and to prevent wear, it is invariably thickest where the pressure is greatest (see Fig. 336). Under normal conditions it never ossifies, although in old age and in persons of inactive life it becomes thinned and infiltrated with lime salts. Should it slough, the bone becomes rapidly worn smooth (eburnated) and the joint is disabled. The superficial cells of the cartilage are flattened, but in the deeper parts they multiply in the line of the greatest stress, and are therefore arranged in columns perpendicular to the articular surface (Fig. 345), in which direction a sudden shock may cause the cartilage to split. The fibro-cartilages found in joints are composed of white fibrous tissue, with sparse elastic fibres to impart the necessary resiliency. Their usual form is that of discs or rings attached mainly to the more movable segment, either by their edges (knee, jaw) or by the edge and one surface (hip, shoulder). The rings may be incomplete, enlarging the cavity on one side only (phalanges).

The original capsular arrangement of the ligaments remains in cases in which the joint is well protected by muscles and the strain is evenly distributed. In most joints, however, the stress being much greater in some directions than in others, the capsule becomes thickened to counteract it, forming bands which have received special names. Atmospheric pressure, acting against the force of gravity, assists in keeping the articular surfaces applied to each other, thus preventing a constant strain upon the ligaments. An important office of the ligaments is to limit the motion of the segments and prevent the shocks which would otherwise occur from the sudden contact of bony surfaces. In some cases they greatly economize muscular force by holding the joint in a set position. Thus but little force is required to maintain the body erect, as it is supported mainly by the tension of the ligaments of the spinal column, by the ilio-femoral ligament at the hip, and by the posterior, lateral, and crucial ligaments at the knee; these lying always on the convex side of arcs subtended by the line of the centre of gravity (Fig. 346). Owing to their function as limiters of motion, it follows that the position of greatest relaxation for all the ligaments of a joint is one midway between flexion and extension. In case of the distention of a joint cavity by a morbid effusion, the patient involuntarily places the joint is such a position.

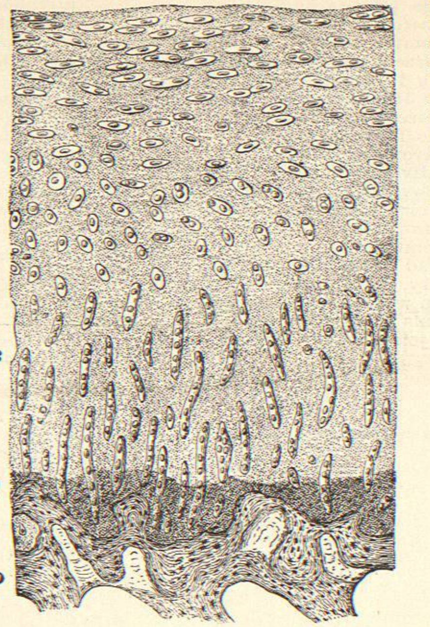

FIG. 345.—Articular Cartilage. (After Sappey.) *A*, Flattened cells; *B*, cells in columns; *C*, region infiltrated with lime; *D*, bone.

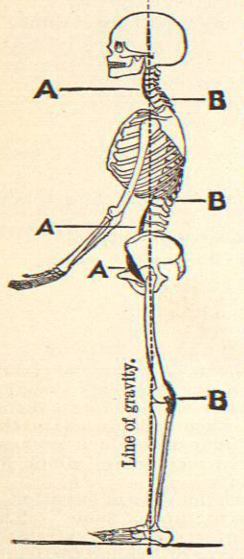

FIG. 346.—Ligaments Supporting Erect Posture. A, Anterior set; B, posterior set.

Synovial membranes originate as continuous and closed sacs, but over the articular surfaces, where pressure occurs, portions of them disappear; so that, at the latter part of fetal life, they merely line the capsule and extend but a short distance upon the cartilages of the joint. In adult age they frequently are further extended by communication with the synovial cavities of neighboring bursæ, and such communications become more frequent and extensive as age advances. They are more lax than the surrounding ligaments, being thrown into folds to increase the blood supply and to pad out intervals, being assisted in this by interstitial deposits of fat. Along the interarticular lines they possess villous processes, or fringes, some of which contain cartilaginous nodules (Fig. 347).

It is at or near the joints that the great vascular trunks divide, an arrangement which is probably connected with the centripetal development of blood-vessels and the bud-like formation of limbs in the embryo. The immediate supply of the joint is obtained from small vessels that anastomose freely with one another. By them the collateral circulation is established when the main trunk is occluded. From these vessels a rich arterial network penetrates the capsule to supply the synovial membrane. Abundant capillaries lie in loops along the synovial folds, and by exudation from them the synovia is formed. The articular cartilages and the compact layer of bone immediately contiguous are normally destitute of vessels, but capillaries rapidly extend into them during inflammation. The fibro-cartilages are stated by Sappey to contain vessels, and may therefore take an active part in inflammatory processes. Lymphatics are numerous near joints. Klein considers the joint cavity itself as a lymph space communicating directly with the lymphatics, and Arnold and Heitzmann claim to have demonstrated a system of lymph canaliculi even in articular cartilage.


