

ON

NITROUS OXIDE.

BY

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HONORARY MEMBER OF THE ODONTO-CHIRURGICAL SOCIETY;
FELLOW OF THE MEDICAL SOCIETY OF LONDON;
MEMBER OF THE BRITISH MEDICAL ASSOCIATION.

*A Paper read at a Meeting of the Odonto-Chirurgical Society held at Glasgow,
October 13th, 1868.*

*With other Communications reprinted from the 'British Journal of
Dental Science.'*

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1869.

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OF ANESTHESIOLOGY

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THE numerous inquiries that have been addressed to me, both verbally and by letter, as to the history, manufacture, and administration of Nitrous Oxide as an anæsthetic, must be my excuse for venturing to reprint the following papers, in the compilation of which I beg to express my great obligations to Mr. Clover and Dr. G. Q. Colton, of New York.

Since these pages were first penned, increased experience has only confirmed my reliance on the safety and efficiency of nitrous oxide as an agent for giving entire immunity from pain, not only in cases of the extraction of teeth but also in the more extended operations of general surgery. This increased experience in over a thousand cases has almost tempted me to modify some of the expressions and remarks in the following paper, which might tend needlessly to alarm a reader who was seeking, by a perusal of these pages to inspire himself with that confidence in the new anæsthetic which would induce him to have recourse to its aid for the relief of his own pain; but the paper was not intended for such readers, but rather for the use of practitioners who desire information on the subject, and the detail of certain appearances and signs of anæsthesia, far from inspiring doubt or dread as to the perfect safety of the agent, should only give additional confidence and consequently success, in the administration of the gas.

CHARLES JAMES FOX.

27, MORTIMER STREET,
CAYENDISH SQUARE.

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A Paper read at a Meeting of the Odonto-Chirurgical Society held at Glasgow,
October 13th, 1868.

The President, Dr. THOMPSON, in the Chair.

MR. PRESIDENT AND GENTLEMEN,—When, three months ago, I undertook to send you a paper on nitrous oxide for this, your October meeting, I certainly felt that it was then in my power to lay before you some facts relating to this interesting subject which would be new to you, and which, from various circumstances, it had been my good fortune to have acquired an early knowledge of. But as time has sped on, the subject has been so well ventilated in the various journals, and so many of you have made yourselves personally acquainted with all the details relating to nitrous oxide, that I feel I am running a great risk of merely telling you what you already well know. I am, however, encouraged to proceed from the remarks of one of your most active members, when on his recent visit to London I made this observation to him, to which his reply was, that although you might be well acquainted with all I can tell you, yet the reiteration by me of these subjects in the form of a paper before your Society, may lead to the eliciting from you much additional information, and give rise to many valuable suggestions which otherwise would have lain dormant. Far more, then, with the hope of myself receiving instruction, than in the belief that I am informing you, I will at once proceed to my subject.

The history of the gas has been so frequently related recently, that I will merely remind you that, although first discovered by Dr. Priestly in 1776, it is to Sir Humphry Davy, in 1800, that we are indebted for that intimate acquaintance with its formation and properties which I cannot find has been much increased in later years. The account given by him in his 'Chemical and Philosophical Researches,' is most interesting, and will well repay for perusal; and it is

a singular fact, that at page 556 of these 'Researches' he distinctly states that, "as nitrous oxide in its extensive operation seems capable of destroying physical pain, it may probably be used with advantage during surgical operations in which no great effusion of blood takes place."

But although the peculiar effects of nitrous oxide and ether were never lost sight of, as may be seen by an article in the 'Quarterly Journal of Science and Art,' vol. iv, p. 158 (written, it is believed, by the late Mr. Faraday), and by the repeated exhibitions of nitrous oxide as an amusement at popular chemical lectures, down to the year 1844: nevertheless, the notion that the peculiar properties of this gas might be used to the benefit of humanity remained dormant.

On the memorable evening of December 10th, 1844, Horace Wells, a Dentist of Hartford, Connecticut, at a chemical lecture by Dr. Gardiner Q. Colton, first observed that Mr. Samuel A. Cooley, under the violent excitement caused by inhaling the gas, struck himself against the benches, and caused the blood to flow from his bruised shins, yet without any feeling of pain. Impressed with the fact, Horace Wells, who was present, the next day got Colton to give him the gas, while a neighbouring Dentist, Dr. Riggs, extracted a molar for him.

