Hydrate of chloral and nitrous oxide gas as anaesthetics / by Charles Kidd.

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NITROUS OXIDE GAS

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ANESTHETICS.

BY

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I WOULD wish to supplement some former observations on anesthetics by a few remarks of a practical kind on a further three years' experience of nitrous oxide gas, chloroform, chloral hydrate, and one or two other agents of this class. The nitrous oxide begins to be used now mixed with atmospheric air, which allows it to be adapted to long operations, and much improvement has taken place in ophthalmic practice in "quick anesthesia," especially at Guy's Hospital.

The present year will be sadly memorable, for establishing in field hospitals, during a terrible and prolonged war, the great value and importance of two new anesthetic or narcotizing agents, the hydrate of chloral and nitrous oxide gas; of the latter, I took an opportunity of specifying its peculiar physiological advantages in short operations, a little while ago, especially in removal of small tumours, dentistry, &c. Military surgery, we need scarcely remark, differs in little from ordinary civil surgery; primary operations are now indeed facilitated, "shock" lessened, excision of joints or extraction of bullets or fragments of shell, made easier, by those benign and quick-acting agents, nitrous oxide, for which it is indebted to dentistry, and hydrate of chloral, so advantageous either with or without chloroform.

The chief reasons for dwelling on this "gas" are, perhaps, two—viz., its greater safety; and now the chance of its being more used in practice, as it has been fluidified. There is, indeed, now an excellent variety of pain-removers or anesthetics; the wounded, notwithstanding conical bullets, needle-guns, and *mitrailleuses*, have reason to bless the happy discovery of chloroform, nitrous

oxide, and chloral. Something like £250 was given in donations, in London, recently, by the public, specially for their purchase, to be sent to the seat of war; at a time, perhaps, when also there existed considerable though idle prejudice to chloroform, together with the old ideas of stuffing all incised sabre wounds with lint and cotton! Short operations are best done with the nitrous oxide, as I had an opportunity of explaining now some two years since, when it was by theory very generally condemned as the most deadly of all anesthetics on animals. That supposition has not been realized in man. Reference was then made to the influence of this gas on the muscles, so different to chloroform, the peculiar "twitching" and stimulating action, and the astonishing rapidity with which the effect of the gas wears off. The exact cause of death from chloroform, or the causes of at least three forms of accident, as Mr. Erichsen would say, are yet subjects of debate. These causes are probably to be eliminated by what Mr. J. Stuart Mill would term the "method of agreements" and differences. The deaths are typical of one or other of three kinds; agreeing now with the phenomena of apnea, now again agreeing with shock or asphyxia, &c. The statistical or chemical school says there will be always one death in some even factor of hundreds of operations, like shipwrecks, and it is as little use to strive to prevent one as the other!

The deaths to me appear rather special, well marked, or typical, from chloroform, and in many instances to be prevented by quick and skilful use of electricity, artificial respiration, turning the patient over on his side, so as to relieve the engorging heart, &c.

In estimating the alleged greater danger of chloroform, we should not overlook the inconceivably greater number of times it is used as compared with the ether or methylene compounds all over Europe; the number also of deaths that may be simple coincidents, which before the era of chloroform were ascribed to "shock." It is, however, a vast relief to the minds of many surgeons that in practice, whatever theory may say to the contrary, deaths are almost unknown from even the deepest narcotism of nitrous oxide, and that most probably the "cardiac syncope" idea of Clover and others is entirely erroneous as to chloroform.

These general formulæ of pure chemistry, as to voltaic narcotism, ethylo-methylic ether as superior to the chlorine "family," the invariably deadly effects of nitrous oxide gas on animals, &c., require, in fact, the correcting influence of large hospital experience.

Military surgery, indeed, as just hinted, aided by the efforts of the public, will have solved the difficulty, in conjunction with the ever increasing demand for the "gas," in the condensed form. It may be true, that nitrous oxide gas, by theory, is the most deadly of all anesthetics, or that blood coagulates only by escape of ammonia, as theory supposes; but the chief physician at Guy's tells me, though their school originated the latter fancy, they do not now believe it in actual practice. Amputations under the "gas" are now numerous; in one, the patient was nineteen minutes under its influence. Its immense safety is its chief recommendation. It stimulates in "shock," so that we cannot be led solely by formulæ or theory. Its action to the patient is pleasant, and there is no vomiting (the great trouble of unskilful chloroform administration).

