

AN ESSAY
ON THE
ABUSE OF NITROUS OXIDE.

BY
GEORGE T. BARKER, D.D.S.,

PROFESSOR OF DENTAL PATHOLOGY AND THERAPEUTICS IN PENNSYLVANIA COLLEGE OF DENTAL SURGERY.

WITH DISCUSSIONS UPON THE SAME, BEFORE THE PENNSYLVANIA
ASSOCIATION OF DENTAL SURGEONS, FEBRUARY 13, 1877.

REPRINTED FROM THE DENTAL COSMOS, MAY, 1877.

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NITROUS oxide, as an anæsthetic, has been extensively used for about twelve years, and has proved to be in many respects efficient when judiciously administered. At the same time it must be admitted by its most extravagant eulogists that it has been exhibited indiscriminately, by those unfamiliar with its properties and appropriate uses, while the laudation that it has received by daily advertisements in the public press, which have been continued without contradiction, has led the general and even the professional public to regard it as entirely without danger, and incapable of producing harmful results.

My object in this paper is to direct attention to these errors, and to raise a warning voice against the indiscriminate use of this agent. In almost all large cities in the United States the business of extracting teeth has been taken out of the hands of regular dentists. I say "regular," because I consider that the practice of dentistry must necessarily comprise, primarily and principally, the preservation of natural organs, and not their destruction. I make the statement as irrefutable, that no one, however well instructed or dentally educated, can continue destroying organs without attempt at restoration of them to health, and at the same time be competent to decide that they cannot be preserved by judicious treatment. There is another view which we must not disregard, and that is the fact that pecuniary interest is in favor of their destruction, instead of their preservation. I refer to those establishments where nothing but extraction of teeth is performed. In one of these with which I am familiar, the operator

does refuse to extract teeth under the treatment of a dentist, although importuned to do so by the patient; but if this request is backed by the desire of the family physician, the teeth are extracted. In two cases recently in my own practice, teeth were extracted, in both instances the patients being unrelieved by the extraction, and in one case the existing neuralgic tendency from dental irritation was so far increased as to confine the patient to her room for two weeks, and to cause the family physician to abandon the case, and I was again called in to give her relief from excruciating sufferings.

It may be urged that the responsibility for the extraction belonged to the family physician. I contend that the extractor was alone responsible, for I agree with my friend, Prof. Flagg, in his article entitled "D. D. S.," DENTAL COSMOS, October, 1875, page 520:

"I will not speak to you of the average medical practitioner. I esteem him as a man. I associate with him as a gentleman. I respect his average attainments. Of him I will not ask, but I will ask of the erudite of medicine, I will ask who of all their professional corps—which one among the most distinguished of their teachers—could stand with credit to himself and comfort to his patient, *five little minutes* at the dental chair?

"And why is this,—that I can ask, but none can answer?

"It is because the two great branches of the healing art are medicine *and* dentistry.

"Medicine first, oldest, and grandest, if you please. Dentistry, second, youngest, and least, if you please; but none the less medicine *and* dentistry,—distinct in their mixing as are oil and water, the emblematic fluids of the two professions!

"Year after year the lines of demarkation have become the more apparent,—methods, appliances, and rules for practice which pertain to one are unknown, unheard of, by the other; subjects may have a vital interest for the medical man, and yet possess but slight importance for the dentist; while all-absorbing questions for the dentist have not that interest to the general practitioner which can secure for them even a passing glance."

If this position is a true one, and I claim it is, then the practitioner of medicine is wholly incompetent to decide as to the advisability of the extraction of teeth, and the extractor, be he practicing dentist or not, is alone responsible for malpractice. Another fact must be here noticed, viz., that, as every dentist is aware, medical men, as a rule, do not place the value upon teeth that we do, or even that our patients do.

I could, if necessary, give scores of instances in my professional experience where patients have been sent to me with the request by the family physician that one or more teeth might be extracted to

give relief to some trouble which a few moments' examination made apparent was not dependent upon dental irritation.

I recall one instance where a prominent professor in the leading medical college in this city called upon me to extract a perfectly healthy lower canine tooth for his sister, when the pain was simply *reflex*, and depended for its expression upon an exposed pulp in an erupting superior wisdom-tooth; and so offended was he at my refusal to extract that I lost the future patronage of his family, which was transferred to the individual who extracted (*with gas*) the healthy canine. Such cases, I doubt not, are familiar to all the members of this association, and I need not dwell upon them. Others, doubtless, are not infrequent, like the following:

I have known patients to leave their houses at night because a tooth was aching, in which paste had been introduced for devitalization of the pulp, and have the tooth extracted at the nearest association where gas was administered. Others have without consultation with their dentist had teeth removed, and when too late appreciated their value.

