, and a posterior flap cut a little longer than the anterior one. As soon as the limb was removed, the vessels in the posterior flap were compressed by sponges until they were separately ligated, when the femoral, profunda and other branches in the anterior flap were secured, twelve arteries in all requiring the ligature. The flaps being then united by four points of the twisted suture, owing to their great weight, adhesive strips covered by the water dressing were applied to the wound. Not more than eight ounces of blood were lost, and the operation only occupied about thirty seconds, the patient being entirely unconscious until placed in bed.

As illustrative of the suppuration in this extensive amputation, Dr. May estimates the discharge in twenty-four hours as equal to half a pint, yet the patient was able to move about in five weeks after the operation. The diet throughout was good; thus, the next day after the operation, he took a little beef-steak for dinner; with coffee, and tea and toast for breakfast and supper; on the second day, stewed oysters; third day, chicken-soup and chicken; fourth day, half a pint of oysters; fifth day, roasted chicken and potatoes; sixth day, half a pint of stewed oysters and potatoes; eighth day, brown-stout; ninth day, beef-steaks, &c. At the same time he took iron and opiates.

Remarks.—This operation is a slight modification of Beclard's, the catlin being introduced from the tuberosity of the ischium and brought out near the anterior superior spinous process instead of

the reverse, and in some cases may prove more convenient. It is important in an amputation like that of the hip-joint, where the suppuration is to be anticipated, that it should be remembered that the diet and treatment are to be of the most invigorating kind, unless fever or violent inflammatory symptoms supervene. The after-treatment pursued by Dr. May is very characteristic of the judgment of an experienced surgeon, and may be followed with advantage, provided it is modified, as was done in his case for a day or two, on the occurrence of inflammation in the stump.

Various modifications of the amputation at the hip-joint have been from time to time suggested, among which is that of Dr. Ashmead, of Philadelphia, in which flaps were formed by cutting from the surface inwards, and then disarticulating the bones. But I prefer the method of Lalouette to all of them, when circumstances permit it, as the hemorrhage can be more readily and coolly arrested by tying the vessels in the outer incision before dividing those in the flap formed on the inside of the limb. The surface of the flap is also well adapted to closing up the acetabulum and covering the surrounding bony structures. But when this method is not available, I would select the lateral flaps either by Beclard's method, or by that of Dr. May.

§ 3.—STATISTICS OF AMPUTATION AT THE HIP-JOINT.

In a valuable paper by Dr. Stephen Smith, of New York,[1] "On amputation at the hip-joint," we find some carefully elaborated statistics of the results of this operation.

From this it appears that amputation at the hip-joint has been performed in continental practice 35 times, of which 14 were successful, and 21 fatal, being a mortality of 60 per cent. Four died in 24 hours, of which 2 were in military surgery and amputations "of complaisance."

In the United States this amputation has been performed 11 times, of which 8 were successful and 3 fatal, being a mortality of $27\frac{3}{11}$ per cent. In 3 cases, the operation was performed by the lateral flaps, 1 successful and 2 fatal, 3 with the antero-posterior flaps, all successful, 1 by the circular method which was fatal, and in 4 others the method is not stated. In 3 cases anæsthetics were employed, and in all, the operation was successful.

[1] New York Journ. Med., vol. ix. p. 184. 1852.

PLATE LXXVII.

AMPUTATIONS OF THE THIGH.

Fig. 1. The Circular Operation. 1. The knife dividing the muscles. 2. Hand of assistant favoring their retraction, and holding back the skin. 3. Hand of another assistant compressing the femoral artery when the tourniquet is not employed. 4. Circular incision in the integuments. The perspective of this line is slightly misrepresented in the drawing.

After Bernard and Huette.

Fig. 2. Amputation of the Thigh by the Double Flap Operation of Sedillot. 1. Tourniquet applied on the artery. 2. The long catlin about to form the second flap. 3. Hand of the surgeon grasping the soft parts, and drawing them off from the bone. 4. First or exterior flap, as cut from the centre of the thigh outwards. 5, 6. Line of incision for the inner flap.

After Bernard and Huette.

Fig. 3. Sawing the Bone in the Circular Operation. 1. A retractor protecting and retracting the soft parts. 2. The large amputating saw.

After Bernard and Huette.

Fig. 4. Amputation through the Knee-Joint by the Flap Operation. 1, 2, 3. Line of anterior incision.

After Bernard and Huette.

Fig. 5. Circular Amputation through the Knee-joint. 1, 2, 3. Line of the incision below the joint. 4. The integuments turned back. 5. The knife opening the joint in front.

After Bernard and Huette.

Fig. 6. Amputation by the Oval Method. 1, 2, 3. Line of the incision below the joint. 4. Flap reverted. 5. The knife disarticulating the bones.

After Bernard and Huette.

Fig. 7. Continuation of the Flap Operation as commenced in Fig. 4. 1, 2, 3. Line of incision for the formation of the posterior flap. 4. Front of the condyles of femur. 5. The catlin. 6. Hand of the surgeon holding the tibia so as to favor the formation of the flap.

After Bernard and Huette.

Plate 77.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

SUMMARY.—The entire number of these cases of amputation is stated by Dr. Smith to be as follows:—

	CASES.	DIED.	CURED.	MORTALITY.
Continental practice . .	53	33	20	$62\frac{1}{2}\frac{4}{3}$
British practice . . .	34	20	14	56
American practice . . .	11	3	8	$27\frac{3}{11}$

SECTION II.

AMPUTATION OF THE THIGH.

