DAWBARN (R.H.M.)

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II. THREATENED DEATH DURING MAJOR ANESTHESIA.
III. A BRIEF DIGRESSION UPON SHOCK.*

BY
ROBERT H. M. DAWBARN, M. D.,
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* A number of papers published in the April and June New York Polyclinic and the August, September and October *Atlanta Medical and Surgical Journal.*

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Which shall we use—ether or chloroform? There is no study less profitable than that of the relative death-percentages all over the world from chloroform *vs.* ether. It is absolutely wasted time. That von Nussbaum saw chloroform used forty thousand times without a death,† and that chloroform has been exhibited thirty-six thousand five hundred times in the Edinburgh Infirmary with but one fatal result,‡ would seem evidence that such danger from the use of this anesthetic as exists is largely due to the personal equation; that is to inexperience on the part of the anesthetist, or to improper methods of meeting the emergency. Whereas, in studying 12,000 cases operated upon in New

* A number of papers published in the April and June New York POLYCLINIC and the August, September and October *Atlanta Medical and Surgical Journal.*

†Wood's Reference Handbook, Vol. I, p. 189.

‡*American Journal of Medical Sciences*, November, 1888.

York Hospital, Dr. Weir found ether-deaths in the proportion of one to each two thousand.*

In New York, Philadelphia and Boston there is a curious distrust of chloroform not apparent in the rest of the world of surgery to the same degree, either abroad or in this country.

The writer was one of a hundred or more auditors when that famous surgeon, Dr. Henry B. Sands, once told a story which it required a man of his eminence and his truthfulness to relate, concerning an experience of his in Germany. He was present during an operation by Dr. Schede in the Allgemeines Krankenhaus in Hamburg-Eppendorf, when Schede happened to remark that he had never in his life seen ether given; that he and all the famous men of his country relied solely upon chloroform. Dr. Sands thereupon agreed to enlighten his inexperience, and taking the anesthetist's place gave ether to the next patient. It is painful to relate that this patient had the bad taste to die from the ether, thus casting discredit upon a most valuable drug. Dr. Sands said that he and Dr. Schede worked over the man with artificial respiration and other means for a long while, but failed to revive him. And I venture to say that Dr. Schede now has the same distrust and fear of ether as an anesthetic

* *Trans. Am. Surg. Assn.*, Vol. VI, p. 544.

which seems to prevail regarding chloroform in the trinity of cities just named.

If it be admitted that, taking averages the world over, more deaths on the table occur from chloroform than from ether, nevertheless were we to add those happening weeks and months later, due to ether-irritation of lungs or kidneys in persons already enfeebled in these organs, perhaps the percentages would be different.

It is unquestionably true that more skill is needed to give chloroform safely than ether. Were the writer to need an operation upon himself he would choose ether, if subjected to an "emergency" anesthetist, but chloroform if that assistant were skilled and experienced.

Even in the three cities just mentioned together, however, certain conditions are recognized as justifying the use of chloroform as against ether. These are:

1. The presence of severe pain. Chloroform is relatively safe in childbirth, even in the hands of inexperience.* The reason is, perhaps, that the suffering causes cerebral congestion to some degree, and with plenty of blood

*H. C. Wood says (*Therapeutics*, 7th. edition, p. 150): "So far as I know, no death has yet occurred from chloroform during parturition."

Wood's Reference Handbook, Vol. 1, p. 195: "Chloroform has been used in natural labor many hundreds of thousands of times, yet but a single case of death is on record where it was administered by a competent medical man, and in this instance there is lack of post-mortem confirmation."

in the brain chloroform is safer than otherwise.

2. In childhood; at least, this is the teaching of Dr. Jacobi and numerous other children's specialists.

3. To control convulsions—uremic, epileptic, strychnic *et al.* Here ether would be too slow in taking effect.

4. In cases where actual cautery must be used about the mouth, ether being inflammable.

5. In certain diseases of the lungs, kidneys, stomach, brain.

6. In military surgery, being less bulky, more rapid in action and cheaper.

7. In hot climates (ether boils at 95° F., chloroform at 142° F.)

8. At night, if flame must be held near the patient. (But chloroform is not free from disadvantage at night, being decomposed by the flame, and chlorine and other gaseous irritants set free. All surgeons have noticed the tendency to cough under such circumstances.)

The Question of Mixtures.—This is one that remains unsettled, the widest divergence of views continuing. Dr. J. C. Reeve, already quoted as to relative mortality, says: "The chloroform committee of the Medico-Chirurgical Society of London in 1864 recommended, among others, a mixture of one part alcohol, two parts chloroform and three parts ether, by

measure, known as the 'A. C. E. mixture,' which has probably been used more than any other. At Vienna a mixture of six parts of ether to one of chloroform has been used so much as to be known as the 'Vienna mixture.' It is stated that there have been eight thousand administrations of it without a death. Billroth, of the same city, used a mixture of three parts of chloroform, one of ether, and one of alcohol."

Against such mixtures the argument has always been urged that a new chemical is not thus made, with a single rate of diffusion; and that while the rate of relative evaporation is doubtless in part modified by the mixture, the patient substantially gets first ether, then chloroform, then alcohol, in order of volatility. The writer agrees with the majority of surgeons in feeling that a gain in security is not made thereby. Straight drinks are safest—to speak after the manner of the world.

Chloride of Methylene. ($CH_2 Cl_2$).—This is mentioned simply as standing as a type of drugs belonging more or less to the chloroform class—the halogen anesthetics. This short essay does not permit of a careful discussion of them. This particular one enjoys the indorsement of Sir Spencer Wells, who after considerable use of it, regards it as the best anesthetic.

Nitrous Oxide.—The writer believes that laughing-gas will be considerably more used in the future, in general surgery, than in the past. Now that it is obtainable in liquid form in small steel canisters* of such a size that one may be slipped within a small handbag, an objection to its use has disappeared. A special closely fitting mask and a large thin rubber bag to hold the gas generated from the liquid, complete the outfit.

