form, and to facilitate the rotation of the flap, a wedge-shaped portion (*b*) may be excised from the base of the flap. In this operation the vermilion border of the flap must be removed, and the fissure in the lip is to be closed at once. Perforations of the nose resulting from wounds or ulcerative processes are generally seated at the sides of the nose. They may readily be closed by flaps of suitable shape and size, taken from the forehead, from the cheek, or from the opposite side of the nose.

FIG. 4020.

The nasal column, when it alone is defective, can be admirably repaired from the central portion of the upper lip, which must be included between parallel perpendicular incisions. When the flap thus formed is brought in contact with the nasal septum, its mucous surface is of course exposed, and is eventually converted into skin.

In the most complicated of nasal defects, finally, other parts of the face are also, as a rule, deficient. This is particularly true of the upper lip, of portions of the palate, and of the cheek. In such complicated cases, as has already been intimated, many operations are required before the face can be made at all presentable. In cases of this character the lip, the angle of the mouth, and the nose all require separate operative treatment. If, however, from one to three years be devoted to the judicious management of such a case, the result will in every way repay patient and operator for the patience displayed.

*Paraffin Injections in Reparative Surgery.*—In order to fill up the scrotum of a very sensitive young man, which had been left empty after a castration, Gersuny [15] in 1900 devised the ingenious method of injecting vaseline. Encouraged by the good result obtained in this case, he extended the procedure to cases in which other than the distinct cosmetic effect was desired. The result which Gersuny [16] obtained in a case of urinary incontinence in a female, which had resisted all other methods of treatment, was so brilliant that other surgeons at once took up the new procedure, and so its use soon became widespread. A considerable amount of good work has been done at von Bergmann's Klinik by Stein.[17] He prepares paraffin, which should have a melting point between 42° and 43° C., by melting and filtering with a hot-water funnel, such as is used in the filtration of bacteriological culture media. The filtered paraffin should be put into wide-mouthed flasks, such as Erlenmeyer's, and plugged with cotton wool. In these it is sterilized in the hot-air oven at a temperature of 200° C. for a half-hour, and can then be preserved indefinitely, ready for use at any time. Before using, the flasks containing the paraffin are heated in a water-bath to the melting point. The injection is made with a Pravaz syringe, wholly made of glass, holding about 1 gm. The object is to have a syringe devoid of all sharp corners and edges, so that the paraffin does not so easily congeal. Before injecting the paraffin, the filled syringe is again put into hot water and then the needle is screwed on. The injection is made by lifting up a fold of skin with the left hand and with the right inserting the needle and injecting slowly until the desired amount has been used. The needle is then withdrawn and a small piece of plaster fastened over the puncture. The paraffin is now moulded into the desired shape, while an assistant allows the ethyl chloride spray to play upon the part. Several injections may be made at different times, but care must be used not to insert the needle over the area previously injected, as it should be inserted to the side of it. According to Juckoff [18] paraffin after its injection acts like any foreign body, and causes a reaction-

FIG. 4021.

ary inflammation with the formation of new tissue. Some of the paraffin is absorbed here and there, so that finally we have the mass pervaded by connective-tissue strands, which emanate from a fibrous capsule around the whole. This capsule is fused with the adjacent tissue.

FIG. 4022.

This excellent method is not without a small amount of danger. The following unfortunate occurrences have taken place: Embolism of lung and intestinal organs from the accidental insertion of the needle and injection into a vein; infection from faulty asepsis; gangrene and sloughing from the introduction of too much paraffin, as a result of which obliteration of the blood-vessels has occurred.

The method is applicable to cases in which the normal contour of the body is lost. It has been used with distinct benefit in saddle nose following caries of nasal bones. In one case treated at von Bergmann's Klinik, the result was striking. Several injections were made at different places and the nose was thus gradually built up. The injection should be made with care so that none of the paraffin shall find its way into the orbit. Cleft palate may be treated by this method, which is chiefly applicable to those cases in which a small foramen has remained after staphylorrhaphy. The contour of the cheek might be re-established after removal of the superior maxillary bone. The scrotum may be filled up after castration. The method is applicable to another class of cases, namely, those of urinary incontinence, especially in the female, in which condition a ring of paraffin is injected about the neck of the urethra so as to replace the sphincter. A cystocele has also been treated, with distinct benefit, by injections between the vagina and bladder wall. By establishing a paraffin depot around the rectum fecal incontinence has been cured. The method is still new and sufficient time has not yet elapsed to establish the permanency of cure in many of the brilliantly successful cases; nor have there been many opportunities to examine the changes produced in the tissues, beyond those produced experimentally on animals in the laboratory. The method promises much in the future, and certainly is a valuable aid to our surgical technique. *Joseph Ransohoff.*




FIG. 4023.