Amputation in the continuity of the thigh, or the division of the femur through its shaft, may be required in any portion of its length, the selection of the point for the amputation being generally regulated by circumstances. As much as is possible should, however, always be preserved in order to facilitate the subsequent application either of an artificial limb or of the wooden peg. In the formation of the portion of the soft parts that is to form the stump, any of the methods of amputating may be selected, though the circular operation of Petit, with reversion of the skin and a circular division of the muscles, or the plan of Alanson, as hereafter described, will generally form better stumps than either the flap or oval method.

As usually performed, this operation corresponds with those described in connection with amputation of the humerus, the same kind of retractor (two tails), and the same dressings being, in most instances, requisite. In a large and muscular limb, the following operation may be made to form quite as good a stump, and be more quickly performed than the ordinary circular method, as it does away with the necessity of dissecting up the "cuff" of the skin.

§ 1.—CIRCULAR OPERATION OF ALANSON.

OPERATION.—The limb to be amputated being carried off from the other, and the artery compressed, the surgeon should place himself between the legs or upon the outer side of them, as he finds most convenient, and then, whilst the skin is strongly retracted by the hands of an assistant, divide it circularly, by holding the knife as directed for amputation of the arm. After

PLATE LXXVIII.

AMPUTATIONS OF THE LEG.

Fig. 1. The Circular Amputation of the Leg, as usually performed below the Knee. 1, 2, 3. Line of circular incision through the skin. 4. The cuff of skin reverted. 5. Hand of the surgeon holding the knife in its proper position for commencing the circular sweep which divides the muscles. After Bernard and Huette.

Fig. 2. Continuation of the same Operation. 1, 2, 3. Line of incision in the skin. 4. The retractor protecting the soft parts. 5. The large amputating saw applied so as to divide the fibula and tibia nearly at the same moment. After Bernard and Huette.

Fig. 3. Appearance of the Wound left in this Operation. 1. Hand holding up the integuments. 2, 2, 2. Position of the bloodvessels in the stump. 3. Section of the tibia. 4. Section of the fibula. After Bernard and Huette.

Fig. 4. Different Positions of the Catlin in dividing the Muscles close to the Bones and in the Interosseous Space. 1. Tibia. 2. Fibula. 3. Position of the catlin in clearing the superior and inner side of the fibula. 4. The same for the parts around the tibia. After Bernard and Huette.

Fig. 5. The same Operation, as performed on the Under Side of the Leg. 1, 2. Tibia and fibula. 3. First position of the knife. After Bernard and Huette.

Fig. 6. Appearance of the Wound after Lenoir's Amputation of the Right Leg. 1, 2. Lateral angles of the flap. 3. Tibia. 4. Fibula. After Bernard and Huette.

Fig. 7. Changes made by Nature in the Femur after an Amputation. 1. The shaft. 2. Cut extremity as closed and rounded by nature. After Bourgery and Jacob.

Fig. 8. Changes in the Stump, as seen several months after an Amputation. 1. Upper part of stump. 2. Integuments on its end. 3. Muscle cut across. 4. The artery. 5, 5. The veins. 6. The nerve. 7. Muscular branch of the artery. After Bourgery and Jacob.

Fig. 9. Appearance of the Tibia after Amputation. 1. Its head. 2. Portion cut by the saw, and rounded off by nature. After Bourgery and Jacob.

Fig. 10. Application of a Boot to the Stump formed by amputating at the Ankle-Joint. 1. The leg. 2. A cushion. 3. A cork in the heel of the boot. After Bourgery and Jacob.

Fig. 11. A boot adapted to the Stump of the Foot, after Lisfranc's Operation. 1. The leg. 2. A cushion. 3. A cork to fill up the toe of the boot. After Bourgery and Jacob.

Plate 78.

Fig.1.

Fig.2.

Fig.3.

Fig.5.

Fig.4.

Fig.6.

Fig.7.

Fig.8.

Fig.10.

Fig.9.

Fig.11.

making this incision, touch with the point of the knife the cellular attachments of the skin to the fascia, so as to favor its retraction by the assistant (Plate LXXVII., Fig. 1), and again applying the knife with its edge directed obliquely upwards, divide the outer layer of the muscles; have them also retracted by the hand, and with the blade of the knife still inclined very obliquely upwards, cut through the deep layer of the muscles, dividing the few fibres adherent to the bone, a little higher up, by carrying the point of the knife around them. Then apply the retractor, and saw the bone close to the muscles, when a conical hollow stump will be formed with the bone in the apex of the cone. Ligate the femoral and other arteries; see that the ischiatic nerve does not protrude; cut it short, if it does; bring the ligatures out of the lower side of the wound, and unite it longitudinally, or parallel with the axis of the limb, by two sutures and adhesive strips, applying subsequently the water dressing.

§ 2.—FLAP OPERATIONS.

The flap operation may be performed either by forming an anterior or posterior flap, or by an external and internal one (Plate LXXVII., Fig. 2). The first is preferable, as it prevents the tendency of the end of the bone to project at the anterior end of the angle formed by the union of the internal and external flaps, which is very apt to ensue unless care is taken to support the muscles and prevent their gravitating to the back of the thigh. The operation by the external and internal flaps is shown in Plate LXXVII., and the antero-posterior flaps may be formed as follows:—

Operation of Vermale.—Seize the muscles on the front of the thigh with the left hand, elevate them from the bone, and, transfixing them with the long catlin, cut a flap of proper length by passing the catlin from within outwards, and from above downwards. Then insert the point of the knife at the same spot, working it around the bone; bring it out at the spot where it first appeared; and then, cutting the posterior flap, divide the few fibres immediately around the bone, apply the retractor, draw back the flaps, saw the bone, and unite the flaps transversely. Care should be subsequently taken, in the cold-water dressing, to make pressure on the lower flap by the pillow, so as to guard against collections of pus.

§ 3.—STATISTICS OF AMPUTATION OF THE THIGH.