Heretofore its exhibition has remained almost solely in the hands of dentists; but it would seem that there is a field here for young physicians to fill. The writer has many times employed a certain dentist to give gas at the patient's house, and on more than one occasion the operation has lasted, with satisfactory anesthesia, fully three-quarters of an hour.†

As every one knows, the color of the patient meanwhile is always ghastly in its lividity; but this seems not dangerous in realty. Differing

* It is liquefied by about forty atmospheres. Since 1860, or thereabouts, N_2O has been liquefied and shipped in large canisters all over the world. But in general surgery at the patient's residence, there has, as yet, been comparatively little use of the small, easily portable steel cylinders of the liquid.

† Prof. R. Ogden Doremus informs the writer that many years ago at a lecture at Steinway Hall, N. Y., for the benefit of the widow of Dr. Horace Wells, Dr. J. Marion Sims stated that he (Sims) had performed an operation an hour and twenty minutes long under laughing-gas anesthesia.

from ether or chloroform, should alarming symptoms appear, removal of the inhaler is followed by prompt improvement—almost with the first breath of pure air inhaled. Of course some little skill is needed to keep the patient from waking repeatedly during an operation of some length, but it is certain that the experience and the care need not be more than for the safe use of chloroform. It is a pleasure to see the absence of the initial choking and struggling and of subsequent anorexia and nausea with these patients; and certain ones who would refuse a needed operation, because of the ether or chloroform, will agree readily to take laughing-gas.

Due largely to the investigations of Dr. Paul Bert, of Paris, as to exhibition of nitrous oxide with oxygen, we know that it has anesthetic qualities aside from merely depriving the patient of oxygen. And the addition of oxygen, by removing the lividity alluded to, seems desirable. Dr. W. W. Van Arsdale has recently shown that the best proportion would seem to be 10 per cent. of oxygen to 90 per cent. of the N_2O—with a tight face-mask, and pressure, as from a heavy book, upon the gas-bag. He also noted that with this addition of oxygen, men, and alcoholics of both sexes, do not so readily

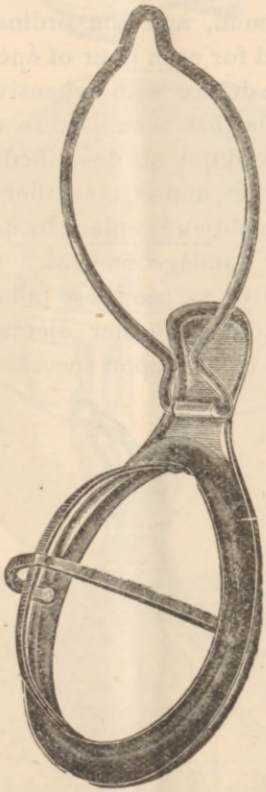
succumb to the anesthesia as do women, and non-alcoholic subjects.*

The kind of inhaler to be used for ether and for chloroform is a matter of no little importance. With chloroform the safest proportion is estimated at from 3 to 4 per cent. of it mingled with the inspired air. Clover's apparatus, permits of such accuracy, but is very expensive. In practice we find that Esmarch's inhaler is safe and it is the one most used everywhere. (See figure) This device permits of abundant admixture of air. The chloroform should for safety, be poured on from a drop-bottle, a few minims at a time. The improved Esmarch inhaler shown in the illustration allows instant change of the flannel or gauze or cotton-wadding cover, for each new patient—a decided gain in cleanliness. The cover is sure to be soiled to some extent whenever used, because (if for no other reason) of the oil or vaseline with which the patient's face should be smeared, to prevent a dermatitis due to the irritant chloroform-vapor. In use, the covering material is laid upon the frame, over this

* It would seem an obvious advantage and great convenience if the laughing-gas mingled with 10 per cent. of oxygen could be liquefied together and supplied from the same canister to the patient. This is not feasible, however. Oxygen requires 300 atmospheres (more than two tons to the square inch) plus the most intense cold to make it liquid, and would hardly be safe in a portable canister. Laughing-gas needs but 40 atmospheres for liquefaction, as stated heretofore.

the wire rim is snapped into place, and any excess of the covering is trimmed away with scissors.

As to ether-inhalers upon the market, their number is considerable. Perhaps, however, the



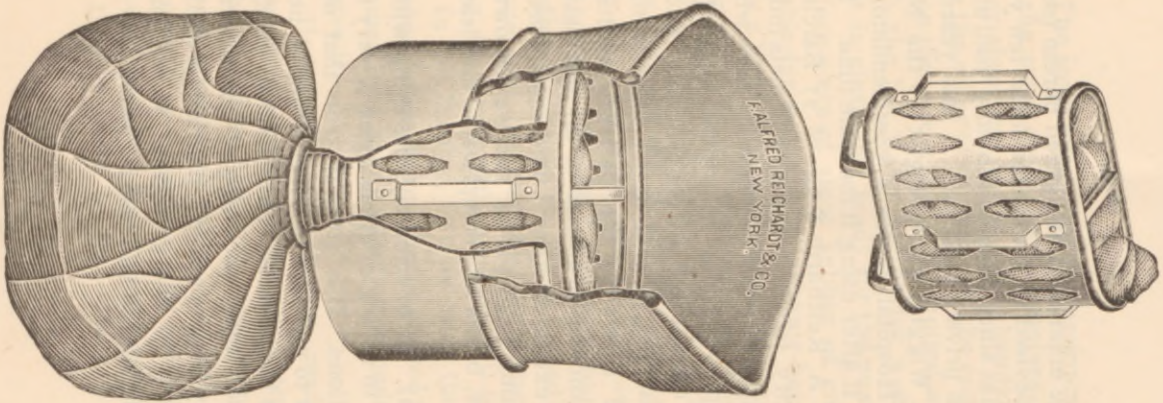
Improved Chloroform Inhaler.

familiar towel-and-newspaper cone of home manufacture is still the favorite with the bulk of the profession. It has at least the merit of cleanliness, for the same cone is seldom used twice. Still, with ether quoted at upwards of a dollar a pound, and the ordinary estimate being a pound for each hour of anesthesia, it is plain that the device is an expensive one.

Allis's inhaler has been used to an enormous extent, and need not be described. It also is wasteful of ether, and as it is rather bothersome to remove the old and replace by new the numerous folds of bandage on which the ether is poured, too often we see these inhalers, though soiled by sputum and other ejecta, continued for some time in use upon successive patients.