[1] Zeits. d. Literat. und Gesch. der plast. Chir., Leipzig, 1863.
[2] Celsus: Lib. vii., cap. ix.
[3] Gurdon Buck: Repar. Surg., p. 11, 1876.
[4] Dennecé: Arch. gén., 1855, t. vi., p. 402.
[5] Szymanowsky: Oper. on the Surface of the Body, Kiew, 1865. In Russian only. [6] König: Lehrb. der Chir., Bd. i.
[7] Arch. f. klin. Chir., vol. xxiii., p. 323. [8] Chir. Réparatrice, p. 116.
[9] O. Weber: Pitha und Billroth, Bd. iii., i., p. 148.
[10] Arch. f. klin. Chir., i., p. 95.
[11] Ollier: Compt. rend., 1861, 53, p. 84.
[12] Arch. f. klin. Chir., 5, p. 33. [13] Gaz. hebd., i., p. 416.
[14] Chir. Répar., p. 118, 1854, Verneuil, p. 311.
[15] Gersuny: Zeitschrift f. Heilkunde, 1900, Bd. i., Heft 9.
[16] Gersuny: Centralblatt f. Gynäkologie, 1900, No. 48.
[17] Stein: Deutsche med. Wochenschrift, 1901, Nos. 39 and 40.
[18] Juckoff: Ueber die Verbreitungsart subcutan., etc. Arch. f. exp. Pathologie, Bd. xxxii.

**REPRODUCTION.**—The various processes by which new organisms are produced are included in the general term, *reproduction*.

It was thought by the ancients that many organisms of complicated structure, such as worms, insects, plants, etc., could be formed from mud, decaying material, and other dead matter by a process of spontaneous generation, or *abiogenesis*. It was proved by Redi in 1688 that abiogenesis does not occur in insects, but it remained for Pasteur and his colleagues in the latter half of the nineteenth century to show that even the minute and simply





organized bacteria are always produced by division of the living substance of pre-existing individuals of the same species; that is, reproduction in the present condition of the world is always a process of *biogenesis*. Not only is every organism produced by a pre-existing organism, but every cell arises by division of a pre-existing cell, and every nucleus by division of a pre-existing nucleus. (See *Cell*.) Moreover, there is good evidence for the belief that the minute but apparently important elements of the nucleus, known as *chromosomes* (*q. v.*), are also produced only by division of pre-existing chromosomes. So reproduction, like all other vital functions in health and disease, must be regarded as essentially a cellular phenomenon.

Reproduction may be either sexual or asexual. The essential feature of *sexual* reproduction is the development of an embryo from a *fertilized* egg, that is, a germ produced by the union of an *ovum* and a *spermatozoon*, or their equivalents (see articles *Ovum*, *Spermatozoa*, and *Impregnation*). The capacity to produce one or the other of the reproductive elements, together with the associated peculiarities, constitutes the quality of *sex* (*q. v.*). Both of the reproductive elements are cells derived from apparently indifferent germ cells by an interesting process of development, which is discussed under the heading *Reduction-Division*. This process takes place in certain special organs, for which the general name is *gonad*, the female gonad being called the *ovary* and the male gonad, the *testis*. When the eggs or spermatozoa are ripe they are discharged from the gonad, and fertilization may take place outside of the body, as in most fishes, or within the oviduct (Fallopian tube, uterus, etc.), as in man. In man and other mammals the discharge of the ova is associated with certain peculiar physiological phenomena described in the article on *Menstruation*.

Fertilization having taken place, the egg proceeds to divide by the usual process of cell division, and by repeated divisions forms a mass of cells which becomes the embryo. The details of this process vary in different animals, as will be seen by reference to the article on the *Segmentation of the Ovum*. Sooner or later the cells of the embryo begin to differ among themselves in accordance with their destiny in the formation of organs. The causes of these changes are discussed under the title *Differentiation*, and the development of the embryo in form and structure is described in detail in the articles *Fœtus* (in THE APPENDIX), *Area Embryonalis*, etc.

Both during development and in the adult condition there is a noticeable similarity between parent and offspring at corresponding stages. This is a fact of great importance, and is fully treated in another place (see articles *Heredity* and *Reversion*).