In the tables formed[1] by Dr. Buel, of N. York, of the amputations performed in the New York Hospital, we find that in 34 cases 10 were fatal, making the mortality 29.16 per cent.; 15 of those amputated at the thigh were by double flap operations, of which 2 were fatal, or one-fifth of all the fatal cases.

In the statistics furnished by Dr. Norris[2] of the amputations in the Pennsylvania Hospital from 1838 to 1840, we find four cases of the thigh, of which all were cured, showing the difference in the results of a few, and of a series of operations, and indicating the little value that can be attached to statistics in these cases. Except in a very few cases, the propriety of an amputation will be decided by the anxiety of the patient to prolong life, few being found willing to die if the surgeon will admit there is a solitary chance of success by performing the operation, and unfortunately the science of surgery is not yet so firmly based as to render the result obtained from any calculation certainly correct.

SECTION III.

AMPUTATION AT THE KNEE-JOINT.

Amputation at the knee-joint has been accomplished by all the methods before mentioned, in connection with amputations generally, the stump being differently formed by different surgeons. Plate LXXVII. exhibits several of these methods very well. Velpeau advises the circular operation: Hoin one flap; Nathan Smith, of New Haven, two flaps, and Baudens, of France, an oval flap, all of which may be made available under certain circumstances, as where the injury has destroyed portions of the integuments. Dr. Nathan Smith, of Connecticut, being the first to perform this amputation in the United States, succeeded in accomplishing this operation by an original and useful method.

OPERATION OF DR. NATHAN SMITH, OF CONN.[3]—Mark two points, one on the outside and the other on the inside of the limb, the lat-

[1] Amer. Journ. Med. Sciences, vol. xvi. N. S. p. 33.

[2] Am. Journ. of Med. Sciences, vol. xxvi. May, 1840, p. 35.

[3] New York Journ. Med., vol. ix. p. 313, on Amputation of Knee-Joint, by Willard Parker, M. D., N. Y., from Am. Med. Review, vol. ii. p. 370.

ter being half an inch below the head of the tibia, and the other opposite to it. Then draw a semicircular line from one point to the other over the anterior part of the leg, in such a direction that its lower part shall touch the lower part of the tubercle of the tibia, and then mark another circle on the posterior part of the leg exactly corresponding to the former, so as to form two flaps, the anterior of which will be formed by the patella and its ligament, and the posterior by the head of the gastrocnemius, tendons of the flexor muscles, and the popliteal bloodvessels and nerves. In operating, the anterior flap should be first raised with the patella by cutting through its ligament, which will expose the front of the joint and render the division of the lateral ligaments easy; after which two or three strokes of the knife will complete the section of the crucial ligaments and the posterior flap. This patient recovered with a good limb, the stump being formed at its lower part by the patella, which became adherent to the femur.

Operation of Dr. Willard Parker, of New York.[1]—The patient being placed on a table of suitable height, anæsthesia was induced by a mixture of chloroform and ether; pressure made upon the femoral artery in the groin; the integuments of the thigh forcibly drawn upwards from the knee, and the leg held in a flexed position. Then, an incision being made upon the front of the leg, about one inch below the insertion of the ligament of the patella, an anterior flap was formed by dissecting up the integuments as far as the upper portion of the joint, when the patella was removed from its attachments, and the knife passed through the joint over the head of the tibia, the flap being completed by cutting it from the posterior part of the calf. The integuments being then brought together were united by sutures, and the stump dressed.

Operation of Baudens, of Paris.[2]—The patient being laid on the table, as in the amputation of the leg, draw with a pen a line, which, starting from the spine of the tibia three fingers' breadth below its tubercle, shall ascend obliquely backwards and from below upwards, towards the popliteal space, *to terminate* two fingers' breadth *below a line corresponding to the insertion of the ligament of the patella.* An assistant now retracting the skin as much as possible, cut with a large scalpel, or small catlin, through *the skin* in the line just described, and reflect the integuments to the level of the knee-

[1] New York Journ. Med., vol. ix. N. S. p. 308.

[2] Malgaigne, Philad. edit.

joint, then dividing the ligament of the patella, flex the leg, open the joint, cut the crucial and lateral ligaments, and by one sweep cut through the structures behind the joint. After arresting the hemorrhage, force down the patella and integuments, and unite the latter on the back of the thigh by a few stitches, dressing the stump with the water dressing.

§ 1.—STATISTICS OF AMPUTATION AT THE KNEE-JOINT.

In the paper by Dr. Parker, of New York,[1] it is stated that amputation in this joint, as performed in the United States, bears a flattering comparison with that of any other country, 12 operations having been performed, of which 7 were completely successful, being a mortality of one-fourth, or 25 per cent.; 2 required reamputation, 1 for gangrene, and 1 for a chronic disease. In foreign practice, there were 28 cases, 12 deaths, and 16 cured, or a mortality of 42⅞ per cent. As tabulated by Dr. Parker, the results are as follows:—

	CASES.	CURED.	DIED.	MORTALITY.
American Practice . .	12	9	3	25 per cent.
Foreign " . .	28	16	12	42⅞ "
Malgaigne's Collection .	9	2	7	77⅞ "
Jäger's " .	37	22	15	40 "
Total	86	49	37	43

Dr. Parker therefore concludes:—

1st. That amputation at the knee-joint is a justifiable operation as respects the nature of the structures engaged.

2d. That it is a justifiable operation as respects the point of election.

3d. That the stump is well calculated to sustain pressure, and also well adapted to the adjustment of an artificial limb.