Chloroform drop-bottle. It is always safest to give the drug drop by drop in this way.

The author's ether inhaler. The upper figure shows the cage removed and filled with gauze.



The ether-inhaler figured herein (see figure) was devised by the writer some ten years ago, and has since been continually used at his clinic and in private practice. A few years ago Dr. F. H. Wiggin, gynecologist to the New York City Hospital, wrote a commendatory article upon it after using it for some time. It is made by F. A. Reichardt & Co. of 27 Barclay street, this city, to whom the author feels indebted for the ingenuity and painstaking care which have so improved upon the original suggestion.

Its advantages are (*a*) economy, and (*b*) ease of cleansing, as well as (*c*) those benefits and added safety to the patient resulting from avoidance of saturation of all his tissues by a great excess of ether. The apparatus is upon the same principle as the well-known one of Clover, but is less complicated and less expensive.

(*a*) As to economy, the thing will pay for itself, in saving of ether, after a very few long operations. It is literally true that only one-fourth to one-fifth as much ether is needed as with a home-made cone; indeed, hardly more of ether than one uses of chloroform in an equally long operation, provided a skilled anesthetist is in charge. Also, it is simple and durable, and should last for years.

(*b*) The stout open cage of aluminum fitting within the solid outer frame receives a little gauze, or absorbent cotton, or a handkerchief. On this the ether is poured. At the end of the operation the cage is removed, emptied, and held beneath the hot water faucet for a moment, when it is clean and ready for the next case.

The face-piece of stout rubber of course is removable for washing, as is the air-bag. This latter is a light, thin rubber bag, of a capacity considerably greater than that of the lungs. The solid rubber face-piece is more durable and simpler than are the pneumatic ones seen on certain other inhalers, and fits the face quite closely enough. To avoid one more contrivance demanding cleansing, no device is used (as with the Clover and the Ormsby, for instance) for pouring in ether without removal from the face. In this inhaler, just as with the home-made cone, when more ether is needed the cone is removed long enough—a few seconds only—to receive it.

(*c*) Under this heading the reader will observe that because of the air-bag attachment the ether is rebreathed again and again. This, of course, economizes ether, but what is more important, it saves surcharging the blood, and the lungs, kidneys and other viscera. The ether thus warmed is also, because of that

warming, less apt to cause an ether-pneumonia; continued evaporation of ether being very chilling, as everyone knows. Since much less ether is given, it follows that the danger of death from ether-narcosis is lessened. It is surprising to one accustomed to the home-made cone to see how quickly the patient recovers entire consciousness; and whereas by the former device the breath remains redolent of ether for nearly twenty-four hours, and for the same reason the anorexia is long continued, by the use of the inhaler we are discussing the elimination is completed and the patient's appetite has returned in much less time.

Because of rebreathing the same air a CO_2 anesthesia is superadded to that from the ether, and consequently the patient is almost as quickly anesthetized and with as little struggling as if from chloroform. To the writer this seems one of the distinct advantages of the Clover air-bag principle, and he would differ from those who consider the CO_2 an objection.* It is, of course, easy to observe the colour of the skin or mucous membranes, and if more oxygen is desired, to hold the cone less tightly to the face, permitting at any time an admixture of air.

*See in corroboration of this view several experiments quoted in Wood's *Therapeutics*, 7th edition, p. 135, showing that a carbonic acid anesthesia is a safe one.

THREATENED DEATH DURING MAJOR ANESTHESIA.

There are two surgical emergencies so appalling in their character, and so quickly fatal if not promptly met, that they may be said to transcend in importance all others. These are, anesthesia-narcosis threatening death, and unexpected hæmorrhage upon the operating table.

In each of these the safety of the patient demands that the surgeon shall have his knowledge at his finger-tips, and be ready instantly and almost automatically to do the right thing.

The first of these is the topic under discussion in this paper; and no one will demur to the statement that it is the duty of every doctor to memorize the measures to meet this indication until they are as familiar to him — as much a part of himself—as is the alphabet. For no time will be left to him for debate when confronted by the actual fact. Every moment is then golden, and indecision equally with unwise choice may cost a life.

PREVENTION.

Prevention is half the battle. If the suggestions under this heading are heeded, few indeed will be the actual cases encountered.

The writer makes it an invariable rule, and has done so for many years, to precede every exhibition of either chloroform or ether by a

hypodermic injection of morphine sulphate guarded by atropine sulphate; in the adult from gr. ¼ to gr. ⅓ of the former, and from gr. $\frac{1}{150}$ to gr. $\frac{1}{120}$ of the latter; allowing, say, a quarter of an hour for it to take effect. Also as a rule, an ounce or more of whisky or brandy is given at the same time.

There are several reasons for this course, but one alone should suffice; namely, that all of these drugs are analgesics, and that consequently much less of the anesthetic need be inhaled, and the danger of death is to just that extent lessened.

Indeed, if any reason exists why neither chloroform nor ether nor laughing-gas should be taken, a fairly comfortable operation is possible by free use of these means alone, as all surgeons know.

Again; nearly 50% of all deaths from CH Cl_3 have occurred before complete anesthesia was accomplished; commonly within the first minute or two of its exhibition, and when only a very little had as yet been used.* Had the stage of excitement and of fright been prevented by a little morphine, atropine and whisky, with their calmative and steadying influence on the reflexes, this mortality would probably have been avoided.

It will be noted that all three of the aids

*Wood's Ref. Handbook, *Anesthetics*, Vol. I, p. 190.

mentioned (morphine, atropine, alcohol) are heart-tonics when used in moderation, and tend also to diminish the likelihood of operative shock; and further, that atropine is one of our best vaso-motor stimulants.

(For all the reasons mentioned in the last sentence the writer approves of the use of strychnine sulphate, in small doses, for a few days prior to any severe operation. Perhaps, when shock is actually present, it is of more value than any one other drug; and if this be true, its use in *prevention* of shock would seem sensible.)

Dr. H. C. Wood has demonstrated the value of strychnine when used by needle in treating anesthesia-narcosis; and here again its use in *prevention* seems occasionally indicated.