FIG. 347.—Synovial Fringes. (× 200.) (Modified from Henle.)

The nerves of joints are distributed mainly to the synovial membrane and the ligamentous structures. It is probable that in these situations special nerve endings exist, as described by Krause and Nicoladoni, for it is difficult otherwise to account for the peculiar sensibility of the structures. A ligament or a synovial membrane may be touched, cut, or pinched without giving much pain, but if it be stretched beyond its physiological limit, threatening the integrity of the joint, the suffering is excruciating, as is well known to those who have suffered from a sprain or a dislocation. Articular cartilage has no nerves, and the gnawing pain which occurs during its ulceration is probably caused by inflammatory products affecting the nerves of contiguous tissues. A remarkable law of correlation has been noted by Hilton with reference to the nerves of joints, viz.: that they also supply the muscles which move the joint and the skin over the insertion of such muscles; the whole apparatus being thus under the control of associated central influences. There is besides strong clinical evidence of this. Remak and Benedikt have pointed out the strong probability that many diseased conditions of the joints originate in irritable states of the spinal cord and of the sympathetic, and Charcot has published some cases showing remarkable atrophy of the muscles of a joint after an injury to the articular surfaces comparatively slight and inadequate to such a result. Locomotor ataxia is usually accompanied by joint lesions. A few years ago (Ord: Belfast Address, July, 1884) it was shown that many cases of joint disease (rheumatoid arthritis, gonorrhœal rheumatism) are so associated with disturbances of the genito-urinary tract as to make it probable that there is a reflex element of causation in these disorders.

For the anatomy of special joints see the following heads: *Ankle Joint; Elbow Joint; Foot, Joints of; Hand, Joints of; Hip Joint; Knee Joint; Pelvis, Joints of; Shoulder Joint; Skull; Thorax; Wrist.*

Besides the systematic works on anatomy by Quain, Gray, Allen, Sappey, Cruveilhier, Henle, Hyrtl, and Gegenbaur, the following authorities have been consulted in preparing this article:

Morris, William: The Anatomy of the Joints, London, 1879.
Turner: An Introduction to Human Anatomy, Edinburgh, 1867.
Marshall: Anatomy for Artists, London, 1883.
Humphry: The Human Skeleton, including the Joints, London, 1858.
Henke und Reyher: Ueber die Entwickelung der Gelenke, Sitzungsber. der Wiener Acad. der Wissensch., Bd. lxx.
Aeby: Der Bau des menschlichen Körpers, Leipzig, 1871.
Martin: Ueber die Gelenkmuskeln beim Menschen, Erlangen, 1874.
Meyer: Die Statik und Mechanik des menschl. Knochengerüstes, Leipzig, 1873.

Frank Baker.

ARTHROPATHIES OF NEUROTIC ORIGIN.—As far back as 1831 the elder Mitchell[1] first described peculiar joint troubles that affected individuals who had suffered from cerebral disease; and in 1846 Scott Alison,[2] of London, more fully described these sequelæ, presenting several cases in which the joints of the paralyzed side only were affected. This arthritis he believed to be due to a condition of the articular surface which results from the diminished vitality of the paralyzed parts and the presence of uric acid, which under such circumstances acted as an irritative agent.

Later, Brown-Séquard[3] and Charcot[4] directed attention to the really important nature of such complications of organic paralysis, and the early researches of Alison, Durand-Fardel, Valleix, Grisolle, and others have been collected and carefully considered by them. Buzzard later investigated these *arthropathies*, especially in connection with locomotor ataxia.

It would appear that such morbid changes are usually associated with those forms of cerebral and spinal disease in which the sensory tracts are most extensively invaded, though this is by no means the invariable rule. They are common in posterior spinal sclerosis and rare in essential spinal paralysis, an affection in which disorders of sensibility are the exception. They are rare in cerebral disease without some ascending degeneration symptomatized by *pain*, and the observations of Charcot regarding the central lesion would bear this out. Arthropathies may be either cerebral or spinal, and the former are much more rare than the latter. They have been observed in connection with coarse brain disease, such as softening, with hemorrhage, tumor, or sclerosis; and are usually early symptoms of established cerebral mischief; especially is this true in the matter of hemorrhage. After a period of from fifteen days to several months after the acute central trouble we find that the joints of the paralyzed hand or foot become affected—the former more often (Charcot)—coincidently with the contractions which mark the advent of rigidity and secondary degeneration. In Alison's cases the knee and ankle were affected.