In my judgment, the statement of the extractor that the patient desired the operation to be performed in no way relieves him. He is just as reprehensible, and is just as guilty of malpractice, as if he had urged the patient to have the extraction performed. Persons in health, much less in pain, are not good judges of what should be done, and no true professional man has a right to have his judgment influenced by their entreaties. In another case which I exhibited to my friend, Dr. George W. Ellis, a sound superior central incisor was extracted (by gas), because it was, as the patient said, a "little crooked." This is no exceptional case, for I believe there is not a dentist in this room who does not know that thousands of teeth are sacrificed in this city each year which could, under proper treatment, be made valuable and useful organs.

Why is this? It is because the public believe nitrous oxide gas to be harmless, that teeth cannot be preserved when they are, as they say, "ulcerated at the root," and some extractor is at hand ready and willing to encourage them in their ignorance.

Another abuse to which I would direct attention is the attempt frequently made by extractors to perform difficult operations in the mouth by aid of the gas. I speak from an extended use of the agent under consideration, and assert that for slight, easy operations it may possibly be indicated; but for difficult cases, as the extraction of broken teeth or roots deeply imbedded in the alveolar process, it is not well adapted, as its effects are too evanescent, requiring the operator to work with such haste that serious injury to both soft and hard tissue not unfrequently results, and as a sequence sloughing and necrosis

occur, all of which could have been avoided by the use of another anæsthetic, which would have allowed more time to the operator. I have notes of several such cases, and in two the sufferers could hardly be prevented from commencing suits for malpractice against a prominent extractor with nitrous oxide.

But passing from the consideration of malpractice on the part of operators who use the gas to such an enormous extent, and ignorance on the part of patients, let me ask the question, Is nitrous oxide, as an anæsthetic, harmless, and, except in well-marked organic disease, may it be used with a reasonable degree of certainty that no bad results will follow?

To this question the answer will be made by this or that extractor, "Look at the tens of thousands of patients for whom I have operated, and yet no fatal result has taken place in my office."

My friend, Dr. Thomas, claims sixty-six thousand five hundred extractions. This is good evidence regarding *immediate* immunity from bad results, but it is not evidence of freedom from after- and serious lesions of important organs as a sequence. I believe such sequence may occur a long time after the administration of the anæsthetic.

Prof. Alfred Stillé, M.D., in his great work on "Therapeutics and Materia Medica," lays down this principle:

"The safest rule is to use no more of a medicine than is requisite to produce the effect which is intended, and to continue it no longer than is absolutely necessary.

"It cannot be too often repeated that *every drug* when used *unnecessarily* is mischievous."

Let us examine the mischief which may be induced by nitrous oxide. In order to avoid the charge of prejudice, I will quote from the little work of the late Dr. F. R. Thomas, on "Nitrous Oxide," p. 61. He thus describes the symptoms of anæsthesia:

"First. By heavy and involuntary respirations much resembling the heavy or snoring sound of ordinary sleep. This is occasioned by the relaxation of the muscles of the pharynx. In some instances this heavy breathing is entirely absent, and consequently will not in all cases suffice as a guide.

"Second. The stertorous breathing is followed by a discoloration of the blood, and the face and lips become darkened. The rapidity of the circulation is increased, and the capillaries are surcharged with discolored blood, as in approaching asphyxia. To a greater or less extent the discoloration is always present, demonstrating the powerful physiological action of this agent on the circulation. This appearance is exceedingly annoying, and has led physiologists to associate it with asphyxia, as the resemblance of the symptoms to it is very marked.

"Third. When narcosis has been completely produced, most patients exhibit a twitching of the entire muscular system, but this is particularly noticeable in the muscles of the face, the back of the head and neck, and also in the hands. The combination of these symptoms furnishes the guide to complete anæsthesia. It is reasonable to expect to meet them all in a majority of cases."