When reproduction takes place by some method without the aid of a fertilized egg, it is said to be *asexual*. In the bacteria and some of the lower animals the reproducing individual divides into two or more nearly equal parts. This is called *fission* (*q. v.*). In the yeasts, the higher plants, and some animals, a small part of the parent grows more rapidly and becomes differentiated into a new individual. This is *budding* (*q. v.*). A third form of reproduction occurring normally in some species is known as *parthenogenesis* (*q. v.*), which may be regarded either as an asexual or as a degenerate sexual process. In such cases the offspring is produced by the development of an egg without fertilization. *Robert Payne Bigelow.*

**RESALDOL** is a light-brown powder prepared by the action of chlormethyl-salicyl on resorcin by means of acetylization. It is insoluble in water, ether, chloroform, benzol, and acids, and soluble in alcohol, acetic ether, and alkalies. Its taste is insipid and astringent. On account of its insolubility in acid media it causes no derangement of the stomach (Hermann), but in the intestines sets free the diresorcyl radical and acts as an astringent and antiseptic. Hermann recommends it in acute and chronic diarrhœa, colitis, the early diarrhœa of typhoid fever, intestinal putrefaction, and infantile diarrhœa, and he finds it useless in nervous diarrhœa or that due to mechanical irritation. Brochocki employed it in twelve cases of tuberculous enteritis, four of acute gastro-enteritis, three of catarrhal dysentery, and three of typhoid. All except the typhoid cases improved, though xeroform, bismuth, and opium had failed. The dose is 1–1.5 gm. (gr. xv.–xxiv.) three times a day. *W. A. Bastedo.*

**RESECTION OF THE JOINTS.**—The history of this operation dates from the year 1783, when Henry Park formally proposed the operation for the removal of disease. In 1786 Moreau first performed it, and became its stanch advocate as a method of treatment. Little was done, however, until Syms in 1831 in the elbow, and Ferguson in the hip, knee, and wrist, made use of this operation as a conservative method of treatment ("Excision of Joints," R. M. Hodges, Boston, 1861). Since this time this method of treatment has been wonderfully advanced and has been adopted by the ablest surgeons.

A resection is the removal of a portion of the skeleton without great sacrifice of the soft parts. Applied to joints it has for its object the more or less complete removal of the bones forming the joint, the preservation of the sensibility, contractility, and vitality of the soft parts influencing the joint, and the ultimate restoration of motion or the production of ankylosis.

When motion is desired—the ideal object of articular resections—the ends of the bones left in contact must be adapted to one another, and so fashioned in shape as to reproduce the joint surfaces removed. The muscles which move the joint must be left undisturbed in their attachment; or, if disturbed, restored so that their functional action is not compromised.

The ligaments and fibrous bands which subsequently develop and unite the bones must be analogous to those present before operation. To obtain this end, all ligaments must be preserved with their bony or periosteal attachments.

To attempt a nearthrosis with a sacrifice of the muscular and ligamentous attachments often results in a useless pseudarthrosis, inferior in every respect to a useful ankylosis.

To obtain mobility with steadiness and strength in action the preservation of the muscular and ligamentous attachments to the periosteum and the continuity of the articular capsule with the periosteum must be made the main object of the operation. Such a method of operating is known as the subperiosteal or subcapsulo-periosteal resection. Its object is motion with strength and steadiness in action.

In case a solid union—ankylosis—is desired, two conditions arise which influence the result. The first is seen when the divided ends of the bones can be brought into apposition and their fusion takes place directly. In this case ankylosis is assured, provided the disease is removed. The second condition exists when the divided ends of the bones cannot be brought into apposition, but are separated by an appreciable distance from one another. The union here takes place principally through the agency of the periosteum, and ankylosis, more or less doubtful and dependent upon the osteogenic power of the periosteum, results. It is in this latter variety that the pseudarthrosis and flail joints occur.

When ankylosis is desired and is reasonably attainable, the preservation of the muscular, ligamentous, and capsular attachments to the periosteum are of secondary importance.

When bone or a bony prominence is separated and replaced *in situ* in order that diseased tissue can be more thoroughly removed, the resection becomes an osteoplastic one.*

Again, resections are either complete or partial: complete when the component bony surfaces are removed; partial when one or more, but not all the articulating surfaces are removed.

Resections may therefore be partial or complete, par-

* This term is sometimes used and applied to operations in which bones not normally apposed are brought together after removal of the intervening bone or bones.

osteal or subcapsulo-periosteal. They may also be osteoplastic.

*The Incision.*—They should avoid nerves and vessels. When possible, tendons and muscles should be spared. This is attained by using the intermuscular septa in approaching the joints.