The joint disturbances begin in one of two ways: (1) Suddenly, the large joints being affected; (2) slowly, the joints of the hand and foot being the parts attacked. In the first form there develops rather suddenly, within a few weeks, a swelling which is unattended by any marked rise of temperature—at least by any such rise as we would expect to find in an acute arthritis of purely rheumatic origin. There are but little local heat and pain, but a great deal of *soreness* when the limb is moved. Jarring produces only inconsiderable suffering. I have never met with the degree of pain described by Brown-Séquard. There is more or less pain produced by pressure over the tendons, the sheaths of which seem to be involved. The joint is greatly swollen, the enlargement being made much more prominent in old cases by reason of the atrophy of muscular masses in the vicinity. There seems to be a deep involvement of the joints and of adjacent parts, and though there may be a synovitis, it is of a low grade, and, as Buzzard[5] has pointed out, there is really great tumefaction, which characterizes the familiar form of chronic synovitis, in which there are three points of swelling, viz.: above the patella, and on either side of the ligamentum patellæ.

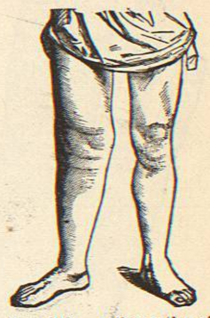
FIG. 348.—Arthropathy of Right Knee Joint. (Buzzard.)

The appearance of the affected joint is peculiar. The swollen limb shows a duskiness and hardness in the beginning, and a cold, "white hardness" in the old cases. In some cases there is, after a few days or weeks, a subsidence of the swelling, and then certain osseous changes, to be presently described, take place.

The occurrence of *spinal arthropathy* may follow a variety of conditions. As has been pointed out by Mitchell, it may be connected with Pott's disease, with myelitis (Gull), with tumors of the gray substance of the cord (Buzzard), with posterior spinal sclerosis (Charcot), and with traumatic injury of the cord (Vignes and Joffroy).

According to Charcot the condition is often an early complication of posterior spinal sclerosis, but others think that it belongs to the late stages of the disease. It is quite true that in acute myelitis we may have a rapidly developing arthropathy, but in cases in which it is associated with a tumor of the cord or with locomotor ataxia the affection is a much more slow affair. Charcot believes that those arthropathies which affect the upper extremities in the disease under consideration are always secondary to others involving the lower extremities, and come only late in the disease as a result of extension of the morbid process. Buzzard reports a case which contradicts this, and the author has seen others.

The enlargement in the chronic variety is slow, and a point is finally reached when deep destructive processes begin, the articular surface of the bones being worn away or absorbed, so that movement of the joint on manipulation will produce a peculiar creaking or cracking sound; and when the joint has for some time been the seat of the trouble it is common for luxation to occur. The position of the extremity upon the bed is peculiar, and the patient often presents a most strange deformity. Happily the arthropathy need not always go on to this stage, and it occasionally happens that cures are made.

On the other hand, the erosion and destruction may be very rapid. Charcot says· "Even within two weeks, or sooner, the 'craquements' may be detected, which indicate a profound alteration in the articular surfaces." At the end of three months the head of the humerus, in one of his cases, was found to be almost completely destroyed.

PROGRESSIVE ARTHROPATHY.—There is a form of arthropathy of a progressive nature of which I have seen

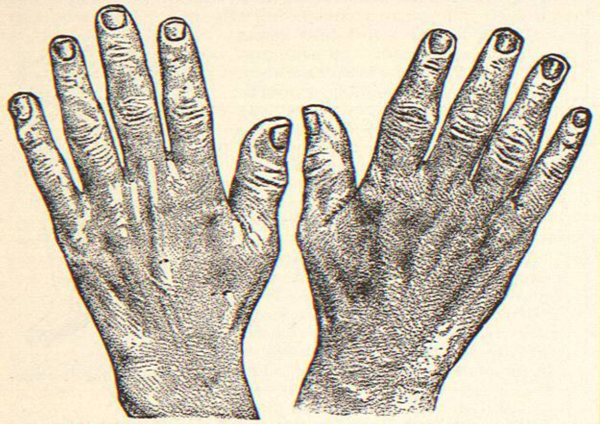

FIG. 349.—Progressive Arthropathy Resembling Acromegaly.