The explanation of the symptoms detailed agrees with my own experience in hundreds of cases. Let us examine what pathological condition has been induced. Again, rather than offer my own conclusions, I select the following. In the "Essentials of Practical Medicine," by Henry Hartshorne, M.D., p. 222, we find the description of a pathological condition which is not *very* unlike that detailed by Dr. Thomas:

"*Congestive Apoplexy Symptoms.*—Premonitory symptoms often seen are flushed appearance of the face and eyes, heat of head, throbbing of the carotids, distension of the temporal arteries and jugular veins. The attack is marked by sudden stupor, with slow and sometimes snoring respiration, full and slow pulse, dusky or turgid appearance of the face. The total loss of perception may be brief, its partial absence or deficiency continuing for some time. Slight convulsive movements are not uncommon. Paralysis of the muscles occurs only a short time after the attack if recovered from.

"The *immediate danger* connected with an attack of apoplexy should not be considered over for at least ten days after the stroke itself. Very seldom after a hemorrhagic attack are the mental or bodily powers so good for the rest of life as before."

I ask any unprejudiced mind if this description differs in any essential particular from the symptoms of anæsthesia from nitrous oxide? If not, do we not in every case induce congestive apoplexy, and have we any right to expect immunity from subsequent lesions?

You will notice that Dr. Hartshorne says *immediate danger* should not be considered over for ten days at least, but mental and bodily powers are seldom so good as before. I do not urge that in every case of anæsthesia from nitrous oxide such a sequence, though possible, will actually result; but that it does occur in more cases than we are aware of, I firmly believe. Patients have many times said to me,—

"I have never felt the same since I took gas. I am much more nervous, and don't sleep as well; have more headache, and would not under any circumstances take it again."

This, it is true, is negative testimony; but have you not all heard the same thing many times in your practice? This position assumed by me is no new one, and it was first recognized twelve years ago by my old and valued friend, Dr. George J. Zeigler. In his little work, "Researches on Nitrous Oxide," p. 49, he says,—

“While, however, the physiological effects of protoxide of nitrogen are usually of a highly pleasurable and sanative character, it cannot, nevertheless, be indiscriminately employed with safety, for the artificial excitement of system rapidly engendered by its free administration may not only prove injurious by directly increasing the tendency to irritation, hemorrhage, and inflammation in the parts subjected to surgical mutilation, but may develop latent physiological tendencies of a different, as well as of a like character in other parts of the body in persons with certain abnormal predispositions, to such a degree indeed as to seriously injure health, if not absolutely endanger life itself. The precise character and particular manifestation of such tendencies will of course depend upon the special predisposition of the individual system acted upon, but they will necessarily be most likely to appear in certain definite parts of the body, in accordance with the peculiarities of action of the disturbing agent,—nitrous oxide having, as before stated, a marked preference for the blood, brain, nervous system, and genito-urinary organs.”

And he further says, in the case of S. P. Sears, of New York, who died two hours after administration of nitrous oxide,—

“It is probable that it hastened death by promoting undue pulmonary congestion;” and of Miss Bell’s case, who was taken ill twenty-four hours after administration of gas, and died three days afterwards: “it is quite probable that the excitant influence of nitrous oxide was injurious in so far as it promoted disorder of the brain and spinal marrow.”

It may be asserted that if bad results follow the use of nitrous oxide it ought to be easy to prove the same by undoubted testimony, but as a general thing patients actually feel better after its inhalation, and so express themselves in laudatory remarks opposite their names in the book in the operator’s office. Does this prove anything? Most assuredly it does, for it indicates continued hyperæmia of nerve centers and cerebrum, which, with the pleasure experienced from the thought that a painless operation had been performed, induces these emotional expressions, and is evidence of abnormal rather than normal conditions; for, as remarked by Dr. Zeigler, “it is a well-known fact that increased functional activity is a primary and constant concomitant of inflammation.”

Would physicians be likely to distinguish these unfavorable results? I think not, for the reason that, unless called immediately to treat a morbid condition, they would be apt to lose sight of the primary irritant, and ascribe the difficulty to the operation rather than to the anæsthetic. Again, it may be stated that while nitrous oxide as an anæsthetic has had comparatively no use or investigation by the medical fraternity, and while less is known of the physiological action