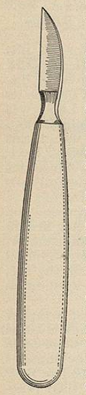

FIG. 4024.

Incisions should be ample, to expose the joints without forcible retraction. They should be so situated that the entrance through the capsule and into the joint is the most direct one. Gentleness should be exercised by all throughout the operation. Maltreatment of the soft tissues not only interferes with the process of repair, but destroys an otherwise successful result. Care should be used in protecting the soft parts from the saw. The tendons, if possible, should be left undisturbed within their sheaths. Their insertions should be left in continuity with the periosteum, or a small piece of bone (Vogt) may be removed with the insertion. If it is necessary to divide tendons, they should be carefully sutured.

If muscles must be divided, they should be cut in the direction of their fibres, the nerve being avoided. If this is impossible, they may be divided transversely or obliquely as near their origin or insertion as possible.

The management of the periosteum is still in dispute. Some advocate the subperiosteal, others the parosteal method.

It must be remembered in any given case that the value of the periosteum in procuring bone is very variable, and is dependent mainly: (*a*) Upon age. The healthy physiological periosteum has but little osteogenic power except in youth. (*b*) Its power to develop new bone depends upon the thickness of the different bones. (*c*) Pathological processes involving the periosteum and causing a thickening of the osteogenic layer will increase its osteogenic power. In but few cases can a comparison be made between these methods in reference to these three points; and since many subperiosteal operations are very imperfectly performed, it is not surprising that a division of opinion should exist.

Ollier, Langenbeck, Sayre, and others have long insisted that the traumatism produced by the subperiosteal (*i.e.*, subcapsulo-periosteal) method was less than by the parosteal method, and have maintained that the reparative process itself was less impaired because of the protection to the soft parts afforded by the capsule and periosteum.

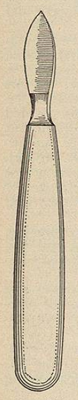

FIG. 4025.

My own opinion favors the subperiosteal method, both for the protection to the tissues, for the production of new bone, and for the aid to the reparative process.

Time is not sacrificed in the subperiosteal method, for the separation of the periosteum can be rapidly accomplished by a to-and-fro motion of the rugine. When one approaches a prominence of bone or a tendinous insertion is met, a small piece of bone may be separated with the periosteum by the chisel or the rugine; such a piece may act as a centre of bone growth. During the separation the rugine is to be pressed against the bone, separating the periosteum entire and not injuring its connection with the overlying tissues.

In the management of the bones, we strive to remove the smallest amount of bone which will remove the disease or correct the deformity. Where the bones can be protruded through the incision and the soft parts sufficiently protected, the butcher, the Emmerich, or the broad flat-bladed saw (carpenter) may be used. When the bones cannot be displaced and the protection of the soft parts can be secured by gentle traction, the Gigli saw can be used. Other varieties of saws seem scarcely necessary in resections.

The sawing is usually done in plane surfaces at right angles to the line of pressure. In some instances, especially where an attempt to obtain motion is made, mortises and tenons are fashioned, which tend to favor retention of the fragments and to preserve the shape of the joint ends of the bones.

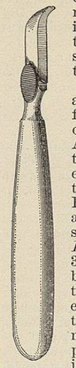

FIG. 4026.

FIG. 4027.

In pathologically involved joints after removal of the articular ends, further removal of foci may be required with the gouge or spoon. After removal of the disease from the bones their fixation is necessary, either in the attempt to obtain motion or in that to secure ankylosis. For this purpose, silver, copper, aluminum bronze, wire, steel and steel-plated nails, bone pins (Marsh, *Brit. Med. Journal*, 1887, i., p. 389), and steel drills (Wyeth's) have been used. My own experience teaches me that fixation is not necessary for a longer period than ten to fourteen days, and that in the majority of cases in which good appliances are obtainable the fixation is not required, in aseptic cases, for a longer period than that during which the first dressing must be kept applied. I have therefore relied completely upon chromicized catgut, which is prepared to resist absorption for from two to three weeks. This has been my practice for fifteen years, and I see no need of subjecting the tissues to the presence of a foreign body, which, if pathological deposits exist in the bone, only offers a *locus resistentiæ minoris* for infection from within or without. I must add, however, that in some instances, as in the hip-joint, it is not always feasible to produce fixation by the catgut suture. In these instances the steel nails, drills, or bone pins may be used. The bone pins are absorbable.

The management of the synovial membrane, capsule, and ligament requires the removal of all pathological deposits affecting them, even if it include the entire removal of these parts. When possible, the synovial membrane, the capsule, and the ligaments should be saved in part or entire, since the perfection of motion in nearthrosis depends in no small degree upon the presence of these structures.