but one true case, and I do not know that any other has been reported. In the patient who came under my notice, a sudden swelling of both ankles occurred, with little or no pain, and in less than one year both thumbs and ring fingers became in turn affected, and ultimately both little fingers. The metacarpal joints were the seat of a hard and quite extensive swelling, with some general œdema, more marked on the palmar surface. The patient could flex neither the thumb nor the other affected fingers, but the second and third fingers seemed to be unimpaired so far as their mobility was concerned The ankle joints were lax and some absorption of bone had evidently taken place. There was no history of gout in this case. The patient's urine was clear and it was passed in large quantities, and I had no reason to suspect the uric-acid diathesis. The affected parts had, *before* the appearance of swelling, been the seat of neuralgic pains. The right pupil was smaller than the left, and there were interesting nutritive skin changes and a peculiar slowness of gait.*

The history of arthropathies in general furnishes us with points which enable us to make a comparatively clear diagnosis. The antecedent cerebral or spinal disease is a determining factor, and the peculiar nature of the joint affection itself is conclusive. It is unnecessary to repeat here what has already been said about the possibility of confusing the condition in question with ordinary chronic synovitis. I may, however, remind the reader that the effusion is always beneath the muscles, and the skin has a polished appearance and presents no appearance suggestive of inflammation There is often great embarrassment in flexion, though, as in Buzzard's case, extension is not interfered with, and there is no pitting at the joint. In the case alluded to, he made an application of the electrodes of an induction battery over the quadriceps muscle, just above the patella When the swelling was very great, he obtained a powerful contraction, which proved the fact that the muscle was superficial to the fluid. The affection sometimes resembles *arthritis deformans*, but it rarely involves the hip joint. It is of sudden appearance, is often cured, the effusion is greater and the swelling more general than in the latter disease, and there are luxations as the result of erosion, which is not the case in rheumatoid arthritis.

Charcot has found in one case evidences of a true synovitis—multiplication of nuclear elements and thickening of fibrous tissue—increase in size and number of capillary vessels, and an increased amount of exudation containing leucocytes. In this case he found macroscopic lesions of the cartilages or of the ligamentous parts.

In the cases of cerebral origin a variety of interesting changes were found by Alison, but none threw much light upon the pathology of the condition, and the same thing may be said of the autopsies presented by other observers Charcot, however, found that in locomotor ataxia there was a disappearance, upon the same side of the body, of the posterior lateral group of large cells in the anterior cornu A case presented by Joffroy and himself was carefully studied, and it was found that the anterior gray horns were "remarkably atrophied and deformed." Fig 350 represents a section made through the anterior horns in the cervical cord of a patient who presented an arthropathy of the shoulder joint In a second case which was examined by these investigators, and in which the knee joint was affected, it was found that the anterior gray substance in the lumbar region had undergone a conspicuous alteration. Charcot does not believe that this degeneration is a result of functional inertia, because in his cases there was considerable freedom of movement, and the central appearances did not resemble in the least those found after amputation

The *prognosis* of progressive arthropathy is by no means good, although it has been claimed that cures have been effected. The benefit of therapeutic measures, if to be obtained at all, must be shown at an early period, and if the morbid process has gone so far as to result in destruction of the articular surfaces, little or nothing can be gained by any treatment. It must be admitted that in spinal disease, especially when the arthropathy is associated with gastric crises and with other symptoms suggestive of advanced cord destruction, the prognosis is wellnigh hopeless

The *treatment* of these joint affections consists in the exhibition of the iodide of potassium in very large doses —even one-half, or in some cases two thirds, of an ounce daily in Vichy water—and in the free application of the

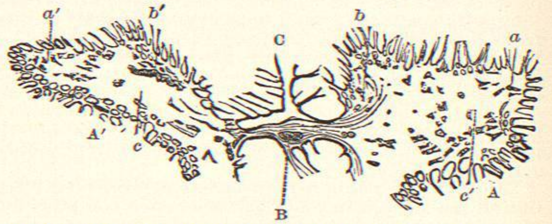

FIG. 350.—(Charcot.) A, A′, Right and left anterior horns: B, posterior gray commissure and central canal: C, anterior fissure; *b*, *b′*, anterior internal group of great cells: *a*, *a′*, anterior external group of great cells; *c′*, posterior external group of great cells on right side; *c*, locality where corresponding cells have disappeared on left side.

actual cautery to both the spine and the affected joints. Careful bandaging and the application of straps of the ammoniated-mercury plaster are of use, while perfect rest is indispensable *Allan McLane Hamilton*

* This case was reported in the first edition of this work, and since then it has in many ways resembled the disease which was afterward described as acromegaly.

[1] American Journal of the Medical Sciences. vol. viii., 1831. p. 55.
[2] London Lancet, 1846, vol. i., p. 277.
[3] London Lancet, July, 1861.
[4] Leçons sur les maladies du système nerveux, 1872-73, p. 100 et seq.
[5] Diseases of the Nervous System p. 214 et seq.