Although we approve of the use of alcohol *prior* to anesthesia, as just stated, because then less of the anesthetic will be needed, a clear distinction must here be drawn between this fact and its exhibition as a remedy *where death is actually threatening from an excess of ether or chloroform.* This distinction must not be forgotten.

The writer has witnessed again and again instances of the accident under discussion, in which the operator and his assistants endeavoured by numerous hypodermic injections of whisky or brandy—narcotics—to revive a pa-

tient suffering from an excess of another narcotic. Dr. H. C. Wood has used the strong language to characterize this procedure, that "it is little better than murder!" To be sure, alcohol is a heart-tonic, but we have other equa ly swift heart-tonics which do *not* tend to deepen the deadly narcosis.

Rather recently the cocainization of the nares and larynx by spray, just prior to anesthe a, has been considerably used. It certainly renders the inhalation less unpleasant, and in the case of chloroform, may quite conceivably prevent danger. We know that very early in a chloroform-anesthesia a certain danger sometimes exists that this irritant drug may cause a reflex action whereby the pneumogastric nerve stops the heart—and it may not wake up again.*

Quite a little work has lately been done by various surgeons regarding anesthesia by ether mixed with oxygen. It would seem that the idea may be of value in helping to avoid narcosis in excess. It has not, however, come into general use. It is a revival, in principle at leas', of the "ozonic ether" of Dr. Richardson, who advised this for anesthesia before the Brit. Med. Association in 1865. He produced this compound by agitating a 30 volume solution of

* The suggestions in the opening paragraphs under *prevention* form an effective safeguard against this danger.

peroxide of hydrogen with anhydrous ether, and adding 5% of alcohol.

Under the heading of Prevention we must remember not to begin cutting until the patient is "under to the surgical degree." Buxton, Reeve and other writers upon anesthetics have pointed out the surprisingly large proportion of cases in which incomplete anesthesia, by lowering vital functions, has permitted fatal shock to result from trivial though painful operations, such as strabismus, tooth-extracting, circumcision, etc. Indeed, it is estimated that 40% of chloroform deaths have been in cases of such a trifling nature, and there seems no other adequate explanation of so large a proportion in comparison with deaths during major operations.

Again, in reference to chloroform, it is probably safer to tip the table so as to have the head a trifle lower than the feet; this as a measure of precaution, and for reasons to be more fully discussed later, under the heading of *treatment*. But the patient may be permitted to choose whether to lie upon the back or the side during the inhalation.

Many are the recorded cases of death from chloroform exhibited in the sitting or the half-reclining postures; which invite anæmia of the vital centres. Dr. H. A. Hare has recently pointed out the fact that chloroform kills really

by vaso-motor paralysis, whereby "the man is suddenly bled into his own veins and capillaries, as effectively as if into a bowl;" and instant anæmia of brain and heart results.*

It is the part of wisdom to insist upon twenty-four hours, at least, in hospital (preferably) and in bed, before anesthesia. Bodily rest, and time in which the mind may grow accustomed to the new environment, are of obvious value.

A rule, which should be inflexible, requires the cautious surgeon to make a physical examination of his patient's various organs shortly before operating. Notably, the kidneys must not be neglected. Presence of albumen should interdict the use of ether. It is believed that those with impaired renal function are more apt than others to succumb to the narcosis. Certain surgeons, and especially Dr.. R. F. Weir, consider chloroform at least equally an irritant to the kidneys. Here we surely have an indication for the employment of nitrous oxide anesthesia.

If any faintness be noted due to the preparatory fasting which we must enforce, nothing

*Under *prevention* Dr. R. C. Kemp's recent ingenious suggestion deserves mention: this is to use rectal flushing by hot salt-water, with his double current tube, during the whole operation; thereby maintaining filled blood-vessels, and inducing a stronger heart-action.

This would also help to prevent shock.

but benefit can result from a nutrient enema an hour or so before the operation. This may also contain whisky or brandy if desired, and is a good way in which to exhibit the alcohol which we have advised for routine use, in *preparation* for anesthesia.

Perhaps it is a waste of words to mention that the bowels and bladder must have been recently evacuated; and that it is a duty of the anesthetist to see that corsets and all tight clothing are removed, also artificial teeth. Let the inhalation be most gradually commenced; it is always a mistake to force a sudden unconsciousness. With a nervous patient grant permission, if desired, to hold the inhaler himself for a time; and meanwhile a few cheery words will often allay fright, which is dangerous.

(The beginner should be taught that the palpebral reflex is practically as good a guide as the conjunctival. There is no justification for the subsequent sore eyes due to frequent rubbing of the cornea or conjunctiva, so often to be noted.)

The writer considers stertorous respiration —which is due to paralysis of the *velum pendulum palati*, from deep anesthesia—a sufficient indication, as a rule though not invariably, for permitting inhalation of a larger proportion of

air. To keep the patient snoring heavily through a long operation, is to subject him to a nearer approach to a lethal dose than the writer deems wise, and also to invite shock.

The colour of the blood is to be noted by the surgeon, and if it seems a shade too dark the anesthetist should be warned. The pupils too are a fair though not quite reliable guide. Should they suddenly dilate it means instant peril.

In using a tampon-canula after tracheotomy, for exhibition of the anesthetic, let it be remembered that here especial care is needed, as it is unpleasantly easy to exclude all oxygen, and to have an asphyxiated patient in consequence.

Perhaps a word may not be amiss regarding anesthesia by the rectum. This is practicable by ether-vapour, the bottle being placed in hot water and the vapour conveyed by a rubber tube *upwards* into the rectum.* The advantage is, avoidance of the excitement, coughing and semi-strangling sometimes observed while beginning the ordinary method; also it is of use where actual cautery about the mouth or nose is contemplated. Disadvantages are, occasional causation of a severe proctitis; and also in

* *Upwards*, to avoid possibility of pouring fluid ether into the bowel.

event of excessive narcosis, the patient, although the supply be stopped, must absorb the large amount of ether-vapour filling his rectum and colon before he can begin to revive.