I have thus briefly reminded you of the names of these four actors in this the opening scene, of a new chapter in the history of man. To detail it to you as I heard it from the lips of Dr. Colton during his pleasant stay at my house, would take too long; but permit me here to say that it is not easy to live for a week with a man without discovering whether he *is* or is *not* a man of truth, and straightforward, unequivocal honesty. That Dr. Colton *is* such a man, I firmly believe. I have tried him in every way, and have never found the slightest deviation from his original statements; and startling though some of these appeared to us at first, yet I have hitherto found many of them so fully borne out in my own subsequent experience, that I have the fullest confidence that I shall find all his other statements confirmed, and I have imbibed from him in a few weeks that intense confidence in the safety of the gas which he has attained from twenty years' experience. Do not think I say this rashly or empirically! I am not advising or giving the gas in blind reliance on the experience even of Dr. Colton, but I have studied the question of nitrous oxide in all its aspects, under the guidance of one to whom I have always looked up, as one of our safest guides and authorities on ænæsthetics, my friend Mr. Clover, whose daily administra-

tion of the gas, under every variety of circumstances, it has been my good fortune to witness.

To continue my history. Colton, who was but a travelling lecturer, and had no interest in the use of the gas for Dental purposes, passed away from Hartford to other towns, where we will leave him for the present.

Wells, having learnt from Colton how to make the gas, administered it successfully in Hartford, and, elated with his success, after a few weeks, proceeded to exhibit it publicly at the hospital at Boston. Here, unfortunately, he was not fully successful; it was only tried in one or two cases, and apparently failed, from the gas-bag being removed too soon; that is to say, the patient *appeared* to feel, and the medical spectators hastily condemned the "laughing gas;" but I have the testimony of some who were then present, that in *their* opinion the gas *was* successful. Still, public opinion was against it, and Wells, a sensitive, retiring man, returned home in disgust. The statement, however, that he gave up the gas as uncertain in its action is incorrect (I have evidence in my possession to the contrary); but he soon after died, and with him the gas practically expired.

Ether, into the rather peculiar history of which I will not now enter; *chloroform*, in the introduction of which the chief credit must unquestionably be given to Sir James Simpson, obtained so strong a hold on the public mind that the gas was forgotten by all but one man; that man was Dr. G. Q. Colton, to whom we will now return.

After leaving Hartford, being, as I said before, no Dentist, all interest in the anæsthetic properties of the gas passed away with him, save as an interesting fact, which he invariably related in his public lectures, laying still greater stress upon it after seeing in the papers an account of Wells' success prior to his unfortunate supposed failure at Boston.

After Wells's death Colton tried unsuccessfully for years to induce some Dentist to adopt and carry out the use of the gas, until 1863, when he induced Dr. Joseph H. Smith, of New Haven, Connecticut, to operate while he made and gave the gas; and from that time to the present he and his colleagues have given it in over 40,000 recorded cases.

The subsequent endeavour of Mr. Samuel Lee Rymer and his colleagues to introduce it into England in 1864; Colton's visit to the Paris Exhibition of 1867; his introduction of the gas to Dr. Evans, who subsequently brought over Colton's apparatus to England, and introduced the use of nitrous oxide first at the Dental Hospital of London, and then to a meeting of professional men assembled under the hospitable roof of Mr. Hepburn, are now matters of

history with which you are well acquainted. You know also how we were prejudiced against it by the highest medical authorities; Mr. Clover alone, of all the leaders in anæsthetics, giving in an early thorough expression of his good opinion of it, after a series of careful observations and experiments on animals, in which I had the pleasure of assisting.

In June, 1868, Dr. G. Q. Colton himself visited England, and on the 5th and 10th of that month addressed two influential meetings of Dentists and medical men at my house, giving us a variety of valuable information, the result of twenty years' experience with the gas.

In our profession Mr. Coleman was the first to take it up warmly and promptly, but directed his attention chiefly to devising an ingenious apparatus for economising the gas; and with the appointment of a committee by the Odontological Society to investigate the whole question of the manufacture and administration of nitrous oxide, the history of the gas closes for the present.

I have been somewhat prolix in my history, simply because we are so frequently asked, who invented this? how long has it been used? that I thought my above *résumé* might be serviceable to all.

As regards the chemistry of nitrous oxide I shall say but little; there is not a test-book on chemistry but will supply full details for those who are not yet acquainted with its chemical history.