REMARKS.—The question of "the propriety of amputating through the joints," is one which has engaged considerable attention at different periods, and been for many years regarded as settled by the general opinion of surgeons, that it is more dangerous to amputate through the joints than through the shaft of a bone in consequence of the presence of the synovial membrane, &c., giving

[1] New York Journ. of Med., vol. ix. N. S. p. 308.

rise to severe constitutional disturbance. In the first edition of this work, I therefore coincided in these views, and discountenanced the operation; but subsequent observation, and an investigation of the more recent accounts of the effects of inflammation on articular cartilages, have induced me to believe that I was in error, and that the opinion generally advanced on the subject is, perhaps, like my own, somewhat the result of the general tendency of many to "follow the leader," or travel in the beaten path, rather than investigate for themselves. A close examination of the evidence for and against these amputations in joints, will show that among the ancients, Celsus condemned, but Galen and Heliodorus advocated them, whilst Sabatier, Nathan Smith, of Connecticut, Brasdor, Larrey, Velpeau, Blandin, Textor, Fergusson, and Malgaigne, among the moderns, advocate it, and that the latter have been ably seconded by Baudens, of France, Parker, of New York, and Pancoast, of Philadelphia. I am therefore induced to regard this question as unsettled, and to incline to the opinion that experience will yet demonstrate its propriety. The idea which appears to have been so very prevalent as to the effects of inflammation of the articular cartilages, synovial membrane, &c., is certainly not sustained by facts, and seems to have been rather a theoretical than a practical objection. In a case reported by Dr. Pancoast, of Philadelphia,[1] cicatrization was completed at the end of the fourth week, and was unattended by a single bad symptom. As one of the condyles also became exposed from the unavoidable shortness of the flaps, the changes in the articulation could be readily noted, and it was found that "the articular cartilages neither became reddened nor painful, nor exhibited any coating of synovial membrane, or other appearance of organization, but by the end of a week became soft and pulpy on its free surface like a recent joint whilst macerating for the anatomist. This pulpy layer was, however, insensibly removed with the discharges, and the articular face of the condyles being completely bared in the third week, granulated and adhered to the cutaneous granulations. No appearance of synovial inflammation of the bursa above the joint was manifested during the treatment, and the patella continued movable on the upper anterior face of the condyles." As articular cartilages, when inflamed, pass through a process similar to the degeneration of inflamed bones—that is, either soften and liquefy, or tend to fatty degeneration—and as they possess few or no blood-

[1] Op. Surg., p. 170.

vessels, there is reason to think that after amputation through the knee-joint, the process observed by Dr. Pancoast must be the usual one, and that the skin and soft structures will, therefore, readily adhere to the condyles of the femur, thus insuring the action of the flexors and extensors of the leg, whilst by transferring their action to the end of the femur, they facilitate very materially the subsequent progression of the patient. In most instances, where nature throws off a part, in the manner formerly designated as ulceration, but now more correctly spoken of as interstitial absorption and liquefaction, there is sufficient lymph effused to serve as a limit to the action, and there is, therefore, no good reason to think that the removal of the articular cartilages from the condyles of the femur will predispose the latter to carious inflammation. In the case reported by Dr. Pancoast, of Philadelphia, the cure was prompt, being within thirty days, so that the liquefying removal of the cartilages does not necessarily lead to sinuses, fistula, and the other tedious symptoms formerly charged as an objection to articular amputations. But admitting that the healing of the stump should be tedious, will not the patient be the gainer in the end by the increased ability with which he can move the limb, to say nothing of the increased ease and gracefulness of his progression? When the patella is left and brought down so as to fill up the trochlea and equalize the condyles, it gives a breadth and roundness to the stump, which fits it remarkably well for a point of support, whilst the skin over it is also well calculated to sustain pressure without the development of inflammation. I therefore commend this amputation to special consideration in all cases requiring amputation of the leg above the tubercle of the tibia, when the femur is not diseased.

SECTION IV.

AMPUTATION OF THE LEG.

Amputation of the leg is to be accomplished by any of the preceding methods, care being taken to leave as long a stump as possible, if the patient is to wear an artificial limb, but to saw off the bone at about three fingers' breadth below the tubercle of the tibia, if he is to wear "the peg," as a long stump, under these circumstances, would be a constant source of inconvenience to the patient, from its projecting behind the body when the peg was applied.

§ 1.—CIRCULAR AMPUTATION OF THE LEG.

The circular operation for amputation of the leg may be accomplished as follows:—

ORDINARY OPERATION.—The patient being placed on a table, or bedstead, with the injured limb projecting over the side of the bed at least as far as the knee, let one assistant apply the tourniquet on the femoral artery, as before directed, or compress it with the fingers, whilst the anæsthetic is being administered. Let a second assistant now support the lower portion of the limb, and a third be ready to control the movements of the sound limb, or let the foot of the sound limb be attached by a towel, or bandage, to the bedpost or table-leg. Then, standing so that the left hand will grasp the upper portion of the leg, take the large amputating-knife firmly in the right hand, kneel or stoop down, and, passing the hand so far around the limb, that the point of the knife will point to the right shoulder, apply the heel of the knife to the skin, and, by a circular sweep, cut it round the leg; rising up and strongly flexing and pronating the hand, in order to terminate the incision at the point where it commenced. Then, laying down the knife, seize the skin and dissect it up by long sweeps of a large scalpel, until a portion can be reverted all round the limb, to about the extent of one-sixth of its diameter. Then again taking the large knife, apply it as before to the muscles, within a half inch of the reverted edge of the skin, and by one sweep, with a slight sawing motion, cut all the muscles to the bone; perforate the interosseous space with the catlin, or the knife, if not too large; pass in a three-tailed retractor, and saw the bones close to the retractor, taking care to divide the fibula before the tibia is entirely sawed through. Then, after tying the anterior and posterior tibial with the peroneal arteries, and any muscular branches that may bleed, bring the ligatures out at one corner, and close the skin with three sutures, so that the cicatrix may be vertical; after which apply the water dressing.