ARTIFICIAL EYES.—(French, *Œil artificiel;* German, *Künstliche Auge.*)

History.—The use of an artificial eye to hide the ugliness of an empty socket or to conceal the deformity of

a shrunken and discolored eyeball dates from very early times. Historians have traced its origin to the Egyptians of the third and second century, B.C., basing their claim on the discovery of mummies and animals in whose orbital cavities artificial eyes had been placed. Artificial eyes are also mentioned in the works of Ambrose Paré (1582), and of Hieronymus Fabricius (1613). Crudely constructed of gold, silver, glass, and painted wood, the ancient eyes bore but little resemblance to the modern finished article, but were rather imitations of eyes than artificial eyes These materials later gave way to specially prepared glass or porcelain, and toward the commencement of the eighteenth century the porcelain eyes were still further improved by an enamel, which, by reason of its durability, its resistance to the chemical action of tears, and the facility with which it received and retained colors, was generally adopted The industry was brought to a scientific basis by Boissonneau, who introduced between 1840 and 1866 many improvements, and created practically the eye that is worn to-day.

Manufacture.—First-class artificial eyes are made in many of the large cities of Europe and America The art consists in the preparation of the material from which the shell is made and in its shaping and coloring The chemicals that enter into the composition of the glass are antimony, calcium, borax, uranium or manganese, oxide of tin, arsenic, and fine flint. The artist is seated before a table with a blow-pipe attached, the flame being regulated by hydraulic pressure so that it is strong and steady To this heat the tubing, closed at one end, is subjected As soon as it is at a white heat the maker blows the ball and shapes it, then at the proper moment he takes a stick of pigmented glass and places a drop on the summit of the ball; it is then heated again and at the same time flattened. This colored glass represents the iris By a process of teasing the iris is made to have a blending of colors, a highly artistic process; then a darker stick of glass is fused to the centre of the iris to form the pupil; as the next step, the cornea is formed of transparent crystal The colored tubing is now drawn out until it has the diameter of the finest silk thread, and, by using its melted tip as a brush or pencil, the delicate shadings and vein tracery are produced. After this the ball is again heated, is cut from the stem on which it was previously held, and its sharp edges are rounded off. When completed the shell has an ovoid form, concavo-convex, the surfaces being smooth and enamelled The pupil in the artificial eye is made of the average size, or, when made to order, of the size of the patient's pupil in daylight.*

Within the past few years ophthalmic surgeons and opticians, having become dissatisfied with the results obtained by prescribing practically the same shaped eye for all orbits, have paid greater attention to the fitting of individual orbits with individual eyes, by making such alterations in their outlines and changes in their

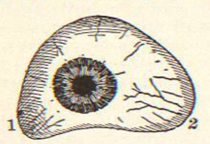

FIG. 351.

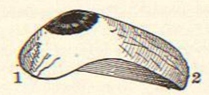

FIG. 352.

FIGS. 351 AND 352.—Fig. 351. Anterior View of Eye Adapted to Deep Upper Fornix. Fig. 352, Profile View of Same Eye· 1, Nasal extremity; 2, temporal extremity

curvature that they may be adapted not only to normally shaped orbital beds, but to those that present cicatricial bands or other obstacles to the wearing of the average eye Such modifications are represented in the accompanying figures.

The ingenious adaptation of the common eye of the shops, shown in Figs. 356 and 357, was suggested by Dr. J. L. Borsch, Jr. Paris, France. It may with little trouble be adapted to most orbits with entire satisfaction. In a normal socket the plate will be at right angles to the sides of the shell. The plate is fastened to the eye by means of silicate paste and the line of juncture is protected by a thin layer of wax In order to overcome the expansion of the air contained between the plate and shell that would necessarily follow when the temperature of the eye is raised to that of the socket, the shell and plate are brought to the temperature of 100° F. or over while being cemented.

FIG. 353.—Solid Eye. One of three patterns described by Mr. Snell in *Ophthalmic Review*, and devised to avoid the suction incident to the usual concavo-convex shell.

The *object of wearing an artificial eye* is cosmetic, to conceal a glaring deformity, and therapeutic, to prevent asymmetrical growth of those bones of the face which enter into the formation of the orbit. A further object

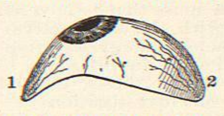

FIG. 354.—The Average Eye. 1, Nasal extremity; 2, temporal extremity.

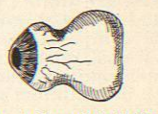

FIG. 355.—A Complete Ball with Indentations on Superior and Inferior Sides for Lids.

is to give relief to the conjunctival irritation caused by distorted eyelids and inturned eyelashes, often the accompaniments of eyeless orbits

The Comparative Value of Substitute Operations.—Formerly, enucleation—removal of the ball—was the only radical operation performed, but, with the object of preserving or creating a bed over which an artificial eye

FIG. 356.

