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 True's measurements.
Evisceration..	15	18	23	35	Average of de Schweinitz's and True'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 conjunctival 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 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.

* 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.

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 animation after which recovery has taken place, but all are unreliable. 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 resuscitate. 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 inclined 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 respiration 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

the edge of the table, air seemed to pass into the chest more readily than when the back of the head rested on the table." A few years later, Dr. Howard in his investigations arrived at the same conclusion, and in his directions he recommends that "a roll of clothing be placed under the back just below the shoulder blades, the head hanging back as low as possible." In a later paper (*Lancet*, May 22, 1880), in discussing the proper position of the head to keep the epiglottis raised, he states: "Having, by bringing the patient to the edge of the table or bed, or by elevation of the chest, provided that the head may swing quite free, with one hand under the chin and the other on the vertex, steadily but firmly carry the head backward and downward; the neck will share the motion, which must be continued till the utmost possible extension of both head and neck is obtained." These diverse views caused some confusion in regard to the proper position in which to place the head, but neither one supplanted the other. The influence of Dr. Howard's work, however, was widely felt, and many cuts representing Dr. Sylvester's method of resuscitation represent the patient with shoulders raised and head hanging low.

Professor Hare, in a paper (*Johns Hopkins Hospital Bulletin*, January, 1895) in which he described some experiments made upon this subject by himself and Dr. Edward Martin, has advanced a step further and advocated an entirely different position of the head. While agreeing as to the effect of the Howard position on the epiglottis, he shows that it at the same time causes the soft palate to apply itself against the dorsum of the tongue and thus cut off the entrance of air through the mouth. The importance of this is apparent when we consider how large is the number of persons in whom the nasal passages are more or less obstructed. He states: "If the head is extended and simultaneously projected forward, both the tongue and epiglottis are raised, and the soft palate is so drawn as to permit of free breathing through the mouth as well as the nose."

Of the many methods of performing artificial respiration, that introduced by Dr. Henry R. Sylvester (*Rankin's Abstract*, 1858, ii.) is almost universally adopted. Modifications suggested by others may be combined with it, but in nearly all cases the principles of this method are followed to a greater or less extent. The object is to imitate the action of the respiratory muscles, by alternately raising and lowering the arms. The patient is placed upon his back, and the movements are made slowly and deliberately about fifteen times in the minute. The directions are as follows: "Standing at the patient's head, grasp the arms just above the elbows, and draw the arms steadily and gently upward above the head and keep them stretched upward for two seconds. Then

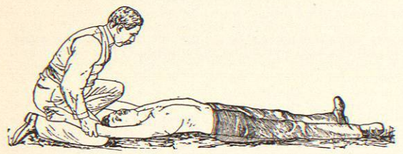

FIG. 362.—Sylvester's Method (First Position). Patient's arms extended to allow the entrance of air into the chest.

turn down the patient's arms and press them gently and firmly for two seconds against the sides of the chest."

In 1856, two years previous to Dr. Sylvester, Dr. Marshall Hall had introduced his "ready method." In this the patient is placed on his face and pressure made upon the back to expel the air in the lungs. He is then turned on the side, in which position the lungs can more easily expand. The directions are: "Place the patient with the face downward and one of the arms under the forehead, in which position the tongue will fall forward leaving the entrance into the windpipe free. Turn the body very gently on the side and a little beyond, and then briskly on the face again. Repeat the movement about fifteen times per minute, occasionally varying the side. On each occasion that the body is placed on the face,

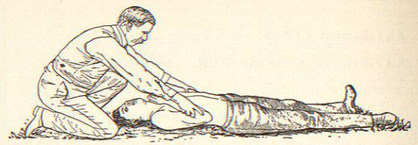

FIG. 363.—Sylvester's Method (Second Position). Patient's arms pressed against the sides of the chest to expel the air.

make uniform and efficient pressure on the back and sides, removing the pressure immediately before turning the body to the side."