of this than of any of the other anæsthetics, yet it seems as if they had adopted the (advertised) estimate of its harmlessness, and had advised their patients to take the gas for even insignificant operations,—operations for which they would themselves, if they were to perform them, utterly refuse to administer an anæsthetic. In this belief they “swim with the current,”—how correctly, let investigation determine. In presenting my views, let me say I am actuated by no motives but those which have for their object the public interests, and I will give all the negative testimony which I present to my opponents, and ask only that reasonable positive testimony should be considered as evidence. For the purpose of ascertaining if others besides myself have noticed bad results following the administration of the gas, I have addressed letters to a number of prominent practitioners, medical and dental, asking if they have recognized any morbid conditions, and have received replies which are presented for your consideration, which may be summarized as follows. Several medical men make answer, “We have seen no bad results that we could reasonably attribute to nitrous oxide.” Others reply, “We have cases of permanent headache, vertigo, syncope, melancholia, insomnia, epilepsy, cerebral hysteria, and irregular action of the heart, which *patients* attribute to inhalation of nitrous oxide gas, but we as medical practitioners are unable, confidently, to decide upon the primary irritant.” The replies of dental practitioners are much the same. They say, “Patients have told us that they considered themselves permanently injured by the use of nitrous oxide.”

If, as I believe, nitrous oxide is not an anæsthetic, but like an overdose of alcohol induces cerebral hyperæmia with strong tendency to structural degeneration, is it not time for us to make careful examination of this agent, and, if found dangerous, to hold up our hands in warning to our patrons, whose health, comfort, and lives are so constantly trusted to our professional care and judgment? In presenting this paper, I am actuated by the simple desire to stimulate investigation not alone among dentists, but among medical men who permit their patients to inhale an agent of which they know absolutely nothing.

The following discussion ensued.

Prof. Barker moved that all strangers present should have the privilege of debate. So ordered.

Dr. J. D. Thomas thanked the association for the privilege accorded him to discuss the paper of Prof. Barker. He admitted that nitrous oxide was used for mercenary ends by some, and that many valuable teeth were sacrificed that might be saved by proper treatment. He believed that nitrous oxide could be administered with safety. He had known of cases where thirty gallons were adminis-

tered to one patient without obtaining anæsthetic effect. He believed, however, that the gas could not be administered in such quantity if pure. Dr. Barker, in his work on nitrous oxide (1866), said that old gas was as good as fresh. It had not been his experience to verify this, and Dr. Barker was responsible for many bad results. By fresh gas he meant gas made one day to be administered the next. Prof. Rand advocated the efficacy of old gas; but he had found that when gas was more than a week old it was inefficient. In proof of this a gentleman had taken at his office seven inhalations of gas a week old with scarcely any effect, while three inhalations of fresh gas affected him almost to unconsciousness. As for perfectly pure gas, he does not think there is one in fifty who knows when he has pure gas. He has never known any patient to be injuriously affected by the gas. A little nausea is sometimes felt; but this passes off almost before leaving his office; and even in these cases he has only observed it in persons who are easily affected at the sight of blood. He differs with Dr. Barker as to the evanescent effect of the gas, holding that one skilled in its administration and management has an abundance of time to extract any ordinary tooth; and extra-ordinary ones indicate difficulty, and are dealt with by those means by which alone they can be dislodged, viz., by grasping the alveolar process along with the stubborn root or tooth. He has seen cases where other anæsthetics were administered, and the parts fearfully lacerated. Dr. Thomas here referred to the cases alluded to in Dr. Barker's paper. He said that when the case presented he advised the patient to return to Dr. Barker to have the tooth treated. She returned with her family physician, who desired him to extract it. He again refused, and told her to return to her dentist, who was the best judge of the case. She still persisted, and, yielding at last to her repeated entreaties, he extracted the tooth.

Prof. E. T. Darby rose, not to discuss the paper, but to give his testimony to the exercise of the prudence which he had always observed on the part of Dr. J. D. Thomas, and also by his late brother. He could testify as to considerable discrimination exercised by these gentlemen, not only in the proper administration of nitrous oxide gas, but also in the extraction of teeth. He believes their motives were higher than those of mere gain. He knows of these gentlemen having made inquiry of persons coming to them to have teeth extracted as to their dentist, and of their advising them against the extraction of teeth which they felt could be saved, and knows, too, of their refusal to extract teeth that they felt could be treated and made serviceable.*

* The discussion here took a turn as to ethics rather than upon the subject of the paper.—REPORTER.