When a child is to be anesthetized, chloroform being the intended means, it is an excellent plan to avoid all excitement and fright by giving it during sleep. With a moderate amount of skill this is not a difficult feat, the child gently sliding from the natural into the artificial slumber. With adult patients, however, while possible of accomplishment in occasional instances, this is not generally practicable.

And finally, under *prevention* still, we should allude to a plan, little advocated in print, but which has only to be witnessed once in order to commend itself. Namely, as a measure of precaution (in a patient of feeble vitality about to be subjected to operation), *maintaining a reserve-guard of pure blood*, by accumulating it in one or more of the extremities; to be released, in event of need, during narcosis.

For other purposes this temporary sequestration of blood has been employed by a number of physicians; but Dr. David Webster was first to suggest it for *this* indication, in 1887, in a letter to the *N. Y. Med. Journal;* and shortly

thereafter the writer was the first actually so to use it.

The technique is simple. The thigh, for example, is corded at the groin; at first slightly, for a few minutes, permitting it to swell visibly from accumulated blood, and then tightly enough to obstruct all flow in either direction. This is done with a rubber bandage. The limb is now kept wrapped in a blanket, with warm bottles or bricks about it. In case of dangerous narcosis, release the band, elevate the limb, and you pour great quantities of pure blood into the body surcharged with ether or chloroform. The good results are striking and supervene promptly, the patient quickly becoming conscious.

It is obvious that in an operation which will probably occupy much time this plan might not be wise; but for half an hour or less the blood can be so retained without danger to the limb.*

Last, under the heading of prevention, but not least, we should mention the advisability of placing on guard at the head of the operating table only an experienced man. In almost every hospital this work is relegated to the

*For fuller details, and a study of the other purposes for which, prior to an operation, this plan may be employed, the reader is referred to the writer's article upon Anesthesia Narcosis, in Vol. IX of Wood's Reference Handbook, and in which is quoted in full an essay by Dr. Charles McBurney upon this point.

junior assistant—in the opinion of the writer, a grave mistake. If that junior has had instead some months during which opportunity is given him to observe the proper methods and learn to avoid the perils of anesthesia, then as senior assistant he becomes a comparatively safe man to trust.

TREATMENT.

Dr. H. C. Wood in his study of this subject for the Berlin Congress teaches that the treatment should be practically identical whether for ether- or for chloroform-narcosis; and this is the doctrine we will follow.

Under this heading, in order to be systematic and orderly, the better to aid memorizing, let us discuss:

1. Respiratory trouble. (*a*) Obstruction to the entrance of air. (*b*) Failure of the respiratory center.

2. Heart trouble.

Of course, too, we may have to treat both 1 and 2 at the same time.

1. RESPIRATORY TROUBLE.

Under (*a*) of the first head we have to deal with dropping of the tongue back upon the larynx, causing asphyxia; and also with obstruction from thick, ropy mucus, or blood, or pus, or vomited food inhaled.

Trouble with the tongue is best met by Benjamin Howard's method of raising the epiglottis. This can rarely be done effectively by use of tongue-forceps (though these may of course be tried), and if such traction fail to relieve the dyspnœa, the Howard position should be adopted, *by over-extending the head.* Turn it as sharply backward as possible, at the same time *closing* his mouth. You have now an almost straight passage from the nostrils to the larynx; and the tense genio- and mylo-hyoid and digastric muscles, and in turn the hyo-epiglottic ligaments, force the epiglottis to stand upright and to ward off the tongue from falling back upon the laryngeal entrance.

Instead of this plan, and somewhat less effectual, is the method of forcing the lower jaw forward by the thumbs of the anesthetizer placed behind the rami. Thereby again the above-named muscles and ligaments are made somewhat tense, also the genio-hyo-glossi muscles, and in turn the glossi-epiglottic attachments; and the epiglottis is thus lifted.

Should our difficulty be with foreign matter in the pharynx and mouth, here we use sponges on long holders. Often the gag meanwhile is necessary. Vomiting implies insufficient anesthesia, and a tendency to vomit should be met

promptly and prevented by pushing the anesthetic, until this reflex is subdued.

One need hardly remark that the operator imperils his patient's life who does not insist upon five or six hours' prior abstinence from food. But occasionally a patient disobeys the injunction and does not confess. Then too, we occasionally, if rarely, meet a case where from previous muscular atony of the stomach, or from obstruction at the pylorus, or from nervous gastric inactivity due to fear of the coming event, food eaten even twelve and twenty-four hours earlier is vomited during the operation.

Should a portion of this be inhaled, it will probably catch in the rima glottidis. In that case, inverting and shaking the patient must promptly be tried; and if imminent suffocation compels, the operation of laryngotomy must be done, which takes less time than the reading of this sentence. It is a single, transverse thrust through skin and crico thyroid membrane, entering the air-space well below the chink of the glottis.

Under (*b*) we may try:

1. Laborde's method of rhythmic traction upon the tongue, quite vigorously, and about as frequently as the normal respiratory act.

2. Dr. W. Gill Wylie's plan, which is to seize a handful of the belly-wall, about the region of the navel, and to lift it sharply forward, away from the spinal column. At once the patient gasps, from reflex stimulation. This is repeated again and again until normal respiration is established.

3. Stretching the sphincter ani vigourously with the thumbs.

4. Ice slipped into the rectum, or placed against the nape of the neck.

5. Slapping the chest and abdomen with towels wet in ice-water.

If the patient be "under to the surgical degree" it is plain that such methods as the foregoing, dependent as they are for success upon reflex stimulation, cannot be really effective until a portion of the anesthetic is eliminated from the blood and the reflexes return. Hence the use of:

6 Large hot saline injections, by rectum or a vein; acting more by direct effect of hotter blood upon the respiratory center than by reflex action.

7. Various methods of artificial respiration, such as Sylvester's, Hall's, Schultze's (with little children); and several more. Those just named are too well known to need description. We may say a word, however, as to the tech-

nique of certain others. Kœnig's plan is intermittent pressure with both hands about the chest, one of the thumbs being placed in a space *over the heart* (differing simply in this latter respect from von Nussbaum's method) between the apex-beat and the sternum. And Maas' modification of Kœnig's, is one whereby the pressure aforesaid is made very rapidly—one hundred and twenty times a minute—instead of at the ordinary respiratory rate of speed.