The instruments which are specially used in resections are: 1. Those which divide the soft tissues immediately investing the bone, or joint-knives. These should have strong handles and short-cutting blades to insure precision and force in action (Figs. 4024 and 4025). 2. Those intended to detach the periosteum from the bones —rugines (Figs. 4026 and 4027). 3. Those intended to fix the bones while the soft parts are being detached and the bones sawed (Fig. 4028). 4. Those intended to divide the bones. When the bones can be displaced and a straight saw can be applied, either a bow saw with a rotating blade (Fig. 4029), or a solid straight back saw (Fig. 4030) may be used. When the bones cannot be displaced so that a straight saw can be used without injuring the soft parts, the chain saw (Fig. 4031), or the Gigli saw should be used. The former is used when the surface to be cut is in one plane; the latter when the cut surface is to be concave or convex. Electrically

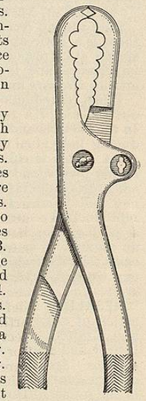

FIG. 4028.





propelled saws seem to have no advantages in resections. 5. Those intended to cut away spicula or prominences of bone with the periosteum attached: (*a*) Bone forceps (Figs. 4032 and 4033); (*b*) chisels (Fig. 4034). 6. Those intended to remove diseased foci in the bone after the sections are made: (*a*) Gouges (Fig. 4035); (*b*) spoons (Fig. 4036). 7. Those intended for drilling the holes required for the wire nails or catgut suture (Fig. 4037).

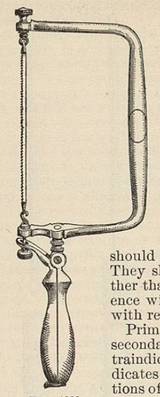

FIG. 4029.

*The Indications for the Resections of the Joints.*—In tuberculosis resections are usually looked upon as a sequel to rather than as a substitute for the conservative treatment. In the young, resections should be partial rather than complete. They should be subcapsulo-periosteal rather than parosteal, with as little interference with the epiphysis as is consistent with removal of the disease.

Primary tuberculosis of the lung with secondary joint involvement usually contraindicates operation, while the reverse indicates it. The mortality following resections of all varieties performed upon 117 patients was 21.3 per cent., with 15.3 per cent. of this number from tuberculosis (König). Whether early resection or the expectant treatment gives better results as regards mortality, function and a cure, must remain in doubt until similar cases are treated by each method and are compared. Undoubtedly many

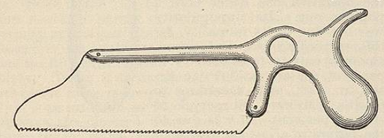

FIG. 4030.

cases treated expectantly and regarded as tuberculous are not so. The same cannot be said of resections, since the cases resected are proven before or after operation by microscopical or bacteriological examination as tuberculous in almost all instances. My own experience leads me to the expectant as the initial treatment, while resection is reserved as a secondary method.

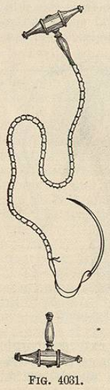

FIG. 4031.

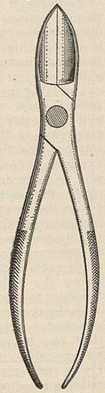

FIG. 4032.

In acute suppurative arthritis and synovitis, arthrotomy, not resection, is indicated. In chronic suppurative arthritis, resection is indicated for the removal of the disease and the relief of the deformity. In arthritis deformans, resection may be indicated for the flail joint. The rarefying osteitis must here run its course, however, in order to give a solid ankylosis. In chronic rheumatoid arthritis, resection is indicated in appropriate cases. In syphilitic arthritis, resection is indicated for the removal of gummatous foci, which have not given way to medicinal treatment. In gunshot and other injuries, resection is preferable to amputation. With the present weapons, the expectant treatment is the initial method, to be followed, in case of failure, by the partial or the complete resection. In malum senile, arthritis nodosa, urica, or neuropathica, resections are practised only in exceptional instances.

The functional results of resections are usually classed as: (1) Bad. This includes cases in which the bones remain at a distance from one another and are held together by fibrous bands only. The limb is without muscular control and cannot be used. (2) Mediocre. This includes cases in which there is also a pseudarthrosis, but the fibrous union is short and strong. The joint is flail, but nevertheless it obeys the muscles in many ways and can be made useful by apparatus. (3) Good. This includes those cases in which there is a nearthrosis and a sufficiently perfect one to differ from a normal joint only in the extent of the motions.