There are, however, one or two points to which I would direct attention. The first is, that when you have the gas *pure*—and it is only then that you should ever allow a patient to breathe it—the gas is *perfectly* transparent and colourless, with scarcely any perceptible odour, and a sweetish taste; in fact, if you are breathing *pure* gas you should be scarcely conscious that you are breathing aught but pure air, save for the presence of the slight sweetness.

Another important chemical fact to remember, as it will assist in our investigations into the physiological action of the gas, is, that the only difference between *common air* and *nitrous oxide* lies in the difference of *proportion*, and in the fact that whereas the nitrogen and oxygen (of which both are composed) in the air is in a state of *mixture*—in nitrous oxide it is *chemically* combined.

Nitrous oxide is composed of	Air is composed of
Nitrogen ·63·6	Nitrogen ·76·90
Oxygen ·36·4	Oxygen ·23·10
<hr/>	<hr/>
100·0	100·0

Another point to be borne in mind in reference to the chemistry of nitrous oxide is its capability of being condensed into the liquid, and even into the *solid* state; a fact which will probably assist in the endeavour to render it more portable. This is an important point. Could we but render it conveniently portable there would be no difficulty in its being manufactured by the chemist, and sold to the practitioner as chloroform now is. This is a matter of more interest to you all than it is to me, I having already invested a considerable sum in all appliances for the manufacture and storing of the gas, and, therefore, the first cost being passed, I can make it cheaper than any manufacturer can supply it, for a considerable time to come; but it is for those who are *not* so provided to bestir themselves, and by exerting a little pressure in the proper quarter induce such gentlemen as Mr. Barth to supply a more portable gas than that for which we are already indebted to him.*

Another point of interest in the chemistry of our subject, and one upon which I am often questioned, is, the results produced by gradually increasing heat. Now this, although a matter of interest in the way of investigation and experiment, is of no practical importance.

I have used a thermometer fixed in the flask in which I have been boiling nitrate of ammonia, but I have always found the indications that I was using too great a heat perceptible, even to an inexperienced watcher, long before the thermometer indicated the degree which we are told we must not exceed—a degree, let me add, varying in every authority I have consulted. I will, however, give you the result of observations recorded by Sir Humphry Davy.

1st. Dry nitrate of ammonia undergoes little or no change below 260° Fah.

2nd. When heated to between 270° and 300° it slowly sublimes without decomposition, and without becoming fluid.

3rd. At 320° it liquifies, decomposes, and still slowly sublimes. It never assumes, nor continues in, the fluid state without undergoing decomposition.

4th. At temperatures between 340° and 480° it decomposes rapidly, yielding pure nitrous oxide and water, as shown above.

5th. If heated to 600° and above the decomposition is accompanied by a luminous appearance of the salt, and nitric oxide, nitrous acid, and nitrogen are evolved.

The consideration of the *physiological action of the gas*

* This has been since accomplished to a great degree by Messrs. Coxeter and Sons, of 23, Grafton Street East, Tottenham Court Road, who have effectively carried out my suggestion to supply iron bottles containing from 36 to 90 gallons of gas.

opens up to us a boundless field for investigations and theories ; and it is curious to observe how opposite are the views held by different parties, one asserting "that nitrous oxide is an asphyxiating agent, the effects of which are identical with those of poisoning with carbonic acid gas" (Dr. Richardson, 'Medical Times,' April 18th, 1868), whilst another high medical authority across the Atlantic distinctly affirms "that it is the direct opposition and natural antidote to narcotizing agents and asphyxiated conditions" (Zeigler on Nitrous Oxide for Medicinal Application).

In the presence of such conflicting assertions I may perhaps be pardoned for considering that until those who make a special study of the science of physiology can offer us some more harmonious views respecting this agent we must be content to take it, to a certain extent, upon the merits of its long and successful use, especially when we can support *our practice* with a theory which, if not quite so extreme as those just quoted, has at least the merit of being clear and concise.