All of these methods would seem to act mainly by frequent expulsion of narcotized air, and admission of fresh; though Kœnig and Maas claim for the thumb in one of the præcordial spaces a mechanical stimulant or irritant effect upon the heart, as well.

8. Insertion of a soft catheter down the larynx and trachea, and use of the operator's lungs to replace narcotized air by fresh.

9. The bellows-method: A special and ingenious mechanism for removing exhausted or poisoned air, and replacing it at each stroke by an equal bulk of pure atmospheric air.

10. Inhalation of oxygen, while efforts at respiration are being artificially maintained. Every well-equipped operating-room should be supplied with a canister of oxygen, against such an emergency.

11. Electricity. (See p. 46 of this pamphlet.)

12. *Drugs.* Of these, atropine and strychnine, both by needle, are our chief reliance. Both have the value, beside being active respiratory stimulants, of being also vaso-motor tonics.

II. HEART TROUBLE.

We now come to the study of the cases in which the leading or the sole factor is heart failure; the respiration meanwhile continuing with a fair degree of regularity and effectiveness. Such instances are more often seen in chloroform- than in ether-narcosis. Sundry chloroform commissions have agreed in reporting that dogs die as a rule by respiratory failure, under chloroform. But while this is possible also in the case of human beings, surgeons know that, with the latter, more frequently the heart fails first. Therefore, a good anesthetist, though watching the breathing, *never removes his finger from the patient's pulse* while exhibiting chloroform. With ether this is hardly so necessary, the respiration being then the danger-signal.

1. *Inversion of the Patient.*—This, the plan of Nélaton,* should be regarded as our first

* The story so current, of Nélaton and the mice, is incorrect. It has this basis of fact, however, that Nélaton *junior*, when a child, having as he supposed killed some mice with chloroform, was directed by his famous father to suspend one by the tail; whereupon it recovered. Thus Nélaton applied for his boy's instruction, a lesson from his own experience in surgery. It will be

choice when the heart is mainly at fault. No one could read without conviction upon this point the graphic account* of a patient upon whom, when threatened with death from chloroform, Nélaton practiced inversion three several times with final success. The first time she remained inanimate during fifteen to twenty minutes, and at length Dr. Sims believed her dead. When the pulse finally began to be noticeable and she was deemed safe, she was changed from the vertical to the horizontal posture. Instantly all signs of life ceased. Again was the patient promptly inverted, and after an apparently even more hopeless fight than before the heart resumed work. Once more the recumbent posture; again, seemingly, death; again immediate inversion. This third time Sims thought her case to be surely hopeless. But not so! And when the heart-beats were at length felt, no one dared to let her lie down until she was both wide awake and kicking vigourously.

Dr Sims remarks that recovery after *one* inversion might not be conclusive proof; but that the *three* collapses successfully met by

seen that this reverses the story as usually told. It is here given upon authority of the Junior Dr. Nélaton, who says that he subsequently tried this experiment upon mice "forty or fifty times or more, and always with the same unvarying result." (Dr. J. Marion Sims, "The Story of My Life," pp. 324-325.)

* Dr. J. Marion Sims, *ibid*, pp. 321-324.

three inversions, in this lady's case, were to him utterly convincing as to the extreme value of Nélaton's plan—to whose coolness in this emergency he also pays high compliment.

(It is to be regretted that the lack of knowledge in those early days as to the proper technique of chloroform-exhibition, and especially as to the modes of *prevention* of such peril as that described above, should have induced Sims to throw the weight of his influence in America against this anesthetic.)

It would be hard to exaggerate the practical value of this plan, although the accuracy of the physiological explanation usually given by way of accounting for its effectiveness may be questioned. Thus, we commonly read that the inversion causes blood to be poured by gravity from the lowermost parts of the person into the anæmic brain, which is thus stimulated to send forth more vigourous nerve-power to the failing heart. To the writer it seems plain that this is only in part the true explanation, and that, in fact, it can only apply to such blood as may be found in the neck and upper part of the chest. In only one way can blood from any point between the heart and the feet reach the brain, if the patient is inverted; i. e., by being pumped through the heart. Certainly it can *not* by gravity alone. And since we know that me-

chanical distention of the chambers of the heart by the circulating fluid is a most important factor in exciting cardiac contraction, the proper explanation is not far to seek.

Probably no other operator has relied more fully upon this one method than has Dr. Chisolm of Baltimore; and yet although his extensive record of operations under chloroform (more than ten thousand without a death) makes his opinion deserving of respect, we think there are few who will, with him, stick to inversion alone, and refuse to use artificial respiration—in order to hasten the exit of the narcotized air—and other valuable aids to resuscitation, in addition to Nélaton's plan. Nélaton himself used artificial respiration *plus* inversion.

The writer would here urge the general use of the following method, which has several times been used successfully in his clinic, and in the employment of which his assistants are trained:

BEST METHOD.

Upon the appearance of heart-failure during the anesthesia, the patient is slid down the table until his legs drop beyond its lower end, thus making a right-angle with the thighs. The table is now inverted; it is turned head downward. Consequently the patient is instantly in Nélaton's position, and his arms drop loosely on either side of his head. One assistant, only, is needed

to hold the patient in place, and this is done by clasping the ankles, the legs giving an abundantly long leverage for the maintenance of the right-angle just mentioned.

Now, the operator, facing his inverted patient, seizes the lower part of the chest with both hands and compresses and relaxes alternately (method of von Nussbaum); his left thumb is in the intercostal space which seems most nearly over the heart (Kœnig); and the acts of compression aforesaid are very rapidly repeated—as much so as possible (Maas); thereby the more quickly pumping out poisoned air and pumping in pure air. In addition, it will be noted that following each such emptying of the lungs by the surgeon, the Nélaton posture (by dragging on the pectoral muscles, through the weight of the arms hanging by the sides of the patient's head) causes a mechanical inspiratory act after Sylvester's principle. So that at one and the same time, by the writer's simple suggestion, we can carry into effect the various treatments recommended by all five surgeons named.