Next let us speak of the chloral hydrate, large quantities of which were eagerly asked for in the war. We hear now of large amputations under a draught containing this new medicine, thus suddenly realizing the magic in the potion in *Romeo and Juliet*, the borrowed likeness of shrunk death:—

"That cold, sad, drowsy humour which shall seize each vital spirit."

A very extended "Report" on the chloral hydrate was given not long ago, with remarks on its effectiveness as a sedative and sleep-producer in sundry nervous affections. All that report I would wish to endorse or further exemplify. Since then these various uses of this agent have been very fully corroborated, especially in the experiences of the Edinburgh school. It is now found that the chloral hydrate furnishes us with a safe and satisfactory means of rendering operations in midwifery more easy, as well as taking away pain in the first stage of childbirth itself, producing that wished-for calm and invigorating sleep usually observed as the first effect of administration of chloroform in that state. This sleep, indeed, in midwifery practice, always strikes me as half the battle in a case, as thereby the labour is made more active and safe. Additional experience, year by year, does not diminish, if it does not increase, the anxiety of the public as to the much dreaded chloroform; especially (as we have so often contended, though so difficult to explain,) in short, slight, or trivial operations—death, sudden, and when least expected—the nitrous oxide gas, now liquified, on the contrary, as safer and pleasanter in administration than chloroform, has had, therefore—as I explained two years ago—an easy triumph, especially in the trouble of teeth extraction and

dentistry generally, while for bullet extraction during the war, Dr. Thudicum has recommended it, but this chloral hydrate may supersede both.

Actual facts, in surgical practice, are often in curious contradiction to what theory in the laboratory, unsupported, would suggest. I have for several years dwelt on a fact that Dr. Richardson has recently learned, that adult persons in rude health, nervous or alarmed, about to undergo a surgical operation, are those most difficult to be anesthetized. It is Millar's "law of tolerance," and nothing can be more exact than the original idea. The accident does not occur in shock, exhaustion, or deep coma. Richardson likewise assumes, from experiments on an already dead rabbit, that electricity will not revive it, as electricity by theory exhausts the remaining physical or nervous force, &c.; but practically, in hospitals, electricity is now our one great hope, but is seldom applied correctly. Electricity, in fact, sets up the best form of artificial respiration in apnea from chloroform, or in drowning cases.

A few technical or empirical facts may be here worthy of being noted, or perhaps repeated.

The plan of alternating ether with chloroform is a good one; the ether in a separate inhaler, which restores a flagging pulse better than anything else I am acquainted with; 20 or 30 drops of sal-volatile in a little water immediately before operation, is also better than brandy. An aloetic purgative the night before an operation helps to prevent vomiting. Bichât tells us that the carbonic acid of venous blood is the proper stimulus of the lung; so that it is to be feared oxygen gas as proposed for inhalation will not prevent death from chloroform; transfusion of warm water with ammonia would be better worth trial.

The explosive, or rather expansive, power of the condensed nitrous oxide—something at one time compared to a soda water bottle, then to a pocket pistol—has been partially got over by further condensation of the gas into a liquid.

The respiration is, perhaps, more important to watch than the pulse. They are, shall we say, rather opposite swings of the pendulum that regulates the heart circulation. This is applicable to the administration of the gas as well as the administration of ether or of chloroform. The nitrous oxide must be used at first undiluted with air to secure insensibility. But it is advisable in prolonging the action of the gas that it be mixed with air. An immense trade is now carried on in this gas, and some five thousand gallons of it have been despatched to the seat of war, in Paris!

It is worth remembering that very complete anesthesia may be produced by injecting the venous blood of the jugular into the carotid artery of the same animal; nay, that anesthesia is sometimes possible without complete unconsciousness.

Cardiac syncope is caused by stimulation of the inferior branches of the vagus, as mentioned several years ago, but it has recently been put forward as new by the chemical school, with the further explanation that this stimulation results from the venous condition of blood. Brown-Sequard and Scheinessan have discussed the point. But experiments in the laboratory, or on animals, where the latter are simply suffocated, it cannot be too often repeated, are not the same as cautious experience with anesthetics on man, where every possible care is taken that accident or smothering shall not take place; hence the errors of the chemical school. We have practically very little to do in hospitals either with "syncopal apnea," or suffocation of animals in 20 per cent. of chloroform, as exhibited in popular lectures, with suffocation by prolonged nitrous oxide gas; and surely, if cardiac syncope is caused by the venous condition of the blood, the venous condition of the blood under this "gas" is most alarming, and yet without cardiac syncope.