Mr. Clover (whom we may regard as being neither so infatuated with the gas as to believe it to be a universal panacea, like some of its over zealous friends, nor yet viewing it as a death-dealing agent, even when most carefully administered, as implied by its great opponent) in a recent note to me expressed himself as follows :

"Nitrous oxide acts by preventing the oxidation of the nervous centres, principally by depriving the blood of its proper supply of free oxygen in the lungs. Although there is oxygen in the nitrous oxide, it is in a state of chemical combination with nitrogen, not free and merely mixed with nitrogen as in the air. It is probable that the presence in the blood of nitrous oxide is exciting so long as some oxygen remains, but as soon as the oxygenating property of the blood is lost the functions of the nervous centres fail, and if fresh air were not soon admitted their functions would cease altogether.

"The functions of the brain proper cease before those of the medulla oblongata ; hence we have loss of consciousness before failure of breathing, and the functions of the medulla are abolished before those of the ganglia presiding over the action of the heart, and hence the heart continues to beat after the breathing has ceased."

Here, for the present, we must leave the question of the physiological action of nitrous oxide, merely adding that the question is not lying by unwatched. The Committee appointed by the Odontological Society will certainly not neglect this part of the subject. We believe, also, many distinguished physiologists are busily engaged in investigating

the whole subject of anæsthesia, and notably Dr. Sanderson and Dr. John Murray are pursuing a systematic course of experiments, which we do not doubt when published will prove of as much value as interest.

The next point for consideration is the manufacture of the gas. For this there are many plans, all, with one or two exceptions, based upon the same principle. The most easy proceeding for those who do not wish to be at the trouble of making their own apparatus is to order Sprague's or White's apparatus from one of the Dental depôts. My only objection to White's is that the connecting tubes are metallic, and liable, therefore, to oxydise and clog, and there is no regulator attached. If you order one of Sprague's apparatus with his regulator you will have, in my opinion, the very best apparatus that has yet been contrived for making the gas. It is the only one I have found after every trial to act with uniform comfort and regularity, and with it I can easily make 100 gallons of good gas in an hour.*

FIG. 1.

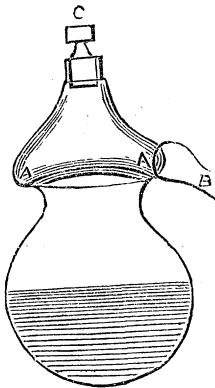
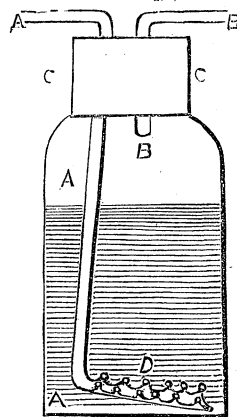


FIG. 2.



You will find a full description of this apparatus in a paper which I read at the Oxford meeting of the British Medical Association, and published in the 'British Journal of Dental Science' for September, 1868; I will, therefore, only now give a brief description of the diagrams illustrating

* Messrs. Ash, of Broad Street, Golden Square, have recently invented a most ingenious form of regulator, which has this advantage over Sprague's, that, should the coal gas be accidentally extinguished, a little valve will open, admitting air into the first bottle, and thereby preventing a rush of water back into the flask.

Colton's apparatus with Sprague's regulator, which you see before you.

First, as to the flask. I use the form you see in Fig. 3 in preference to those with flat bottoms; they can be obtained at Messrs. Griffin, Garrick Street, St. Martin's Lane. But Fig. 1 shows an excellent description of flask used in America, and supplied by Mr. Rutterford, of 11, Poland Street; it is so formed as to prevent the condensed steam given off from the boiling nitrate of ammonia from falling back into the flask, giving it a ready exit from the internal gutter, *A*, to the tube *B*: the stopper, *C*, is also extremely useful, as by removing it the working of the apparatus can be stopped at any moment.

Fig. 2 represents one of the wash-bottles, the advantage of which over the ordinary Woulfe's bottle is, that it can be worked for months without leaking or requiring any attention beyond changing the water. It consists merely of a glass jar containing eight pints; the mouth is closed with a cork or india-rubber bung, perforated to receive two glass tubes, the one *A A A*, Fig. 2, for the entry, the other, *B B*, for the exit of the gas; a tin rim, *C*, about three inches deep should stand on the bottle, surrounding the neck about half an inch from it all round; the bung with the tubes having been placed *in situ*, plaster of Paris must be poured in until level with the top of the tin rim; when set hard cover with a solution of sealing-wax in spirits of wine. The tubes should have an internal diameter of about half-an-inch; that one, *A*, for the entry of the gas, should be closed at the end within the bottle and perforated along its surface with a number of small holes, *D*. The gas by thus escaping in smaller bubbles is more thoroughly washed.