This fact need not of course preclude the use of yet additional plans, if thought best, at the hands of assistants.

The method of Hill (abdominal compression, the patient lying horizontally upon the table

meanwhile) which forces blood toward the heart, while obviously of some value in heart-failure is certainly less efficient for such purpose than gravity, by Nélaton's position. The same is true of tightly bandaging the lower extremities.

2. *Heat.*—It cannot be questioned that among methods of exciting a narcotized heart to resume work one of the most efficient is heat.* A quart or more of water (normal salt-solution preferred) as hot as the hand can bear, poured through a funnel, or by irrigator, into the rectum while the patient is inverted as just advised, is standard treatment. (The average capacity of the large gut, colon and rectum together, is nine pints). Of course, if coffee is at hand, this, or other *non-alcoholic* stimulants, may be added to such enema.

The patient's body and limbs should not be left uncovered to be chilled, but should be wrapped in warm blankets. This po nt s important, and too often neglected.

Moist heat applied over the heart is of much value. The late Dr. Sands, of New York, used it repeatedly, to the writer's knowledge, who has seen not only this gentleman but several

*The writer places it only second in value to Nélaton's posture, and thinks it should always be used as soon as the patient is inverted.

others of the best known surgeons of New York cause a blister several inches square on the præcordium by application of steaming hot cloths during dangerous anesthesia-narcosis.

Dr. Charles McBurney said some years ago in a letter to the writer: "When the heart flags seriously in ether and chloroform-narcosis I regard very hot applications directly over the heart as of decided value as a means of stimulating that organ to renewed activity. * * * I like the idea of your intravascular hot saline injections very much, and shall use it at the first opportunity."

The latter sentence has reference to a plan devised by the writer, whereby heat may with infinitely more directness and efficiency be brought to bear on the heart. This is *to introduce hot salt-water directly into the blood-current*, and thereby to stimulate both the heart and the respiratory centre in the medulla.*

This is so self-evidently a useful proposition as hardly to need argument in its defence. (See article upon "Anesthesia Narcosis" in Vol. IX, *Wood's Reference Handbook*, in which the writer first suggested it).

If, as is generally admitted, heat applied over the heart can stimulate that viscus—whether

* The hot enema, advised on a previous page, acts similarly, of course; being in part absorbed from the bowels by the vessels; but in an ugly case, more speedy heart-stimulation than this is called for, additionally.

directly, by extension through the chest-wall until felt by the apex-beat, or reflexly—how much more efficient must be that stimulation when that heat is brought directly into the heart-chambers, in the blood! The method has additional value as a heart-stimulant by increasing the bulk of circulating fluid, and thus accomplishing in a different way what Nélaton's posture does.

Four points have here to be considered: (*a*) the place of entrance, (*b*) the solution for injection, (*c*) the proper temperature of that solution, (*d*) the proper amount.

(*a*). In most cases, perhaps, a vein or an artery in the operation-wound will offer almost instant entrance to the canula; if not, it is the work of but a few moments to expose any superficial vein, for instance, the median basilic.

(*b*). The fluid used should be the "normal* salt-solution," which is six-tenths of a part of common table-salt per hundred; roughly, a heaped teaspoonful to the quart, boiled and filtered. At the present writing this is always kept at hand during severe operations by

* *Normal* in the sense of corresponding with the proportion of Na Cl in the blood; and not with the chemical use of the term *normal*.

Let it not be forgotten that *plain water* (devoid of Na Cl) thrown into the blood in any considerable amount is promptly fatal by disintegrating the red discs. The writer has witnessed this result, upon the dog.

most surgeons, for another purpose; namely, to *prevent* shock when this is feared, by using intravenous saline infusion while the patient is still on the operating table.

DIGRESSION UPON SHOCK.

As a brief digression, the writer begs to remark that since the autumn of 1891, this plan of *prevention* of shock has been in use at his clinic, as a consequence of some months of experimental work upon dogs, with hot saline vascular infusion after bleeding; testing intra-arterial pressures, at differing temperatures of the injected fluid, with the kymograph and the mercurial manometer, in the Columbia College physiological laboratory during the winter and spring of '90—'91. So far as known, other surgeons did not until later adopt this plan against shock.* In evidence is submitted a brief quotation from the writer's article in the *N. Y. Med. Record*, Jan. 2nd, 1892. "Whoever has seen cases of cardiac failure upon the operating table, whether from anesthetics or from other causes, knows that surgeons rely much for resuscitation

* A careful study of the Index Medicus and the N. Y. Acad. of Med. library justify this statement.

Dr. F. Lange did, however, in 1888, advocate water *by rectum* to prevent shock, where a very bloody operation was anticipated; and Drs. Weir, Tiffany and others approved.—(*Trans. Am. Surg. Ass'n.*, Vol. VI, p. 540 *et seq.*)

upon the application of almost (or quite) scalding hot, wet cloths over the heart. As in many such instances the patient is devoid of reflexes, being completely anesthetized, I must believe that the undoubted stimulating effect of these applications is in such instances due to the direct extension of heat until felt by the cardiac ganglia.

"Whoever has noted the vigour with which unstriped muscle, everywhere, reacts to the use of heat—for example, the much stronger and decidedly more permanent uterine contractions which result from hot post-partal injections, as opposed to cold ones—must believe it probable that such unstriped muscle, forming as it does a most important tunic of the blood-vessels, would be greatly aided by *hot saline infusion* in regaining its lost tone. Perhaps, too, the central sympathetic centres would feel and respond to this stimulus.

"Now, since a more vigourous cardiac action, accompanied by a somewhat restored vascular tone, would go far toward recovery, both from hæmorrhage and its attendant shock, I have felt that the experiment was well worth trying."

Again, a quotation from the writer's article in the *Med. Record* of Nov. 12th, 1892: "And why would it not be well, at the end of any and every operation grave enough to make shock a probable result (though, because of the ether, not yet

at hand) to inject subcutaneously a quart or two of hot salt-water? It would be painless, the patient not yet being out of anesthesia. It would certainly be harmless. And I believe it would do much to *prevent*, by maintaining filled blood-vessels, otherwise fatal shock from developing. *It seems not improbable that we shall ultimately see this done as a matter of routine, after all severe operations.*" At that date the writer had tried the method in but very few instances to *prevent* shock, using a pint or more within the vessel, and a pint or more in the cellular tissues; and of course could not speak, as all can to-day, with absolute certainty as to its value.