FIG. 357.

FIGS. 356 AND 357.—Fig. 356 Shows the Common Eye with a Glass Plate, which Forms the Base of the Concavity of the Eye. The plate may be cemented forward or backward, or to one or the other side, in order to tilt the cornea into any desired direction. Fig. 357, the plate.

may be worn, and by which movement and concomitant rotation will be imparted that will be superior to that following simple enucleation, various other operations have been suggested: optico ciliary neurectomy, or division of the optic and ciliary nerves with retention of the ball; sclero-optic neurectomy, or resection of the pos-

FIG. 358.

FIG. 359.

FIGS. 358 AND 359.—Fig. 358, Aluminum Button-Shaped Vitreous. Fig. 359, Aluminum Vitreous with Flat or Concave Base.

terior part of the sclera and of the adjoining optic nerve, eviscero-neurotomy, or emptying the scleral sac and dividing the nerve; evisceration, or emptying the scleral sac; evisceration with the insertion of an artificial vitreous; implantation of a glass or metal globe (such as is shown in Figs. 355 and 360) in Tenon's capsule after enucleation: abscission of the anterior third or fourth of the ball; and complete keratectomy or abscission of the cornea. But most of these operations have few advocates because of their failure to accomplish the objects

* This description is taken from the previous edition of the REFERENCE HANDBOOK. Its accuracy has been verified by the present writer during a visit to the factory of Müller Bros., Wiesbaden, Germany, in the summer of 1899.

for which they were devised or because they have been proven to be an insufficient barrier to sympathetic inflammation. The strongest rival to enucleation is the Mules' operation—evisceration with the insertion of an artificial vitreous. Operators are divided in their opinion as to the value of this procedure. It is conceded that it will give ideal cosmetic results when successful. It has, however, not been generally adopted for the following reasons: the reaction is far more severe than that after enucleation; the recovery is more prolonged—a serious obstacle to the breadwinner; the danger of sympathetic inflammation is not avoided; the artificial vitreous is subject to fracture or alteration in shape from accidents; primary success is no assurance that the vitreous substitute will be permanently retained; enucleation of the scleral sac may be demanded. The advantages claimed—viz., that the artificial eye is more movable, owing to the better stump secured, and that the operation can be safely performed in panophthalmitis—do not warrant its frequent performance or its unqualified adoption as a substitute for enucleation. If we except the isolated cases in which Mules' operation is successful, the most movable support for the prothesis is afforded when as the first step of enucleation the distal extremities of the recti muscles are united by suture to a mass that is covered by, and later becomes amalgated with, the conjunctiva.

The comparative value of enucleation, evisceration, and Mules' operation, considered only in reference to the concomitant movements of the prothesis, is well shown in the table, made from recent investigations.*

	Out.	Up.	In.	Down.	
Average rotations	45	31	50	55	Average of Landolt's and Stevens' measurements.
Rotations after enucleation *with* suture of tendons	19	22	20	50	Average of three cases.
Rotations after enucleation *without* suture of tendons	15	15	12	25	Average of de Schweinitz's and Truc's measurements.
Evisceration	15	18	23	35	Average of de Schweinitz's and Truc's measurements.
Mules' operation	25	30	23	58	Average of de Schweinitz's cases.

Choice of an Artificial Eye.—In the choice of an artificial eye one must be guided by the size and shape of the socket and by the condition of the orbital contents. Only in exceptional cases is the selection from the large stock carried by opticians difficult. When irregularity of the conjunctival sac demands a specially constructed eye a leaden pattern may be moulded from which the artifical eye is fashioned. In cases of small sockets a series of leaden scales or glass shells (Fig. 360) of increasing size may be successively worn until the cul-de-sac has been sufficiently stretched. It is essential not only that the eye shall look well but that it shall be comfortably worn and not cause irritation. The points to be considered are that it shall resemble the sound eye, that it shall have both mobility and stability, and that it shall easily be adapted to the orbital contents.

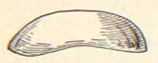

FIG. 360.—Glass Shell.

The stability depends upon the accurate adjustment to the conjunctival bed behind and to the lids in front, upon the degree of curvature, and upon the length of the prothesis in relation to the length of the commissure. The size of the eye must be particularly regarded; if it is too large the lower lid is pushed in, the cul-de-sac is effaced, and the eye is spontaneously protruded; if it is too small it shifts its position independently of the movements of the other eye, and engages itself in the superior cul-de-sac, so that its lower border is protruded from the inferior cul-de-sac. A contraction of the con junctival sac may form a bridle that will necessitate cutting a piece out of the eye or surgical intervention in the orbit for the destruction of the bridle and rehabilitation of the sac.