In Fig. 3, you have the whole apparatus for making gas, as I now use it.

The flask, *A*, is half filled with nitrate of ammonia, *B*, suspended by a copper wire, *C*, to a bracket, *D*; the suspended flask and the Bunsen's burner, *E*, are enclosed in a cupboard of wood (*F*) lined with tin, the whole side facing the spectator being of glass hung on hinges; from the flask, *A*, a bent glass tube, *G*, passes through the india-rubber bung and descends into the first of the four wash-bottles, which are marked *H*. (Fig. 3.)

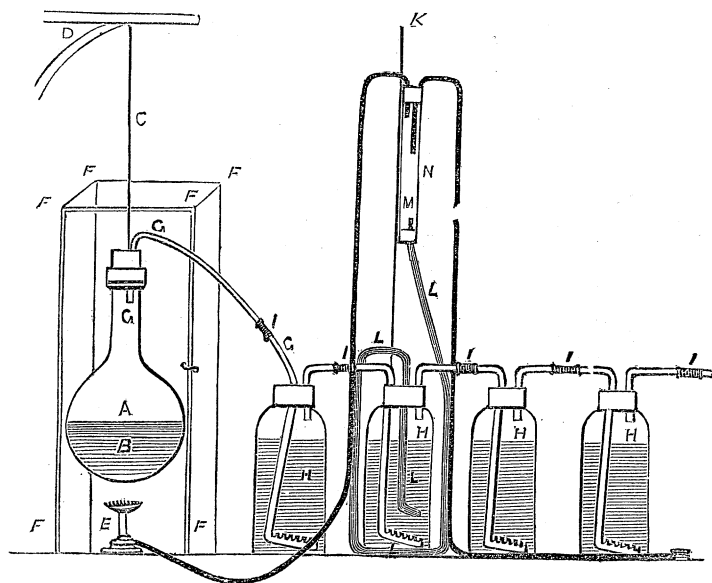
The wash-bottles are connected one with the other with stout india-rubber tubing, *I*, and in this tubing, where it unites the flask with the first wash-bottle, lies nearly all the danger and trouble that the maker of the gas has to apprehend.

The extreme heat imparted to the glass tube *G* by the pas-

sage through it of the steam, and the gas (as yet) unwashed thrown off by the boiling nitrate of ammonia, rapidly decomposes the india-rubber, Γ , ϵ , which, bursting generally when the apparatus is working most briskly, permits the escape of the unwashed gas, which is then unpleasantly pungent. This accident may be guarded against by a close approximation of the ends of the glass tubes within the rubber, and by surrounding the rubber joint with a piece of wet cloth or flannel.

This is one of the many points of the apparatus which I

FIG. 3.



trust will benefit by being brought under the notice of so many ingenious minds.*

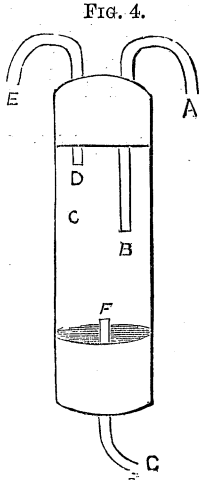
The gas entering the wash-bottles and escaping through the minute perforations at the end of each long tube passes through the water with which each bottle is two-thirds filled and escapes by the short tube into the long one of the next bottle.

On the second bottle stands the apparatus, κ , Fig. 3, for regulating the supply of coal gas, and thereby controlling the heat to which the nitrate of ammonia is subjected; this

* Since reading this paper I have devised a plan for overcoming this difficulty by the addition of another bottle.

apparatus may be more fully understood by reference to the next diagram, Fig. 4.

It consists of a glass tube about an inch and a half in diameter, and about a foot long; it is closed at both ends, but through the top a small gas-pipe, A B, connected with the main, is introduced, reaching about half way down; at the end of this, B, is an orifice about a quarter of an inch in diameter; the gas escaping from this fills the glass chamber, c, and, escaping from another opening at the top, D, is passed through an india-rubber tube, E, to supply the burner.



At the bottom of the glass chamber there is another tube, F G, which, descending along the outside of the second wash-bottle, (see L, L, L, L, Fig. 3), and, passing up again, turns into the mouth of the bottle, and again descending, passes through the water nearly to the bottom.