REMARKS.—In this amputation, attention should be given to the length of the stump, before commencing the operation—a long stump being requisite for the attachment of an artificial leg, whilst, if the stump is to rest on the "peg," the bone should be divided within three fingers' breadth of the tubercle of the tibia, for the

reasons before assigned.[1] The remarks in relation to the advantages of a stump formed by the circular operation over one formed by the flap, as before made,[2] are also especially applicable to amputations of the leg.

§ 2.—FLAP OPERATION ON THE LEG.

FLAP OPERATION OF VERDUIN.—The artery being compressed on the thigh, and the leg carried somewhat off from its fellow, stand on the inner side of the limb for the left leg, and on the outer for the right, unless ambidexter; then, feeling for the fibula, draw the muscles of the calf off from the bones, transfix them with an eight-inch catlin, passed close to the bones, but not so as to pass between the interosseous space, and cut a flap about three and a half inches long. Withdrawing the catlin, place it with its heel on the far side of the limb, at the point where the catlin punctured the skin, and form an anterior semicircular flap, by drawing it towards the opposite side of the limb, terminating the incision at the internal point of puncture. Perforate the interosseous ligament with a small catlin, cut the fibres around the bones (Plate LXXVIII., Figs. 4 and 5), apply the double retractor, saw the bones, and unite the flaps by one or two sutures.

REMARKS.—This operation usually forms a well-covered stump, and may, with a little practice, be very promptly performed. It is, however, in my opinion objectionable, for the reasons stated in connection with the general observations on the flap method of amputating.

§ 3.—OVAL METHOD.

Lenoir's operation, which is figured in Plate LXXVIII., Fig. 6, forms a good stump, and is well calculated for the attachment of an artificial limb. In this operation, a circular cut is made in the skin one and a half inch below the point of amputation, and a vertical cut, two inches long, afterwards made in the skin on the spine of the tibia, commencing at the line where the bone is to be divided. After this revert the flaps, and make an oval incision around the

[1] See vol. ii. p. 441.

[2] *Ibid.*, p. 416.

limb on each side, so as to divide the muscles, and complete the operation as before. The vertical cuts freeing the skin from pressure against the tibia, prevents, it is said, subsequent ulceration from the contraction of the tissues consequent on cicatrization of the stump.

SECTION V.

AMPUTATION AT THE ANKLE-JOINT.

The importance of preserving as much as possible of the leg, in order that the patient may not be compelled to obtain the support of an artificial leg, has induced many surgeons, and especially Mr. Syme, of England, to revive the amputation formerly practised through the tibio-tarsal articulation when the disorder was limited to the foot. It may be accomplished by either of the following methods:—

Operation of Mr. Syme, of England.—Make a semilunar incision of the skin, with its convexity towards the toes, by carrying a short catlin around the front of the ankle from one malleolus to the other, and dissect up the flap. Then placing the foot at a right angle to the leg, form the posterior flap by drawing the knife through the skin from the centre of one malleolus to the other directly across the sole of the foot, so that the points of the anterior and posterior incisions may join and form an angle of 45°. On dividing the front of the capsular ligament of the ankle, free the astragalus and dissect the posterior flap off from the os calcis by working close to the bone, so as to preserve as much as possible of the posterior tibial artery for the nourishment of the posterior flap. Then, either sawing off the projecting malleoli or cutting them with the bone-nippers, arrest the hemorrhage and close the flaps with sutures. Apply the warm water dressing until the vitality of the flaps is certain.

Operation of Velpeau.—Make two semilunar incisions convex forwards through the skin, one over the instep and the other above the heel, twelve or fifteen lines in front of and behind the joint, and unite them so as to form another semilunar incision on each side about an inch below the ends of the malleoli. On dissecting back the skin, divide as near the joint as possible the extensor tendons of the toes, the peronei tendons, the tibialis anticus, the flexors of the foot, the tendo-Achillis, and the external and internal lateral

with the capsular ligaments. Disarticulate the bones, and bring the antero-posterior flaps together, so that the lateral flaps may cover the ends of the malleoli—these ends, according to Brasdor, being rounded off by nature, and not therefore requiring to be excised. If the astragalus can be left, as advised by Ligneroles, it will improve the surface for pressure.

Remarks.—The advantages of the amputation at the ankle-joint, like those at the knee-joint, have been much discussed, and many arguments advanced for and against it. Of four cases that have come under my notice, three did well, the patients being able to walk with a boot similar to that shown in Plate LXXVIII., Fig. 10. There is, however, as far as I have seen, always trouble in preventing the accumulation of pus beneath the posterior flap, in Mr. Syme's operation, and also a tendency to sloughing in the edges of the flaps, which sometimes goes to a greater extent. Although successful in some instances, this amputation can never, I think, be generally adopted—the difficulty of getting a good shoe, the tendency to a tender stump, and the occasional necessity that has occurred of reamputating higher up, rendering surgeons unwilling to attempt it—especially as the circular amputation immediately above the joint furnishes a good stump for an artificial leg, the foot of which is less unnatural in its appearance than the inflexible cork, which must be employed to fill up the shoe that is required after amputation at the ankle-joint.

SECTION VI.

AMPUTATION OF THE FOOT AT THE TARSUS.

In order to save as much of the foot as might suffice to support the patient, amputation through the tarsal and metatarsal joints has been suggested, and often practised. Either of these amputations requires an accurate knowledge of the relations of the articulating surfaces of the bones, and should not be attempted without a recent examination of the part by those not perfectly familiar with it. In the hands of an anatomist, they constitute two of the most valuable and scientific methods of amputating ever resorted to. To facilitate reference, the parts have been fully shown in Plates LXXIX., LXXX.; and their anatomical relaticns may, therefore, be omitted here.