The most lamentable results occasionally arise at coroners' inquests, or in other legal proceedings, as I have elsewhere explained, from this popularizing of the idea, that chloroform, as at lectures, is a most deadly agent under every circumstance, whereas, with care and average skill, it is as safe as any other anesthetic.

Military surgeons need not be afraid of these deadly experiments, or syncopal apnea, or electricity in impending death. All goes right while the respiration, as just said, is good; but now fifteen grain doses of the chloral hydrate, repeated two or three times, will produce a state like the sleep of chloroform. Three cases of tetanus, after the battle of Sedan, were wonderfully relieved by the chloral hydrate. Military surgery is thus improved.

Surgeons in war should have correct views on such chloroform accidents. A now dead superstition as to large balloon apparatuses had impeded progress, and been the cause of several deaths and actual imprisonment of a surgeon in China because death had happened!

In a word, sudden accidents from a cautious administration of chloroform in small half-dram doses, where alarm in the patient's mind, exceptional depression, or idiosyncrasy, are at work in causing syncope, are most probably altogether unlike the state

of the system in animals, slowly suffocated by large doses. This syncopal apnea which alarms popular audiences, as well as the always deadly action of the nitrous oxide gas, at least on the lower animals, are also not consistent with plain hospital experience. And so is it, as far as I have seen now in at least a dozen cases of impending death from apnea, where electricity has restored life, we cannot say exactly when the physical or nervous force is in danger of further exhaustion, though theory at popular lectures may do so. We cannot say mere physical force is nervous force and nothing else, as the chemical school would do.

The controversy, indeed, widens till, as old Burton says, somewhere to cut down one head of this hydra, is to give occasion for another head to spring up. Military surgery, however, as said, is improved *malgré* the denunciations against the nitrous oxide and chlorine "family," or popular solemn balloons, or fright of heart disease. Dr. Chapman very early established the nature of death from chloroform as attended with dilated right heart. Lallemand and Perin have superabundantly demonstrated it. Dr. Richardson has stated the idea again as new, but with a supposition that in such accidents the patients ought to be sickly, with varicose veins and other indications of heart disease, or sluggish venous system, and yet we know as a rule they are persons in rude health, generally for trivial operations; in the administration of the nitrous oxide, on the other hand, there is intense congestion of the venous system, but no danger, so that we are met with contradictions or anomalies at every side; a livid, cold, death-like appearance, as I described before, with venous congestion, suffocation, and impending death, but still not the least danger; and so is it, one sometimes thinks of chloroform as one has seen it, and in over ten thousand administrations without one death, yet in "sensation" lectures with the electric light and camera, skin diseases in London, and death always under chloroform from heart disease, and this meaning malpraxis so dear to coroner's juries, theory opposed to every day observation, the instinct of the public right to subscribe nevertheless, disbelieving in fatalism and statistics, painless dentistry only by voltaic narcotism or ether spray, all these things keep up a good deal of popular error that it is well to understand.

Yet thus we go on widening the controversy as to these several agents, popular errors not diminished, theory often opposed to plainer practice, the nitrous oxide condemned but adopted by the public.

The changes in the blood during the action of these medicines is also suggestive and peculiar. Formiate of soda, according to Liebriech, one of the results of the chloral administration, while with sulphuric ether the blood corpuscles are altered; less so under chloroform. But during the use of the nitrous oxide the presence of this gas cannot be detected, even by spectroscopic help or other test, so that it (nitrous oxide) seems to induce a form of asphyxia by mere absence of air; these several changes of the blood taken in connexion with divers experiments with ammonia to re-act on the deadening pyemic poison of puerperal fever, as explained to me by my excellent friend Dr. Tyler Smith, open up a new vista in practice of great hope and promise. Theory has already condemned Dr. Tyler Smith also, but further practice does not do so, the theory that condemned the nitrous oxide gas! Laboratory theory or speculation, as said so often, has condemned the nitrous oxide as inferior to some methylic ether and methylene compounds; Voltaic narcotism, or ether spray in dentistry; several alarming deaths have occurred from bichloride of methylene, but none perhaps that can be fairly ascribed to the nitrogen protoxide, though exhibited now in some hundreds of thousands of cases. The methylic ether also having proved dangerous, if not useless, in general practice, so that we cannot trust too much to laboratory ideas built up on the molecular composition of methylene or chloroform. Nor am I sure there is any solid foundation in this condemnation of the "chlorine family" of anesthetics that would deny all usefulness to the chloral hydrate; a new school with a dogma of infallibility is, however, now in power in London, where the patient's mental or nervous state before taking an anesthetic counts for nothing, and theory sets aside clinical teaching, with its slowly arrived at but invaluable facts, for superstitions worthy of Apollo or Paracelsus, as to three and a decimal per cent. of vapour in a balloon, with patent stop-cocks, as above, thus only safe, else (in China) it proves manslaughter if death occurs. No matter, numerous deaths already with the impossible cocks and valves, so like the invariable danger of the nitrous oxide condemned, as just said, by abstract theory, but adopted by the public; or like the chloral hydrate of the deposed chlorine family, or dynasty, the controversy widens, but military surgery and the public have been benefited—*nos mentimur omnia.* "We are all deceived at times," says Plautus. The wounded and sick now, as in the Crimea, were a month without chloroform—the public at first frightened—we only strive to smile away these fears.

