When at the end of the granulous retraction of a large wound, the edges of the old epidermis are still at a distance of 20 or 25 mm. the new epidermis cannot spread on the granulations and the cicatrization of the wound comes to a standstill.

It seems that the time of the epidermization and its rate depends mainly on the dimensions of the wound. This point has been ascertained by several other sets of experiments.

By observing trapezoidal wounds it was found that the smaller side about 8 mm. wide was completely epidermized while the larger side about 20 mm. wide presented an epithelial band of about 2 mm. along the edges of the old epidermis. On irregular wounds the epidermization begins always on the points where the edges are closer to each other. In lozenge-shaped wounds the epidermization begins in the acute angles and the wound becomes an ellipse. On several kinds of trapezoidal wounds it was always found that the epidermization begins sooner and spreads more quickly between the points which are separated by the shortest distance.

Therefore, it appears that the law of reparation by epidermization is absolutely different from the law of separation by granulous retraction. *The rate of the epidermization is inversely proportional to the dimensions of the wound.* It is very slow when the distance between the edges of the wound is more than 10 or 15 mm. The maximal activity of the epidermization seems to take place when the cicatrization is nearly complete, and when the edges of the new epithelium are very close to each other.

4. *Cicatricial Period.*—The dimensions of the scar can easily be measured when the edges of the old epidermis are stained with India ink, or when the animal is black. It was found that the scar of a large wound is comparatively smaller than that of a small wound. On the same animal, two wounds of 66 mm. and of 26 mm. were observed. The 66 mm. wound gave a scar of 22 mm. and the 26 mm. wound a scar of 13 mm. The scar of the large wound was only one-third the size of the wound, while the scar of the small wound was one-half the size of the wound. If the wound is still smaller, 10 or 12 mm., the scar is almost the same size as the wound. This is the natural result of the law of granulous retraction.

The evolution of the scar is very slow and the cicatricial period of a wound very long. As soon as the epidermization is completed, the distance between the points A and B of the edges of the old epidermis grows greater. The tracing shows a slight movement upward of the line representing the different values of the distance A and B. The points A and B have a tendency to go back to their former position. This progressive enlargement of the scar lasts for a long time and its result should be a complete redintegration.

The mechanisms which are instrumental in the cicatrization of a wound are coordinated in such a way that the reparation is continuous and progressive. Nevertheless, the reparation presents phases of maximum and minimum activity during which the rate is higher or lower. During the quiescent period, the end of the period of granulous retraction and the beginning of the period of epidermization, the rate of the reparation is slow. It is maximum at the beginning of the period of granulous retraction and at the end of the period of epidermization. The two mechanisms are adapted to the healing of small and middle-sized wounds, the width of which is not over 40 mm. In a wound 30 or 40 mm. in width or smaller, the retraction of the granulations

is very efficient, since it can quickly bring the edges to a distance of 10 or 15 mm. This distance is very favorable to the epidermization. Therefore, at the same time when the rate of reparation by granulation becomes very slow, the epidermization starts and the reparation goes on without interruption, although by a different mechanism. But if the wound is larger, 60 or 70 mm., the retraction of the granulations cannot bring the edges to the minimum distance. They remain at a distance of about 20 mm. and the reparation comes to a standstill because the epidermization cannot take place easily under these conditions. The mechanisms are very efficient for the healing of the injuries to which the animals are exposed in their every-day life. But they do not work as satisfactorily for the larger wounds.

VAPOR ANESTHESIA APPARATUS

JAMES T. GWATHMEY, M.D.
NEW YORK

In 1905 I first presented my apparatus for vapor anesthesia to the medical profession. At that time it seemed quite complicated. It consisted of three bottles connected by tubing, one of which was for ether, one for chloroform and the other being a bottle containing hot water or hot neutral oil for warming the vapor, and having a tube through which the vapor was delivered to the patient. Each bottle was provided with a stop-cock, and a mixture of chloroform and ether could be given. The ether bottle contained a drum for assisting in vaporizing the ether. I have perfected the different parts and

Fig. 1.—This shows the three bottles of the vaporizing apparatus, with the single stopcock. The figure at the right below shows the tubular frame of the mask through which the vapor passes to the gauze covering. The tube at the left below is used in delivering the anesthetic in operations about the mouth or throat in which the mask cannot be used.

now present a simplified apparatus consisting of three bottles with one stop-cock. The drum in the ether bottle has been modified (as suggested by Dr. Charles E. Boys, Kalamazoo, Mich.), so that it now vaporizes all of the ether, and it does not necessitate refilling the bottle as often as before. A small bottle holding 10 drams of chloroform has also been placed within the chloroform bottle. This is enough chloroform for a long operation. The end of the tube in the chloroform bottle has been closed and a number of pinhole perforations made at the bottom of this tube, so that it is impossible to waste the chloroform as the air passes through. The last improve-

ment has been to place around the mask a rubber covering which confines the vapor and assists in making the anesthetic more manageable.