A defective or misfitted prothesis will cause pain throughout the entire orbit or at that portion of the conjunctiva which is wounded by the imperfection and aggravated by all movements. If the eye is too convex forward, it encroaches upon the lid at an acute angle and wounds it; if it is too flat, its posterior surface rests in contact with the cornea or with the cicatrix and produces pain. An old eye that has lost its polish gives the sensation of a foreign body in the orbit.

FIG. 361.—Lateral and Posterior View, showing expanse of sclera upward and backward for adaptation into shallow lower fornix.

To Insert an Artificial Eye.—The upper lid is elevated by traction on the skin below the orbital margin; the upper edge of the shell is introduced under the upper lid and almost in contact with it until the superior border of the cornea is hidden by the ciliary border of the lid.

The lower lid is now retracted and partly everted, sufficiently far to permit the lower edge of the eye to escape it and to pass into the lower cul-de-sac. By easy movements vertically and laterally the eye is forced into the socket, where it is held by the lids.

To Remove the Eye.—The head of a large pin or a similar instrument is inserted under the lower border of the eye, during eversion of the lower lid, and by this means the artificial eye is gently pried out so that the inferior edge may pass over the lower lid, when, by holding the head slightly forward, the eye will fall into the extended hand. After a short experience the insertion and removal of the eye are easily and safely done.

Care of the Eye.—The eye should not be worn for twenty-four consecutive hours.* At night it should be taken out and cleansed with soap and water and allowed to remain in oil until morning. Under favorable circumstances an artificial eye, when well made and fitted, will retain its polish and smoothness for about two years. In cases of much discharge of mucus and tears it corrodes in a few months, when its edges must be ground down and its surface repolished or it must be replaced by a new one.

Care of the Orbit.—How soon after operation may a glass eye be worn? The interval depends upon the reaction following operation, upon the disease of the eye that necessitated its removal, and upon the time required for perfect healing of the tissues. Writers specify the average interval after the usual operations as four weeks. We have, in a number of instances, when it was important that the patient should return to his occupation as soon as possible, inserted the eye seven days after enucleation and have had no reason to regret the action. When all signs of previous disease and of reaction from the operation have disappeared, and there has been no complaint of sympathetic trouble, the eye may be worn without fear of consequences. After enucleation for sympathetic irritation, at least two months should elapse because of the danger of exciting a pathological process that may be destructive to the opposite eye. Cases have been recorded by Lawson, Mooren, Keyser, Salomon, and Warlomont in which sympathetic ophthalmia has followed the wearing of an artificial eye over atrophied globes and after enucleation. This accident is all the more probable in the case of a stump that is ossified and painful. In threatening sympathetic disease the prothesis is badly tolerated. On the other hand, unnecessary delay enhances the difficulties of inserting and wearing an artificial eye, in consequence of shrinking of the contents of the orbit, which is prone to be rapid and progressive. For the first few days after fitting

* From a paper read by Dr. G. E. de Schweinitz before the Section on Ophthalmology, College of Physicians, Philadelphia. February, 1900.

* Dr. Chisolm has reported a case in which an artificial eye had been worn for twelve years without ever having been removed and with no bad symptoms.

an eye it should be worn only an hour or two at a time, so that the tissues may become gradually accustomed to its presence. Should inflammation of the mucous membrane arise, it is to be treated by desistance from wearing the prothesis and by applications of cauterants or astringents, such as silver nitrate, tannic acid, alum, etc.

Howard Forde Hansell.

ARTIFICIAL LIMBS. See *Limbs, Artificial.*

ARTIFICIAL RESPIRATION.—This procedure is frequently required for the purpose of sustaining a feeble and failing respiration, or to restore that function after the lungs have ceased to act. Its value as a restorative measure is undoubted, and by its use very many lives have been saved. If death in its proper sense has taken place, all efforts are fruitless, but in many instances the respirations cease, the pulse is imperceptible, and all signs indicate an absence of life, yet the heart remains in action and the blood continues to flow Clinical experience and experimental work have shown how life may be restored so long as there remains any contractile power in the cardiac muscle, and on this is based the hope of artificial respiration.

The length of time that may elapse between the cessation of breathing and its restoration is uncertain. This, however, is not of much practical importance, as in nearly all cases it is impossible to determine when the respiration ceased. In cases of drowning, smothering, poisoning, etc., there is more or less struggling and we are unable to say how much air was breathed. In the cessation of breathing during anæsthesia, and in cases of shock, the patient is under observation and the change is quite evident. In such cases assistance is at hand and efforts to restore are commenced at once. Many remarkable stories are told of long periods of suspended anima tion after which recovery has taken place, but all are un reliable. Three or four minutes are generally given as the limit, and it is probable that if respiration has ceased for that length of time, death has taken place. The important fact is, that a very slight interchange of air will support life, and no matter how long the respirations have apparently ceased there is the possibility of moderate breathing, and every effort should be made to resusci tate. What is of great importance is the length of time that artificial respiration should be maintained. Many cases are reported in which it was performed for ten, fifteen, and twenty minutes before breathing began, and in some cases it is stated that an hour, or even a longer time, elapsed before natural breathing was secured. It should always be continued for twenty minutes, and if there is the faintest sign of life no limit should restrict the operator. In some cases in which breathing continues, but is weak, as in opium poisoning, it may be required for hours. In the asphyxia due to gas poisoning artificial respiration may have to be kept up for days.