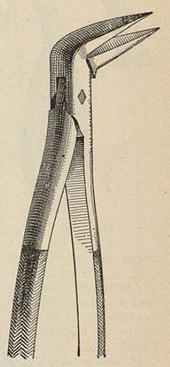

FIG. 4033.

In most resections ankylosis is the common result and is in some joints to be preferred to any other result than the ideal one (3). Flail joints are rare. Mediocre results are common.

During the operation the Esmarch bandage is a great help in exsanguinating the field of operation. It allows a complete inspection and renders possible careful dissection of the tissues. It must be used with discretion, and must not be employed in those whose arteries are diseased. Again, the exsanguination of the tissues should not be extended over a great length of time. This can be avoided in a measure by the more rapid work which it renders possible. After removal of the bandage there is some vaso-motor paralysis, but it soon yields or is corrected by elevation of the limb. In applying the bandage, care must be used to avoid direct compression of the motor and sensory nerves between the bone and the bandage.

The limb should be completely exsanguinated as regards both the arteries and the veins.

RESECTION OF THE INTERPHALANGEAL JOINTS OF THE FINGERS (Fig. 4038). — The most important of these joints is that of the thumb.

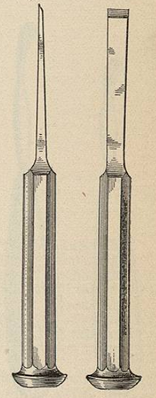

FIG. 4034.

*Indications.*—Complete destruction; chronic tuberculous arthritis; chronic suppurative arthritis; chronic non-suppurative arthritis.

The preferable situation for the incision is the dorso-lateral aspect of the joint, somewhat nearer the dorsal than the palmar surface. The incision may be a single one upon the internal surface of the thumb and forefinger and upon the external surface of the little finger. Wherever fistulæ are present the incision may best be made so as to include them. The preferable method, however, is that of two incisions placed dorso-laterally, one upon each side of the extensor tendons. By means of these two the denudation of the bones and the

exposure of the joint are easily accomplished. Each incision is carried through the capsule and the periosteum for the full length of the skin incision, which should extend above and below the joint sufficiently to expose and to dislocate the articular ends of the bones. With a sharp and curved rugine, the denudation of the bones is made from both incisions. Fine blunt retractors are used to expose the bone and to protect the separated periosteum and capsule and the tissues covered by them. When the capsule and periosteum have been freed sufficiently (subcapsulo-periosteal method), the ends of the bones are luxated without force through the more convenient of these incisions. The articular ends are now removed by the saw or cut away piecemeal by the bone-cutting scissors or rongeur forceps. After this is accomplished, the synovial membrane of the joint and the pathological foci in the soft parts about the joint are removed, preferably by dissection. The ends of the bones are now drilled, and one or two ten-day chromic-acid catgut sutures are inserted, bringing them in close apposition if ankylosis is desired. They are only loosely tied if an attempt at pseudarthrosis is made. In case a nearthrosis is desired, no sutures are necessary, as the suture of the divided periosteum and capsule will sufficiently hold the bones in their normal layer of tissue.

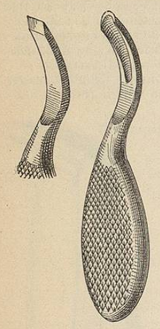

FIG. 4035.

If an Esmarch bandage has been used, it is now removed. The larger vessels are secured. The periosteum and capsule are sutured with catgut or silk. The remainder of the wound is closed, with catgut for the subcutaneous tissue and silk for the cutaneous. Drainage is not employed unless suppuration is already present. An aseptic dressing is applied. A fixation splint is applied over the dressing. The splint dressing is removed in ten days. At the end of two weeks all splints are removed. At the end of three weeks gentle passive motion is employed, unless ankylosis is desired.

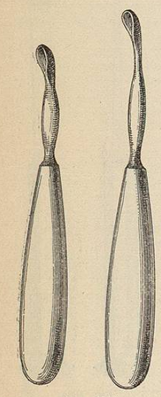

FIG. 4036.