Chopart's Operation.—After recognizing the position of the

joint, grasp the foot with the left hand, so that its *palm* may present to the sole of the patient, placing the thumb upon the external extremity of the joint, and the forefinger upon the internal. In the right foot, the thumb would therefore rest against the cuboid, and the forefinger on the scaphoid bones, whilst in the left foot it would be the reverse. As this position indicates the joint, the thumb and finger should be held there until the skin is divided.

Then, being sure of the joint, carry a small catlin across the top of the foot, from the thumb to the point of the forefinger, making a semicircular incision slightly convex forwards, which shall descend about half an inch in front of the articulation, and, directing the assistant to draw up the skin, divide the extensor tendons and the dorsal ligaments, rendering the latter tense by pressing the toes downwards (Plate LXXIX., Fig. 2). Then divide the lateral ligaments, and pass the knife through the articulation at such an angle of inclination as will enable it to adapt itself to the surface of the bones, after which the flap should be formed by shaving it off from the sole of the foot (Plate LXXIX., Fig. 3).

LISFRANC'S OR HEY'S OPERATION.—Amputation at the metatarso-tarsal articulation was suggested by Mr. Hey, of England, who accomplished it by sawing off the ends of the metatarsal bones, and the amputation is, therefore, now often spoken of as Hey's operation. As the section of the ends of these metatarsal bones was frequently followed by caries, and subsequent abscesses, it has generally been deemed best to disarticulate them, as proposed by Lisfranc, and as this is an important modification, the disarticulation should be designated as the operation of Lisfranc, and so described. To find the joint, "draw a transverse line across the foot, from the superior extremity of the fifth metatarsal bone, and it will fall upon the inside of the foot two-thirds of an inch *behind* (or above) the articulation."

OPERATION.—After finding the position of the joint, seize the foot, so that the thumb, if in the right foot, shall rest on the tuberosity of the fifth metatarsal bone, and the index or second finger half an inch in advance of the internal side of the joint at the cuneiforme internum, and retain them in this position until the first incision is made (Plate LXXIX., Fig. 9). Then, with a strong short catlin, make a semicircular flap incision on the dorsum of the foot, cutting from the thumb towards the finger, half an inch in front of the articulation, and by a few touches of the point of the knife upon

PLATE LXXIX.

AMPUTATIONS OF THE FOOT.

Fig. 1. A View of the Bones composing the Tarsal Articulation, as concerned in Chopart's Operation. 1. Astragalus. 2. Os calcis. 3. Cuboid. 4. Scaphoid. 5. Internal point of joint, or tuberosity of scaphoid bone. 6. External point of the articulation. 7. Head of fifth metatarsal bone. 8. Fibula. 9. Tibia. 10, 10. Two pins to show the direction of the articulating surfaces or line in which the knife must be passed.

After Bernard and Huette.

Fig. 2. Position of the Hand of the Surgeon, and Line of Incision in Chopart's Operation. 1, 2, 3. Line of incision. After Bernard and Huette.

Fig. 3. Continuation of same Operation. The joint being opened, the knife is about to form a flap from the sole of the foot. 1. Anterior tibial artery. 2. The knife. After Bernard and Huette.

Fig. 4. Sedillot's Operation. 1, 2, 3. Line of incision.

After Bernard and Huette.

Fig. 5. Side View of the Outer Side of the Bones of the Tarsus, showing the Oblique Direction of the Articulating Surfaces over which the Knife is to pass. 1. Os calcis. 2. Cuboid. 3. Pin in the joint. 4. Joint between the astragalus and scaphoid, with a pin in it to show its inclination.

After Bernard and Huette.

Fig. 6. Side View of the Inner Side of the same Bones. 1. Astragalus. 2. Scaphoid. 3, 4. Pins in the joints. After Bernard and Huette.

Fig. 7. Dorsal View of the Bones of the entire Foot. 1. Tibia. 2. Fibula. 3. Astragalus. 4. Os calcis. 5. Scaphoid. 6. Cuboid. 7. Internal cuneiforme. 10, 11, 12, 13, 14. The five bones of the metatarsus. 15. The phalanges of the toes. After Bernard and Huette.

Fig. 8. Dorsal Articulating Ligaments of the Foot. 1, 1. Anterior tibio-tarsal ligament. 2. Anterior portion of the external lateral ligament. 3. Internal calcaneo-scaphoid. 4. External calcaneo-scaphoid. 5. Astragalo-scaphoid. 6. Calcaneo-cuboid. 7. Scaphoideo-cuneiforme. 8. Cuboideo-metatarsal. 9. Cuneiforme metatarsal ligaments.

After Bernard and Huette.

Fig. 9. Lisfranc's or Hey's Operation on the Right Foot. 1, 2, 3. Line of incision in the skin. 4. Thumb of the surgeon on the extremity of the fifth metatarsal bone. 5. His forefinger on the metatarsal bone of the first toe. After Bernard and Huette.

Fig. 10. Manner of Opening the Articulation of the Second Metatarsal with the Middle Cuneiforme Bone. 1, 2, 3. Arch of the circle formed by the knife in its different positions. 4. Second metatarsal bone. 5. First metatarsal bone. 6. End of the fifth metatarsal bone.

After Bernard and Huette.

Plate 79.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 10.