"What a blessing from Heaven is this chloral hydrate," exclaims Dr. Marion Sims, as he walked through his tent hospital at midnight, the day after the battle of Sedan; 400 poor, amputated and wounded, at rest, quietly asleep. American humanity had broken through the harsh circumlocution rules that would prohibit anæsthetics, harsh chemical theories, false notions of the dread danger of nitrous oxide, chloroform, &c., that so bewilder the English public. And yet amputations under this gas or the "chloral" are now admitted to be quite safe. What a blessing! Yet, Christmas of 1870—a time of peace on earth, good-will to men—war still, and even at Paris; chloroform neglected, at least in the florid picture galleries at Versailles, turned into hospitals.

Verily, curious contrasts for future English war studies. Quarter of a million sterling, subscribed for medicines for wounded and sick; but 35,000 deaths at the surrender of Metz, "chiefly from medical neglect:—no chloroform for three weeks; amputations terrible." Fisher, of Breslau, bravely fighting with this neglect, gives, however, 34 resections at Metz, 30 recoveries. Lint and cotton "sufficient for thirty years' war;" bandages that would "go round the world," we quote the words of men on the spot; but chloroform forgotten.

Curious old remembrances, then or now, of how, at Lucknow, Havelock's poor soldiers melted away from like causes. In the Crimea, too, where our great ally at that time lent us 300 mules and ambulances, and chloroform—as these were things too trivial for commissaries or adjutants to attend to, not that we blame the excellent efforts of the Geneva convention or "red cross" surgeons.

The Dutch and Americans have done best, as voluntary aids, in this war of 1870; our only want was practical knowledge or organization. "Troops without tents; bivouacking in mud—a mud composed of earth, filth, tramped corn, rice, hospital dressings," says Humphrey Sandwith, of Kars. Savage Africans could have been bivouacked better. The medical profession snubbed, while lords are ready to command a fleet or perform a surgical operation. Conservative surgery, that saves half the deaths, pooh poohed!—Conservative surgery, another name for chloroform surgery.

Need we any specification of how the chloral hydrate is to be administered in twenty grain doses dissolved in wine or mint water, to procure ease from pain? Our error in the Crimea was that because a soldier brought in wounded was exhausted and could not

have chloroform now; that he could not have it twelve hours hence after reaction from shock. Soldiers do not die for want of cotton to plug into fresh sabre wounds, as feared in Waterloo times. A gypsum bandage would be more useful in fracture, or silver suture to sew up such sabre wound. "Pain," said a Horse Guard's circular, in the Crimea, "is a healthy stimulus." Brave soldiers do not want such a weak womanish thing as chloroform. Poor wounded soldiers waited their turn at a canvas tent to be amputated, listening to the shrieks of those inside; what hours of anguish, sinking, and despair; and so was it at Metz, and in a minor degree at Versailles.

But yet, finally, civil practice tells us pain is not a stimulus, but a leveller, or agent of destruction. Travers and Dupuytren bear us witness in this. And of "rest" for the shattered leg or arm. What experience have we had of Mr. Hilton in a thirty years' watching at Guy's? Surely no stimulus is pain, or nights without sleep, tossing about, mental agitation, anguish, torture. Of the soldier we may say as of *Lear*—

> "Our foster nurse of Nature is repose,
> That which he lacks—but to provide in him
> Are many medicines, operative, whose power
> Will close the eye of anguish."

But it required the humanity of good men to prove this; nor can it be proved too often for present, and, aye, for future men who esteem the Geneva red cross.—"Many medicines, operative"—the chloral hydrate superior to chloroform in procuring sleep, and that repose necessary for satisfactory recovery.