Prof. T. L. Buckingham hoped the discussion would not drift from the topic. He had used nitrous oxide in his practice, but he must confess that he had not discovered any difference between old and fresh gas. Chemically, he believed no difference existed. He had been told by Dr. Sprague that he had used it when six months old. Sansom, in his work on chloroform, relates of two young girls, one in full health, the other just recovering from a case of typhoid fever, who attempted suicide by inhaling the fumes of carbonic acid from burning charcoal. The one in full health died from the effects of the gas, the other recovered. A canary-bird was placed in atmosphere partly composed of carbonic acid until it was nearly asphyxiated; he then introduced another canary-bird into the same gas, and the bird last introduced died first, showing that when there is a sudden change from a normal condition there is a greater danger than when the change is more gradual.

For his part his experience with nitrous oxide was but limited, and to tell the truth he was afraid of it, so that he felt himself much obliged to Dr. Thomas for taking a disagreeable duty off his hands.

Prof. Barker said that Dr. Thomas and his brother had instructed the people that there was no danger in taking the gas, so that now people wanted it for the most trivial operation. Parents even brought children to him to have his consent to the removal of deciduous teeth with the gas, and now there is scarcely any one who will submit to the extraction of a tooth without gas. He believed this wrong, as he felt there was danger of ill effects from the inhalation of the gas which might not show themselves immediately, but might be felt for a long time after, and it may be through life, to say nothing of the wholesale slaughter of valuable teeth by unscrupulous, mercenary men. As for old gas and new, he held that the old was better, because it was purified by standing over water which absorbed its impurities, if any were present. The reason the fresh gas acts quicker is because of the presence of free ammonia and nitric acid fumes, which may induce quicker anæsthesia. He cannot exonerate the nitrous oxide men for extracting teeth merely on the will of the patient, nor on the consent or counsel of their medical advisers, as he conceives that neither the one nor the other knows anything about the true indications. As to the patient's teeth being her own, and she being a free agent, will you find a surgeon amputating a finger with whitlow merely because the patient says her hand is her own and she can do what she likes with it? He knows of cases of ladies who have never been well since they took nitrous oxide gas at the hands of Dr. Thomas. As for medical men, they know nothing about the diseases of the teeth. He does not care how many teeth Dr. Thomas extracts if they ought to be extracted, but he does not admit that he

has the right to take out *one tooth* that can be retained. When the veins become engorged with blood, the face blue, and convulsive twitchings come on, he held that the subject was nearer the grave than we have any right to place one merely for the operation of teeth-extracting.

Dr. Peirce desired to say a word on this subject. He has not had much experience, but has been more successful with old gas than with fresh. He referred to the influence of the gas on patients, and to the case of a physician who claimed that it had a very pernicious effect on him; that he had never been well since he took the gas, and had been confined to the house for a time, and had observed large quantities of sugar deposited from his urine; he had lost considerable flesh, and had to refrain from all food of a starchy nature, living almost entirely^{as} on milk and eggs. For himself, he has not the least doubt that people have been seriously injured by it, yet there are many who do not complain of any ill effects. He must believe that Dr. Thomas was wrong in yielding to the solicitation of his patient and extracting the tooth when such operation was contrary to his own judgment. He should have refused, and let her go to some one else, if she were determined to have the tooth extracted. Dr. Peirce related being present in a physician's office when a hearty man came in and requested to be bled, whereupon the physician bled him. When the man left the office he asked the physician why he bled the man, and his answer was that he had asked to be bled, and he bled him. Patients are not to be supposed to have correct ideas as to what operations are demanded or are likely to prove beneficial to them. No dentist ought to allow his judgment to be influenced by the desire of the patient. The experience of every operator proves that subjective sensations are extremely unreliable and should not be made the justification for an operation involving the loss of a tooth.

Prof. J. H. McQuillen had listened attentively and with interest to the paper of Dr. Barker. He had imbibed originally a strong dislike to the use of nitrous oxide gas, on account of the manner in which it had been introduced into the city by Colton. Its skillful and conscientious administration at the hands of Drs. Frank and J. D. Thomas had, however, won his confidence and respect, and of the many patients he had taken or sent to them, had yet to hear of a single case in which any ill effects had attended or followed the use of the agent. He knew of repeated instances in which Dr. Thomas had refused to extract teeth that could be saved. In the case of extraction for one of his patients, he not only exonerated the gentleman from all blame in the matter, but in addition thanked him for relieving the lady of a tooth that had been a repeated source of trouble to her long before she came under his (Dr. McQ.'s)