If one ounce of the oil of bergamot or terpineol is placed with 3 ounces of water in the hot-water bottle, the odor of ether or chloroform will be so disguised that the patient will be unable to distinguish when the anesthetic is turned on, and consequently no resistance or asphyxial symptoms present themselves in going under the anesthetic. Then again, it is much pleasanter for the surgeon, nurses and others in the room to smell the oil of bergamot or terpineol than to be constantly inhaling the odors of ether and chloroform.

At any time the anesthetist can give either chloroform or ether, or any combination of the two, by simply turning the single stop-cock, the change being made in less than a fraction of a second, all of the vapor passing through the third bottle, usually filled with hot water, and terpineol or a hot neutral oil. Unquestionably a smaller amount of anesthetic is used with this apparatus, or with some similar apparatus, than with any other method now known. It has been used constantly in some of our largest hospitals since 1905, with increasingly gratifying results in the following particulars:

1. A smaller amount of anesthetic is used. In a chloroform anesthesia, in which ether was contra-indicated on account of an ulcer in the stomach, I used 2 drams of chloroform for a

five minutes, and with this warmed vapor, the kidneys, heart and lungs are never seriously affected.

In order to discover the value of passing this vapor through hot water, the following tests were made by Dr. Chas. Baskerville, professor of chemistry, College of the City of New York:

1. Pure oxygen was passed for seventeen minutes through 4 ounces of anesthetic ether, the resulting mixture passing through the hot-water bottle with the water at 60° C. The first 10 c.c. of distillate were collected. The ether used in this test had given a pronounced aldehyd reaction when allowed to stand over potassium hydroxid for six hours, but the distillate obtained in the above experiment gave only a slight response.

2. An experiment was made, using water at 40° C. and applying external heat to the water-container sufficient to insure vaporization of the ether. The ether distillate obtained under these conditions, gave a negative reaction for aldehyd. It will appear from these results that the aldehyd is removed when ether vapor is passed through water in the neighborhood of 40° C., and that the aldehyd content of the ether passed through is considerably diminished and its toxic value is especially lessened, when the water is kept at a temperature in the neighborhood of 60° C.

The vapor apparatus may be used in combination with a vacuum water pump, similar to the one used by dentists for removing blood and secretions from the mouth and throat in operations about those parts, in which it is necessary to remove the mask. The anesthetic vapor in this instance is administered through a metal tube attached to the delivery tube of the apparatus. I have improved the pump by the addition of an adjustable connection that can be attached to any hydrant or tap.

124 East Sixteenth Street.

Fig. 2.

Fig. 3.

Fig. 2.—Illustration of mask one-third size.

Fig. 3.—Illustration of rubber covering for mask, which helps to prevent cooling and waste of the anesthetic.

twenty-five-minute operation. Two or three ounces of ether with one to two drams of chloroform per hour is the usual amount used.

2. The technic can be acquired with less danger to the patient than with any other anesthetizing method. In getting the patient entirely under, with this apparatus alone, excitement is usually absent, or so slight that it is unobjectionable.

3. In over 90 per cent. of the cases unpleasant after-effects are entirely absent.

4. A continual narcosis is always maintained, as we know exactly what per cent. the patient is getting at all times, and in addition the gradations are easily and readily made by moving the one lever according to the degree of narcosis demanded by the operation. An intermittent narcosis, which is wrong in principle, is thus avoided. It is especially indicated for nose and throat operations, and is the apparatus for mastoid operations. The anesthetist can maintain primary anesthesia, moving backward and forward between what is commonly known as the second and third degree of anesthesia, without once arousing the dangerous vomiting center. All of the vapor, being warmed, is more respirable, reducing the after-effects and increasing its safety as regards life. With this attenuated vapor, an infant three days old can be safely anesthetized and an alcoholic can be easily kept under, after reaching the surgical stage. All patients can be narcotized within

EYE-STRAIN A CAUSE OF EXOPHTHALMIC GOITER

GEORGE M. GOULD, M.D.

AND

A. C. DURAND, M.D.

ITHACA, N. Y.

Exophthalmic goiter, it is said, is, or may be indicated by four symptoms, tachycardia, exophthalmos, goiter, and tremor. Tachycardia is usually held to be the early, leading, or primary symptom, the other three trailing off in relative unimportance. Indeed, any one or two, perhaps three, of the four may be absent, and yet the real morbid Proteus be present, concealed and yet pathogenic by means of the one or two remaining.

Pathology of a serious or rational standing has really nothing to offer as to the cause and nature of the disease. The oculists have kindly shoved the problem off into the far country labeled "ductless glands," and it has been quizzically suggested that the exophthalmic principality of the quadruple-crowned and loosely joined grand-duchies, owes all its independence to a wondrous little, and little wondrous, "muscle of Müller," situated at the orbital fissure. How it is possible for these tiny fibers by contraction to produce the distortion of a huge, or of any degree, of exophthalmos, with its attendant signs and symptoms, what may be the physiologic function of this muscle in the first place, and consequently what is its morbid function, how the thyroid secretion can execute such a task—all these, and more, raise the corners of the mouth of the genuine scientist. Indeed, the illogicalities of the symptom-complex and of the group-name