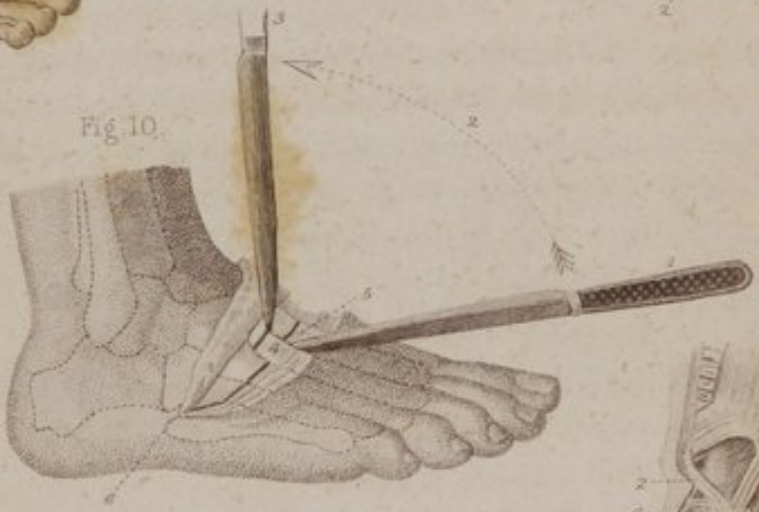


Fig. 7.

Fig. 8.

Fig. 9.

the adhesions facilitate its retraction by an assistant. Then, placing the point of the knife close to the end of the fifth metatarsal bone, divide the lateral and dorsal ligaments, and open the joint as far as the third metatarsal bone; and, on reaching this point, carry the point of the knife half an inch backward, or nearer to the ankle, cut the dorsal ligaments, and expose the second metatarsal bone. Then, acting only with the point of the knife, and holding it perpendicularly (Plate LXXIX., Fig. 10), insert its point on a line with either the first or second metatarsal spaces, or close to the side of the head of the second metatarsal bone, and rocking it backwards and forwards cause it to graze the lateral surface of the first metatarsal bone, and then, by a sawing motion, open the joint between it and the internal cuneiforme. Do the same thing on the outer side of the head of the bone, and dividing the interosseous ligament, press upon the metatarsus, and complete the division of the remaining ligaments, when, passing the knife flatwise beneath the foot, form a flap out of the integuments on the sole of the foot, by shaving them off close to the metatarsal bones.

Remarks.—The circumstances under which either Lisfranc's or Chopart's operation would be performed being very different, it is hardly desirable to attempt any comparative estimate of their value. Lisfranc's or Hey's operation is certainly preferable to Chopart's, when it is admissible, in consequence of its affording a greater length of foot, and thus adding to the patient's stability, and, with a good shoe, constructed as shown in Plate LXXVIII., Fig. 11, a very useful limb can be obtained from this method.

SECTION VII.

AMPUTATION OF THE TOES.

Amputation of the Toes (Plate LXXX.) may be usually accomplished by the same methods as the fingers, with the exception of the articulation at the metatarsal bone of the first toe. In this amputation, whether performed by the flap, oval, or circular method, it has been recommended to saw off the round head of the first metatarsal bone after the phalanx is removed, as it is apt to become a source of irritation from pressure against the boot. But if the hard skin of the under surface of the foot can be made to cover it thoroughly, I

PLATE LXXX.

AMPUTATION OF THE TOES.

Fig. 1. A view from above of the Dorsal Ligaments as opened by the point of the knife in Lisfranc's Operation, as previously shown in Fig. 10, Plate 79. 1, 2, 3. Points opened. 4. Hand of surgeon.

After Bernard and Huette.

Fig. 2. Manner of forming the Flap from the Sole of the Foot in Lisfranc's Operation. 1. Anterior tibial artery. 2. Resection of hand of surgeon on the foot whilst forming the flap. 3. Position of the knife.

After Bernard and Huette.

Fig. 3. Wound left after Lisfranc's Operation. 1, 2, 3. Shape of plantar flap. 4. Dorsal flap. After Bernard and Huette.

Fig. 4. Wound left in Chopart's Operation. 1, 2, 3. Plantar flap. 4, 4. Bloodvessels. After Bernard and Huette.

Fig. 5. Amputation of all the Toes through the Metatarsal Bones. 1. The retractor passed in each interosseous space. 2. The saw.

After Bernard and Huette.

Fig. 6. Wound left by the preceding Operation. 1, 2, 3. The plantar flap. After Bernard and Huette.

Fig. 7. Disarticulation of all the Toes. 1, 2, 3. Line of the dorsal incision in front of the joints. After Bernard and Huette.

Fig. 8. Continuation of the same Operation. 1, 2, 3. The dorsal incision. 4. The Catlin, after opening the joints, about to form a plantar flap. After Bernard and Huette.

Fig. 9. Wound left by the preceding Operation. After Bernard and Huette.

Fig. 10. Disarticulation of the Third and First Toes. 1, 2, 3, 4. Wounds resulting from the oval method on the great toe. 1, 2, 3. Wound formed by two flaps on the third toe. After Bernard and Huette.

Fig. 11. 1, 2, 3. Line of incision in disarticulation or resection of the first metatarsal bone. After Bernard and Huette.

Fig. 12. Amputation of the Great Toe. 1, 2, 3, 4. Line of incision in the oval operation. After Bernard and Huette.

Plate 80.

Fig. 1.

Fig. 4.

Fig. 2.

Fig. 3.

Fig. 6.

Fig. 5.

Fig. 9.

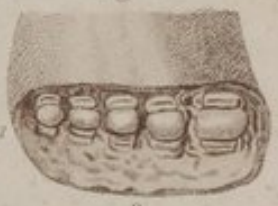


Fig. 8.

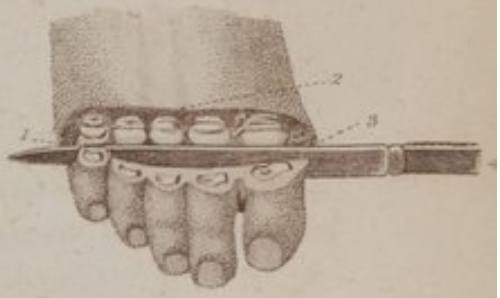


Fig. 7.

Fig. 10.

Fig. 11.