care, and in this instance was aggravating nervous prostration of the entire system. He did not regard the opinion of a medical man as entitled to much consideration with regard to the question of the extraction or retention of a tooth. He could recognize, however, the possibility of a case in which a tooth, valuable as it might be, would be as nothing in comparison with the shock to the system from prolonged pain attendant upon its retention. Of all the anæsthetics in use, nitrous oxide gas in his opinion was the least dangerous; at the same time he recognized that in incompetent hands it might become the source of incalculable injury. In the cases reported this evening in which serious derangement of the system was attributed directly to the use of the nitrous oxide gas, he was free to confess that the evidence presented did not to his mind warrant the emphatic conclusions arrived at. There may have been other and unrecognized causes at work as all-important factors of the trouble named. Scientific men who know how easy it is to be mistaken, particularly in questions directed to the relations of cause and effect, are cautious in expressing an opinion. The non-committal letters from prominent medical men read to us are evidence of that fact. The case of diabetes attributed to a single administration of nitrous oxide gas was, in his opinion, an open question. What is diabetes? One of the important functions of the liver is the constant formation of sugar, the normal production meeting the needs of the economy; but it is sometimes formed in excess and is carried out of the system through the kidneys with an increased flow of urine. This constitutes diabetes. Is it reasonable to infer that nitrous oxide gas, single and alone, could produce this? Is it not more than probable that other influences were at work? Dr. Barker had claimed that nitrous oxide gas was not an *anæsthetic*, and said its influence was merely due to cerebral hyperæmia. What is an anæsthetic? An agent that renders a person under its influence insensible to pain. Nitrous oxide gas does this most effectually, not only producing *anæsthesia*, or loss of sensibility, but *narcosis*, complete unconsciousness.

He then directed attention to the two theories entertained with regard to the manner in which anæsthetics produce their effect. One theory is that they act upon the nerve centers as a direct poison, being carried there by the circulation. The second theory is that the anæsthetics interfere with respiration, and hence anæsthesia or narcosis is due to privity of oxygen.

Prof. T. C. Stellwagen. The question was not only to be answered for Philadelphia or Pennsylvania, but for the whole world. We must learn to look at this agent as a two-edged sword, and to use it carefully. If old men in the profession are apprehensive about it, the young should be the more careful, for it is a dangerous remedy if

used unduly. As to the gas, he thinks the old is better than the fresh, because by standing over water this absorbs any nitric oxide or impurity that may have passed over in the process of manufacture. He does not think teeth are like warts or corns, to be cut off or extracted, but their preservation should be entrusted to skillful practitioners. It has been said, "If thine eye offend thee," etc., but teeth that offend should be rendered comfortable and not ruthlessly extracted. Dr. S. related a case in point of a lady. If we administer nitrous acid at a time of any particularly susceptible condition of the system, it may produce ill effects from its changing the equilibrium or distribution of the blood. Notwithstanding the danger attendant on the use of anæsthetics he regarded them great boons, and although having had a critical experience with his own wife, he would still never hesitate to administer when he thought it indicated. We should discriminate cases, and for cases of simple extraction he believes it should not be used as freely as it is. It is better to persuade the patient to submit than allow the use of the gas on every occasion. If we encourage the indiscriminate use of nitrous oxide gas we encourage cowardice. Dr. S. related how, by cultivating the reliance of the patient in the operator's willingness to stop at any step in extraction, he seldom failed to obtain such influence as to have them eventually submit to the operation without anæsthesia.

Dr. Buckingham must differ with Dr. Barker as to the nitrate of ammonia. He doubted if one could inhale the deutoxyd of nitrogen; it would irritate the trachea all the way down. If the gas should contain free chlorine this would produce inflammation of the fauces. He had asked Mr. Johnson, of New York, what were the impurities in nitrous oxide gas, but he had not told him. He thought the gas did not give oxygen to the blood. If it did furnish oxygen to the blood, why this blue color in the face and lips when it was inhaled? The gas evidently produced some specific effect. He thought it may have been instrumental in producing diabetes or scarlet fever by putting the system in a condition that these effects were brought about, or by affecting the system in such a way that these conditions were hastened or incited. Let us endeavor to find out if it can produce these effects. It is a very important subject, and one we should ponder well, whether we should incur these risks for so trivial an operation as the removal of a tooth.