Where the gravity of the operation, or severe loss of blood, make shock a probability, let the surgeon use the "ounce of prevention" by *striking first*. If he waits to treat shock until it has already struck its deadly blow at his patient's vitality, experience teaches that very likely no means at his command can then save the victim.

The writer discusses the matter here and now, both by way of further explanation as to why the hot saline infusion is of such value (against both shock and narcosis), and because it explains why the operator should always have hot salt-water at hand, for either indication.

(*c*). The proper temperature for the injection fluid is *as hot as the hand can bear* (both for treating narcosis and for prevention of shock; upon which point see the writer's experiments, *Record*, Jan. 2d, '92, quoted). This will be about 118° to 120° Fahr.* Of course the temperature at the *heart*, when the great bulk of blood has diluted the slowly entering fluid, will be much lower than this. There need be no fear of injuring the blood or other tissue by such heat. Very many times, (against shock mostly, of course), the writer has now used it, as hot as the hand could tolerate, and never with cause for subsequent regret.

(*d*). The proper amount to be injected against heart-failure from anesthesia may be set down as at least one pint; a quart if the gravity of the symptoms does not abate. It must for this indication be started promptly—the patient being in Nélaton's position meanwhile—but we must avoid excessive speed of flow. Take five minutes at least, for a pint; and stop as soon as distinct improvement in the pulse can be noted. (But to *prevent shock* where there has been severe bleeding, the writer never, in the

* This fact has very recently been re-verified by Dr. R. C. Kemp, also in the Columbia laboratory; showing that 118-120° F. best stimulates the heart.

adult, uses less than a quart, intravenously, and often three pints or more, according to effect; and occasionally has to repeat this within a few hours; and in ugly cases, perhaps yet again. But almost equally efficient in prevention and treatment of shock is the long-continued hot salt-water enema* *post operationem*; the foot of the bed being elevated meanwhile.)

3. *Cold.*—Although not so efficient as heat, the application of a piece of ice over the heart, or slapping the præcordium with a towel wet in ice-water, will sometimes reflexly excite more vigourous contractions. It will be useless if the patient is under anesthesia "to the surgical degree," for most of the reflexes are then abolished.

4. *Use of Drugs.*—Our fountain syringe and canula are still in place—the latter tied within a vein. Either mingled with the hot salt-water, or preceding it, or following it, we may use properly diluted *aqua ammoniæ*, a remedy of unquestionable value. The latter with strychnine and digitalis comprise all the drugs recommended as of real use in this condition by Dr. H. C. Wood, in his Berlin report in 1890; who, however, did not experiment with stro-

* This is best maintained at an even temperature, and without soiling the bed, by use of Dr. Kemp's double-current rectal tube. (Reynders & Co., N. Y.)

phanthus and many other heart-tonics. He says: "From fifteen to twenty-five minims of the aqua ammoniæ fortior, diluted with four times its bulk of water, should be thrown directly into a vein of the arm, and repeated in fifteen minutes if necessary."

The only hypodermic abscess for which the writer has ever been personally responsible was caused by an injection of aqua ammoniæ—and not the *fortior*—in a case of extreme opium narcosis with a failing heart; not injected within a vein, as it should have been, but into the subcutaneous connective tissue of the thigh. A slough more than an inch across resulted. The same drug may be exhibited by inhalation, with distinct caution, as it is capable of causing violent local inflammation when used in excess.

Regarding *amyl nitrite*, recommended by Burrall and others, Wood found it inefficient on dogs. Paralyzing as it does unstriped muscle everywhere, and consequently completely dilating the blood-vessels, it must inevitably diminish the resistance, caused by vascular tone, against which the heart has to work in pumping blood; and is hence an indirect heart-stimulant. If that tone be lost from complete narcosis, then it is plain that in such cases, at such time, this drug would be almost useless, since its *direct* stimulant effect on the heart is

but slight. Now, as Dr. Hare points out,* paralyzing and dilating the blood-vessels is just how chloroform kills. So that amyl nitrite may be said to do more harm than good.

Strychnine has already been discussed. Both as a heart and vascular tonic and as a respiratory stimulant it is of great value.

Regarding *digitalis*, the testimony is equally strong so far as the heart and vessels are concerned. The writer carries regularly to his operations a solution of strychnine sulphate in equal parts of the tinctures of digitalis and strophanthus, and has repeatedly used this combination by hypodermic needle with benefit.

Strophanthus alone he has not employed. However, since it is more rapid in action than is digitalis, and stimulates the heart vigourously and very much like digitalis, it would seem obviously indicated.

5. *Electricity* in the treatment of anesthesia-narcosis is mentioned rather with disapproval by most recent writers. Although the poles are applied to neck and epigastrium, to stimulate the phrenics, the current would seem as likely to stimulate the pneumogastrics and thus help to stop the heart. The writer has not personally been convinced that it does any good in these cases.

* See pp. 21–22 of this pamphlet.

Two remaining devices the writer has never seen used; but cannot doubt that they may be of value in absolutely desperate cases. This has been repeatedly demonstrated on the lower animals. One of these is—

[echanical stimulation of the heart by a long, slender needle passed through the anterior chest-wall (D. W. Buxton).*

7. The other, introduction of a finger through a cut in the præcordium, thus permitting intermittent pressure on the heart through its uncut pericardium; to be repeated some twenty times, at the rate of seventy or eighty times per minute. It is not necessary to empty the heart thereby; a slight pressure will drive on some blood. (G. Rowell).†

In conclusion, it is perhaps needless to say that surgeons employ not one alone but as many as are deemed wise, at once, from this list of weapons against an enemy that comes unexpectedly, and kills quickly if at all. The writer has endeavoured to indicate which methods among all of these are most to be relied upon, so far as his personal experience enables him to judge.

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* Anesthetics, 2nd edition, 1892, p. 122.
† *Brit. Med. Jour.*, Oct. 29th, 1892.