Fig. 12.

think it is better not to do so, as this end of the bone is of great service in giving the patient a firm step, and preventing an inclination of the foot inwards. The other amputations of the toes are sufficiently explained in Plate LXXX., Figs. 5 to 12.

SECTION VIII.

ORGANIC CHANGES RESULTING FROM AMPUTATIONS.

The changes which result from the removal of a portion of the extremities by amputation may be noticed both in the part and in the general health of the patient within a short period after the operation.

In the stump, the approximation of the superficial to the deeper-seated parts, produced by closing the wound, naturally leads to a general matting together of the skin, fascia, muscles, bloodvessels, and nerves, whilst the inflammatory changes connected with the process of healing often create bands of condensed cellular tissue, which, when thickened by pressure, become almost cartilaginous in their density. The changes produced in the muscles, it has usually been thought were due to atrophy, and that the difference in the development of a stump, as compared with the muscles of the opposite limb, was the result of a defect of circulation. The observations of Mr. Spence, of Scotland, as stated[1] to the Medico-Chirurgical Society of Edinburgh, seem, however, to disprove this. In one stump, formed by a flap operation twelve years previous, dissection showed it to be well formed and covered by muscle. For a few weeks after the healing of a stump, any angles caused by closing the wound remain prominent, and the cicatrices which are formed near them cause a wrinkling of the surrounding integuments; but ultimately the process of absorption and deposition equalizes the surface to a considerable extent, making it much more round and ball-like than before, provided a free amount of integument has been preserved in forming the flap.

The division of the nerves of the part is most frequently followed by a bulbous enlargement at or near the point of section; and, if their extremities become inflamed, or involved in the line of the

[1] New York Journ. Med., vol. iii. p. 408, from London Journ. Med.

cicatrix, the contraction of the latter, by pressing upon them, will occasionally induce severe neuralgia, which, in some instances, has required the stump to be opened, and the nerves to be dissected from the part. Mr. Spence[1] believes that Neuromata are unavoidably formed when nerves are divided, no matter how deeply covered or in what method the amputation is performed. When a nerve is cut across, he has generally found that its neurilemma contracted, and that the nervous fibrillæ projected and ultimately became firmly connected with the lymph effused about the point of section, some fibrillæ being spread out on the surface of the lymph and others imbedded and interwoven in it. These tumors, however, were not productive of pain, unless exposed to pressure against bone, or so thinly covered as to be exposed to atmospheric influence. The size of these neuromatous tumors was not dependent on their being more or less thickly covered, as some were found, of large size, very deeply seated in the stump.

The cancellated structure of the bone becoming also more or less inflamed after its section, effusion of lymph ensues, granulations are formed at the extremity of the medullary membrane, and, as these become organized, a new deposition of bone follows, which closes the medullary cavity and gives to the extremity a sort of cap, which, becoming rounded and convex (Plate LXXVIII., Figs. 7, 9), is well adapted to sustain pressure without irritating the soft parts which are forced against it. In some instances, there has been an evident growth of the end of the bone, and an apparent increase in its length.

The constitutional changes ensuing upon amputation are often not less marked than the local alterations. In amputations for chronic diseases, and especially in those accompanied by hectic fever, the first night of comfort obtained by the patient is often that immediately ensuing on the operation, whilst the fever will sometimes disappear promptly. When the portion of the extremity that has been removed is considerable, there is apt to be considerable disturbance of the equilibrium of the system, the process of nutrition going on rapidly, and the patient increasing in size to a remarkable degree. At the same time, there is a liability to plethora which may require treatment on the general antiphlogistic plan.

[1] New York Journ. Med., vol. iii. p. 408, from London Journ. Med.

SECTION IX.

SUBSTITUTES FOR THE NATURAL LIMB.

After the cure of an amputated limb, the surgeon should make it a point of duty to direct the patient in the attainment of some useful substitute for the portion which has been removed. This must, of course, vary with his social condition.

For the arm of the laboring man, a cap formed of strong leather, to which an iron hook can be attached, and which should be made to strap on to the stump, will answer the purposes of prehension, whilst those of larger means can now obtain excellent substitutes for the arm and hand from various ingenious mechanics. In one instance, a patient, for whom I obtained one of the artificial arms made by Gildea, of Philadelphia, was able to grasp his hat and hold a pen or other light articles by a neat mechanism that caused the fingers to approach the palm of the hand.

Many varieties of artificial legs can now also be readily obtained, in which the support is furnished by a graduated pressure around the stump; but it is to be hoped that every surgeon will, in accordance with the recommendation of the American Medical Association, abstain from the recommendation of any of these limbs when they are patented. Those of Gildea, above mentioned, are very neat and free from this objection.

In Plate LXXVIII., Figs. 10, 11, are represented two boots, which will prove useful in affording support to the foot after the performance of Lisfranc's or Chopart's operation.

The common peg or wooden leg, usually employed by laboring men as a substitute for the natural leg, requires no further reference, as it is universally known. As a general rule, few stumps will be able to sustain the pressure arising from the constant use of a peg or wooden leg under eight or ten weeks after the entire healing of the wound, even when the stump is well soaked every night in a strong decoction of white oak bark to harden the skin. In the best formed artificial limbs, although the main support is borne by the limb above the stump, yet the strain thus put upon the newly-formed cicatrix is also very apt to induce ulceration, and this, when repeatedly established, becomes very difficult to heal. It will therefore prove useful to omit the use of all these artificial supports for

about three months, and then, on the appearance of increased redness in the stump, to intermit their employment, when worn, until the congestion of the skin has passed away. The anxiety of patients to try their new limbs will often create so much irritation in the newly-formed stump, as to require that their movements should be regulated by the surgeon, before ulceration or sloughing of the stump is induced by their ignorance or imprudence.

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