These rival methods produced a great deal of controversy. Each one had its followers who praised their method and decried the other. The subject attracted so much attention that the Royal Medical and Surgical Society appointed a committee to inquire into the relative merits of the two methods. The work of this committee was very thoroughly done and their report was a valuable contribution to the subject of artificial respiration (Trans. Royal Med. Chir. Soc., vol. liii., 1862). In regard to the two modes, the evidence was very decidedly in favor of that advocated by Dr. Sylvester. They found that by his method the amount of air drawn into the lungs averaged about thirty cubic inches, while in Marshall Hall's method not more than fifteen cubic inches could be obtained. Quite recently, in 1895, Hare, in his experiments, which were carried out with much more exactness, obtained the same preponderating evidence in favor of the Sylvester method. He found that the amount of air expelled from the lungs, when the latter method was employed, was sixty-two cubic inches, while in Hall's it amounted to only twenty-two cubic inches.

In addition to the advantage just mentioned, there are others which Sylvester's method possesses. It may be easily and perfectly carried on by one person, while the other method requires the presence of an assistant to support the head in a proper position. In the former the two sides of the chest are being acted upon, while in Hall's method only one side is undergoing expansion.

Another method, ascribed both to Professor Pacini and to Dr. Bain ("Holmes' System of Surgery," v., 906), requires that traction be made directly upon the shoulders. According to Prof. Pacini, the operator, standing at the patient's head, should place a thumb upon the head of each humerus and his fingers in each axilla, and should then draw the patient upward by the shoulders until he occupies a sitting posture. According to Dr. Bain's method the operator's hands are to be placed in such a manner that the thumbs shall rest upon the patient's clavicles while his fingers press against the sides of the chest in the axillæ. The next step is to lift the patient's shoulders upward.

In the older methods of resuscitating the apparently drowned the effort was made to expel the air from the lungs by simply compressing the chest walls; it being assumed that the natural elasticity of the ribs would suffice for effecting a re-expansion of the lungs. Another factor upon which some dependence was placed was the reflex contraction which takes place in the diaphragm when pressure is exerted upon it. Among these methods special mention should be made of that of Dr. Benjamin Howard (*Lancet*, August 11, 1877). It is thus described by its author: "Turn the patient face upward, the roll of clothing put under his back just below the shoulder blades, the head hanging back as low as possible. Place the patient's hands together above his head. Kneel with

the patient's hips between your knees. Fix your elbows against your hips. Now, grasping the lower part of the patient's chest, squeeze the two sides together, pressing gradually forward with all your weight for about three seconds, until your mouth is nearly over the mouth of the patient; then, with a push, suddenly jerk yourself back. Rest about three seconds, then begin again. Repeat these movements about eight or ten times a minute."

In what is known as the Michigan method, the patient is placed with the face downward. The operator stands astride the body and seizing the shoulders raises them as high as he can without permitting the head to leave the floor, and then returns them to their original position; he next places his hands on the lower ribs and presses downward and inward with gradually increasing force; he then suddenly lets go to begin again with the first motion.

Another way that is frequently recommended is to apply pressure to the soft abdominal walls, directing it upward against the diaphragm. In this way a large amount of air is expelled; but the objections are, that considerable force is required and that there is danger of injuring neighboring organs.

Dr. Howard Kelly (*Johns Hopkins Bulletin*, January, 1895) describes a method which he has adopted and which should prove of service when the respirations cease during an abdominal section, as it prevents the escape of the abdominal contents during the manipulations. It also places the patient in the most favorable position under such circumstances, the value of the lowered head being well recognized. He thus describes it: "An assistant steps upon the table and takes one of the patient's knees under each arm, and thus raises the body from the table until it rests upon the shoulders. The anæsthetizer in the mean while has brought the head to the edge of the table, where it hangs extended and slightly inclined forward. The patient's clothing is pulled down under her armpits, completely baring the abdomen and chest. The operator, standing at the head, institutes respiratory movements as follows: inspiration, by placing the open hands on each side of the chest, posteriorly, over the lower ribs, and drawing the chest wall forward and outward, holding it thus for about two seconds; expiration, reversing the movement by replacing the hands on the front of the chest over the lower ribs, and pushing backward and inward, at the same time compressing the chest."