RESECTION OF THE METACARPO-PHALANGEAL JOINTS (Fig. 4038).—Here also a single or two incisions may be used. When one is used it is placed upon the external dorso-lateral aspect of the thumb and index finger, upon the internal for the little finger, and upon either side for the other fingers. If two incisions are used, they are made as in the interphalangeal joints, on each side of the extensor tendons. For the metacarpo-phalangeal joints a single incision will often suffice. If feasible the operation should be the subcapsulo-periosteal one. The incision is carried directly through the skin and subcutaneous tissue to the periosteum and capsule, of sufficient length to expose the joint well above and below. The digital nerves are avoided if seen. The short muscles passing between the metacarpal bone of the thumb and its phalanx, as well as the aponeurotic canal for the extensor and flexor tendons in the fingers and thumb, are also avoided. The capsule and periosteum are now exposed and are incised. The denudation of the periosteum and the elevation of the capsular attachments are carefully made, especially at the metacarpo-phalangeal joint of the thumb, in order that the muscular insertions may be preserved.

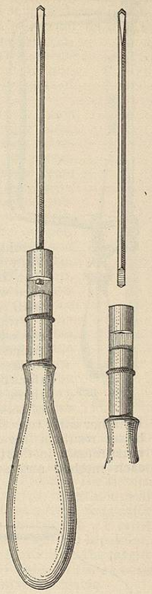

FIG. 4037.

When this is accomplished, the bones are dislocated through the incision and are divided with the saw or by the rongeur forceps. In some instances the Gigli saw can be used without dislocation of the bone. If the operation has been a subcapsulo-periosteal one, no sutures in the bones are needed, provided a nearthrosis is attempted. If not, and a pseudarthrosis is desired, a retention bone suture is used, with a small interval between the fragments. When ankylosis is desired, the bones are held in apposition by the bone sutures.

RESECTION OF THE WRIST.—The history of this operation dates back as far as 1750, when Cooper, of Bungay, removed the lower end of the radius and ulna for injury. In 1762 Bagieu excised the joint for a gunshot wound. In 1794 Moreau excised the joint for disease. Lister in 1865, Boeckel in 1867, Langenbeck in 1874, and others gave a great incentive to this operation by admirable papers; yet in spite of these papers the operation has never been a popular one. Its unpopularity was not due to its mortality, for this, according to Culbertson, amounts only to from one to 1.73 per cent. for all cases (Prize Essay, p. 628), and, according to Gurlt's "Military Surgery," to sixteen per cent. It was due to the failure to arrest the disease or because of the utter worthlessness of the hand after recovery. At the present time, with an improved technique and the aseptic treatment, these bad effects are to an extent avoided, and as a result the operation is again being strongly advocated.

*Anatomy of the Wrist* (Fig. 4039).—The anterior or palmar surface of the wrist is so well covered with tendons, arteries, and nerves that an approach from this side is not feasible. Upon the dorsal or lateral surfaces the bones are more easily exposed. Upon the back one can enter between the tendons without coming in contact with arteries, unless upon the external and posterior surfaces of the trapezium. The usual places selected are those between the extensor indicis and the extensor secundi internodii pollicis upon the outer side, and between the extensor carpi ulnaris and extensor minimi digiti upon the inner. In this interval one encounters only the extensor carpi radialis brevior before entering the joint. None of the tendons to the fingers passing over the dorsum of the wrist is attached to the wrist, so that they can be easily retracted to either side without injury.

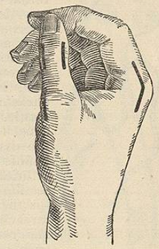

FIG. 4038.

Upon the outer side of the dorsum the extensor carpi radialis longior and brevior and the flexor carpi radialis are intimately connected with the joint and bones to





be removed. Upon the inner side the extensor and flexor carpi ulnaris are inserted into the base of the fifth metacarpal bone, and are intimately associated with the capsule and ligaments.

The bone which plays the most important part in this operation is the trapezium, which conceals and retains upon its anterior surface the flexor carpi radialis, and is covered by the radial artery upon its dorsal surface. From its crest it gives origin to the annular ligament, and by its articulation with the metacarpal bone of the thumb it becomes very necessary for the function of the thumb.

Provided the tendons are not incised, any incision which will enter the joint upon the dorsum, either to the inner or to the outer side of the mass of tendons made up of the extensor communis digitorum, extensor proprius pollicis, and extensor minimi digiti, will be found sufficient.

The bones of the carpus are united by a capsular ligament, of which the anterior is the strongest portion. The carpus itself may be regarded as one short and wide bone, articulating above and below with the bones of the forearm and those of the hand. The lower epiphyses of the radius and ulna join their shafts at twenty years. The radial epiphysis is entirely within the joint. The ulnar epiphysis reaches as high as the top of the radio-ulnar articulation.