The apnœa, or asphyxia, which we are called upon to relieve may be produced by two distinct conditions It may arise from an absence of oxygen and the saturation of the system with carbonic acid and its products, or it may be due to a direct action on the medulla and to paralysis of respiration. In the first condition the air breathed may be impure, or charged with carbon monoxide, or there may be an obstruction to the entrance of air, as in drowning, smothering, hanging, the pressure of tumors, and in disease of the air passages. In the second condition the cause may be traced to shock, to opium, chloroform, and other poisons, and to disease of the brain.

The various methods of carrying out artificial respiration are directed to the relief of these two conditions. The alternate expansion and contraction of the lungs brings to them the pure air and carries off the impure, and, at the same time, the respiratory centre may be reflexly excited by the entrance of the pure air into the lungs, by the sudden pressure over the chest walls, and by the drawing forward of the tongue.

The preliminary treatment of the patient is of as much importance as the artificial respiration. It varies somewhat with the various causes, but it must always be carefully observed if we wish to obtain success.

In the first place, it is necessary to make a correct diagnosis. Unless the cause is known, all efforts may prove of no avail, as some important detail may be overlooked. If the air of the room is impure the patient should be removed to more favorable surroundings. If any foreign body obstructs the entrance of air it should be removed; the stenosis of the larynx should be overcome by intubation or by tracheotomy; in cases of drowning or smothering, efforts should be made to remove the fluid or foreign substance that may have entered the lungs. If poisons have been taken, the proper antidote, the stomach pump, and lavage will be required.

Whenever there are indications for employing artificial respiration the necessary steps should be taken without delay, as the first few efforts may save the patient's life. At the same time the many other means of resuscitation may be carried on by assistants. Heat to the surface of the body and the extremities is of much service; if the body heat has been lowered by exposure or by immersion in cold water this becomes a necessity. Death from drowning is much more rapid in cold than in warm water, and hope of recovery is much greater if the temperature of the body is maintained. Fortunately, heat is usually readily procured. The transfer of the patient to a warm room, the removal of his damp clothing, the application of hot blankets to the body and of hot water bottles to the extremities, and the employment of friction over the surface of the skin, are all measures which are generally available. In some cases it may be preferable at once to immerse the body in a hot bath without waiting to remove the clothing.

Of drugs, the cardiac and respiratory stimulants, such as strychnine, digitalin, ammonia, ether, and brandy, may be administered hypodermically; also hot stimulating rectal enemata may be used. Oxygen may be added to the air inhaled, particularly in the asphyxia of noxious and poisonous gases.

Blood-letting has been recommended. In all cases in which the system has been deprived of oxygen, the lungs are congested and the right cavities of the heart are distended. Under such conditions the abstraction of venous blood will lessen the engorgement and allow the heart to regain its contractile power.

So far as the question of position is concerned, it is generally recommended that the patient's body be in clined slightly upward and a pad of clothing be placed under the back to raise the chest, as this allows of the greatest degree of expansion. Under ordinary conditions this advice should be followed. but in the failure of res piration during anæsthesia it is desirable at once to lower the head and shoulders, as this position favors the flow of blood to the cerebral centres and will of itself revive many patients. In cases of drowning the patient should first be placed with the face downward and the head lower than the body, the tongue being drawn forward. This allows any water that may be present to escape, and the emptying of the lungs may be further assisted by pressure on the chest walls. The position of the head is a matter of the utmost importance, as upon it, in a great measure, depends the freedom of the air passages. In asphyxiated patients the relaxed tissues allow the epiglottis to close the larynx and the tongue to fall back against the posterior pharyngeal wall. It was generally taught that traction on the tongue would overcome both these obstructions, but it is now well known that drawing the tongue forward exerts little or no influence on the epiglottis unless the base is grasped and very forcibly raised. The epiglottis, however, is very readily raised and the air passages kept free by maintaining the head in a proper position; but much confusion has arisen from the many positions that have been advocated. Sylvester, in describing his method of artificial respiration, directed the head to be held "in a line with the trunk." The committee of the Royal Medico-Chirurgical Society, in their report on artificial respiration, states that "when the head of the subject was allowed to hang back over