A very valuable addition to our many methods of resuscitation is that of Professor Labord, presented to the Paris Academy of Medicine, in 1892, and the subject of numerous papers in the *Tribune Médicale* during the following year. The object of this method is to induce reflex action on the part of the diaphragm and lungs by traction on the tongue. He traces the impulse through the glosso-pharyngeal and lingual nerves to the respiratory centre, and thence to the phrenic and other respiratory nerves. The mode of applying this method is extremely simple. After the ordinary preliminary measures have been carried out the tongue is held deeply and drawn forcibly forward, about fifteen times to the minute. The claims of Professor Labord are, that it not only is a good means of resuscitation, but the best, and in his reports of successful cases there are many in which other methods had been adopted without success. Very many others have also reported favorable results. Two points are to be carefully observed, viz., to grasp the tongue deeply so that the whole organ is acted on and not the tip only, and to draw the tongue sharply and relax it suddenly and completely. As in all methods it must be conducted patiently for some time. During its performance other methods of exciting the reflex action may be attempted. The finger of the other hand may be placed in the pharynx, the mucous surfaces of the nose and fauces may be tickled, or ammonia and other volatile substances may be used. Labord's method is particularly valuable in resuscitating newly born infants. In them the lungs have not acted, and some excitation is required to awaken the respiratory centre. Sylvester's and similar measures are not of much service in such cases, as the respiratory muscles are not properly developed, nor can the compression of the chest walls avail, as the lungs have not yet been inflated.

In infants dependence must be placed on reflex excitation and insufflation. For the former we have Labord's rhythmic traction of the tongue, slapping the surface of the body, etc., while at the same time an attempt may be made to compress the chest walls and to carry out Sylvester's movements. To inflate the lungs, the most ready method is to breathe directly into the mouth of the child eighteen or twenty times a minute. To insure a proper passage of the air, the larynx is to be pressed upward and back, to close the œsophagus, the tongue is to be drawn forward, and the nasal cavities are to be closed. Expiration is aided by pressing upon the chest walls. Catheters or rubber tubes may be introduced into the larynx, and various bellows and pumps have been devised for forcing air into the lungs, but the objections to them are, the valuable time lost if they are not at hand and the difficulty in placing them in proper position for use.

Faradization has been proposed as a means of contracting the diaphragm, and has been employed as an adjunct to other efforts to inflate the lungs. It is not of much value alone, but should always be utilized when at hand. One electrode is to be pressed over the right phrenic nerve, just outside the carotid artery, while the other is to be placed over the lower ribs. The left side is avoided in order not to interfere with the heart's action. The current should be applied regularly during the elevation of the arms, and cut off as soon as the arms begin to descend. The abdominal electrode should not be placed too low for fear of contracting the abdominal muscles instead of the diaphragm.

In all attempts at artificial respiration it is quite evident that one method must not be followed to the exclusion of all others. Fortunately, no one of them precludes the employment of another, but rather there is every reason to expect a greater benefit from their combined use. If a sufficient number of assistants are available, Sylvester's, Labord's compression of the chest walls, and electricity may be conducted at the same time. The only precaution required is, that they should be carefully and regularly conducted, and that the various efforts to promote inspiration and expiration should coincide.

Beaumont Small.

ARUMBARO SPRINGS.—Municipality of Morelia, State of Michoacan, Mexico. These springs are thermal. According to an examination by Dr. Zuñiga the water presents the following characteristics: "Perfectly transparent, yellow in color, unctuous to the touch, of a saline taste and alkaline reaction." A qualitative examination showed the following chemical ingredients: carbonates of calcium, magnesium, potassium, sodium and iron, sulphuric, sulphurous, and phosphoric acids, chlorine and organic matters. Total solids per United States gallon, approximately 118 grains. The soda salt appears to be the preponderating constituent. The water discharges sulphureted hydrogen in abundance, giving to it its peculiar odor. It is used for bathing, although no buildings have so far been erected. The baths appear to be beneficial in cases of eczema, herpetic eruptions, rheumatism, and diabetes.

N. J. Ponce de Léon.

ASAFŒTIDA.—"A gum resin collected from *Ferula fœtida* (Bunge) Regel (fam. *Umbelliferæ*)" (U. S. P.). To this definition the British Pharmacopœia adds "and probably other species."

Over the desert steppes of Western Asia grow in great numbers a variety of gigantic perennial species of *Umbelliferæ*, which perpetuate themselves during the long dry seasons by very large fleshy roots, protected against decay and foraging animals by antiseptic and obnoxious resins and volatile oils. So abundant are these plants that immediately after the occurrence of the first rains,