A total resection of this joint includes the removal of the articular ends of the bones of the forearm and those of the metacarpal bones besides the bones of the wrist. Any resection short of this is a partial one.

*Indications.*—In both civil and military practice partial rather than complete resections are indicated. This holds good in most gunshot wounds, in compound and complicated fractures and dislocations. For tuberculosis, chronic suppurative arthritis, syphilitic arthritis, resection is indicated after medicinal and expectant treatment fails. Such is the case in other forms of joint disease where resection, partial or complete, is used to relieve deformity or increase motion.

Resection, especially the complete, is not permissible before the fifth year of life. It is rarely demanded before puberty. When it is demanded, the epiphyses of the bones of the forearm are not interfered with, and the operation is an informal or incomplete one. The object is to remove the diseased tissue and nothing else. After puberty the operation has its best results, and it is here that complete resections are made with good chances for functional results.

When, in an adult, tuberculosis exists in the carpus, with tuberculosis elsewhere in the body, the question to be decided is between amputation and complete resection. The general rule is that amputation should be selected if the local process succeeds the pulmonary, and that resection should be preferred if the local antedates the pulmonary. This must be taken with reserve, however, as many such cases of primary wrist involvement do best with amputation.

The older the subject the more we must consider amputation in preference to resection.

The methods of incision for entering this joint are:

1. The radio-dorsal incision, which, commencing at the centre of the ulnar border of the metacarpal bone of the index finger, is carried upward to the middle of the dorsal surface of the radial epiphysis between the tendon of the extensor indicis and that of the extensor carpi radialis brevior, and thence between the tendons of the extensor indicis and the extensor secundi internodii pollicis. The length of this incision varies between 8 and 12 cm., of which one-third should be above the articulation (Boeckel, *Gazette Médicale de Strasbourg*, 1867, and Langenbeck, *Archiv für klin. Chir.*, No. xvi.).

2. The dorso-ulnar incision. In abduction and slight flexion an incision of 7 to 8 cm. is made from the lower third of the fifth metacarpal over the ulna and vertically upward. In the lower part the incision passes between the tendons of the extensor carpi ulnaris and the extensor minimi digiti; over the ulna it passes in the interstice between the extensor carpi ulnaris and the extensor indicis muscles (Kocher, *Archiv für klin. Chir.*, No. 37).

3. Both radial and ulnar incisions. Both are upon the dorsum (Ollier, "Mètral Thèse," 1882, p. 45). One is dorso-radial and the other ulnar (Lister, *Lancet*, 1865).

Where two dorsal incisions are used: The radial commences opposite the centre of the shaft of the second metacarpal bone, and is continued upward along the extensor indicis tendon until it meets a line joining the two styloid processes. From this point it passes upward in the axis of the forearm. The ulnar incision extends from the centre of the fifth metacarpal bone along the radial side of the extensor carpi ulnaris and the ulnar side of the extensor minimi digiti until it reaches the ulna. From this point it passes between the muscular bellies of the extensor carpi ulnaris and the extensor indicis. One-third of both incisions is above the radio-carpal articulation; two-thirds below it.

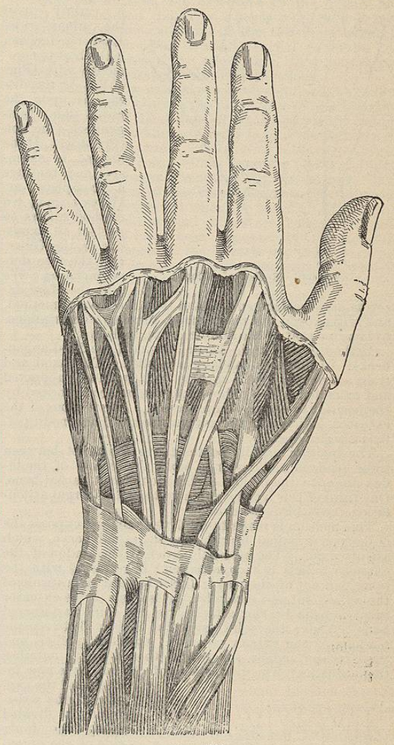

FIG. 4039.

Where one dorsal and one lateral incision is used: The radio-dorsal commences at the middle of the dorsal aspect of the radius at a level of the styloid process, and is carried toward the inner aspect of the metacarpo-phalangeal joint of the thumb, running parallel to the tendons of the secundi internodii pollicis. When the radial border of the second metacarpal bone is reached, the incision is carried along this border for one-half its length. The ulnar incision commences 5 cm. above the extremity