Prof. Remington, College of Pharmacy, could not see how impurities could creep into nitrous oxide gas, especially in the use of "fused nitrate of ammonia" for its manufacture. He had once been employed in the establishment of Powers & Weightman, and knew they used every precaution in the production of a pure article. He thought impurities might be caused by improper washing, and questioned Dr. Thomas on this point.

Dr. Thomas related three cases where the gas had successively exhibited a depressing effect on three patients one after another. This being an unusual result with it in his experience, he tested the gas and found "chlorine" present. He immediately sent to Messrs. Powers & Weightman to complain of the nitrate of ammonia, when they explained that the substance had a strong affinity for chlorine, and as at the time of its manufacture they were manufacturing chlorides in an adjoining room, they accounted for its presence in the liberation of the chlorine and its absorption by the nitrate of ammonia from the atmosphere. He tests his gas with nitrate of silver, and has little faith in the wash-bottles.

Prof. Remington spoke of using warm instead of cold water in the wash-bottles for purifying, and thought the gas was frequently generated so rapidly as not to be purified in its passage through the wash-bottles.

Prof. Barker said it was a popular error that the commercial nitrate of ammonia contained any deleterious compounds; most of the nitrate of ammonia found in the United States was the product of three prominent manufacturers of chemicals, and he had on several occasions tested samples of each for his class lectures, and found them equally pure; as they all contained as an impurity a slight excess of nitric acid, the substance was not therefore as it should be, a neutral salt; but in the preparation of the gas the water in the wash-bottles or in the receiver would absorb the free nitric acid, and hence, as before stated, fresh gas was not suitable for inhalation until allowed to stand over water. If the position assumed by Prof. McQuillen was a correct one, viz., that nitrous oxide was an anæsthetic because it produced narcosis, then other agents, as alcohol, opium and its compounds, aconite, belladonna, Indian hemp, and hosts of other substances, could be justly classed as anæsthetics, as they certainly produce insensibility. He regarded those substances only as anæsthetics which, being vaporized and used judiciously and carefully, enter the lungs in a gaseous state, and by osmotic action pass into the circulation, and while suspending nutrient action in the remote capillaries did *not* destroy organic life or produce dangerous metamorphosis of organized structures. It has been asserted by Dr. Thomas that nitrous oxide is not a dangerous gas; he asked the members of the association to follow him in the prominent symptoms step by step. First, it is usual for a patient to take only two or three inhalations before there is marked evidence of vascular excitement, action of heart increased, and violent respiratory efforts. These symptoms are not seen to any such extent with ether or chloroform, and they indicate absence of oxygen in the lungs and disturbance of the equilibrium of the circulation so happily referred to by Prof. Stellwagen. They also indicate

that the heart recognizes the presence of a powerful irritant in the blood, and under its stimulus this fluid is forced with great rapidity into the carotids, from thence to the brain, distending the capillaries there, and inducing that condition to which he (Prof. B.) referred in his paper as cerebral hyperæmia. As a consequence of this condition, metamorphic changes occur with such rapidity and to such an extent in the brain that the veins are charged with discolored or carbonized blood, and the face presents the dreadful blue appearance which shocks not only the attendant of the patient narcotized, but the intelligent surgeon. He would ask, if nitrous oxide does produce this engorgement of capillary vessels of the brain, what changes are liable to ensue from such a morbid condition? and would answer, congested vessels may relieve themselves in one of two ways, either by transudation of serum or watery constituents of the blood through the coats of the vessels into the brain-structure, or by the rupture of vessels and formation of clot or clots in the brain-substance. It may be asserted if this occurred death would at once result; but would answer that this might not be the result if such effusions were limited in quantity or size, but it would certainly give rise to and account for the morbid conditions to which he referred in his paper, viz.,—epilepsy, melancholia, insomnia, irregular action of heart, etc. If it is admitted that these powerful systemic influences can be induced without danger with nitrous oxide, then it may be asserted that it stands alone in the *materia medica* in its physiological action; for when any such approximating symptoms are induced with *any* other agent, death is regarded as impending, and the intelligent efforts of the surgeon must be immediately, persistently, and actively directed to ward off a fatal result.

Dr. Barker said he could well understand how a system weakened by inhalation of an irritant gas, acting as an exciting cause, could develop an existing predisposing disease in the patient, establishing perhaps scarlet fever, when such germs were in the atmosphere inhaled, or a diabetic tendency in the liver and kidneys if the diathesis existed.

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