Before setting the apparatus in action care must be taken that the water of the second wash bottle passes continuously through this tube into the glass chamber (M) of the regulator (K, M, Fig. 3), with which it communicates; the result is, that when the nitrous oxide gas is passing over, should the heat from the burner cause the evolution of the gas with greater rapidity than is consistent with its purity, so great a pressure is brought to bear on the water in the wash-bottle that it is forced through the tube L up into the chamber of the regulator, where, rising to the level of the coal-gas tube (N, Fig. 3), it first diminishes, and ultimately cuts off, the supply of gas. The burner is an ordinary Bunsen's burner.

The relative positions of the apparatus for making the gas, the gas receiver, and the operating chair, are shown in diagram 5.

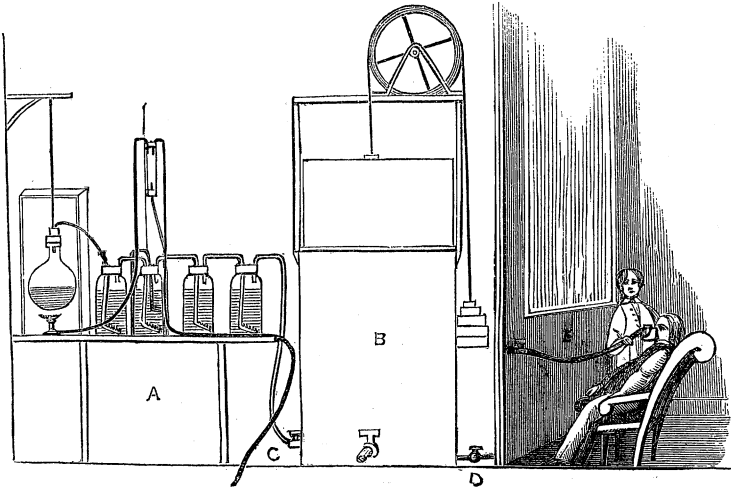
The gas passes as made, from the wash-bottles, A, into the receiver, B, and from this a tube, D, may pass to the operating room or surgery, where issuing from the wainscot in front of the chair there is nothing more alarming to be seen by the patient than a few feet of india-rubber tubing, E, with Mr. Clover's face-piece attached.

If you desire to fit up your own apparatus, all you need is a flask or retort, connected with glass tubing, of about one quarter of an inch to one half of an inch in the bore, to a set of three Woulfe's bottles, holding about four pints each,

stopped with perforated corks to receive the tubes, which should be connected with india-rubber tubing.

This was the plan I adopted at first, and is the one still used

FIG. 5.



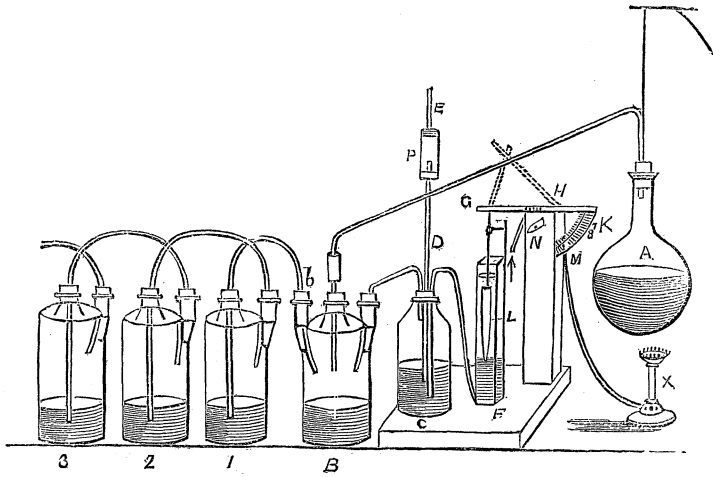
at Messrs. Bell & Co.'s, the eminent chemists in Oxford Street, who make all the gas supplied to the Dental Hospital. Mr. Porter, the gentleman who has the especial charge of this department, takes particular pride in the purity of his gas, and the completeness of his apparatus, and he has certainly contrived one of the most complete, and, I may almost say, automatic gas-making arrangements that I have ever seen, by which not only the amount of coal gas turned on is regulated, thereby controlling the heat, but, in case of any accident causing the nitrous oxide to be evolved too rapidly, a whistle sounding calls attention to the danger.

The apparatus as contrived by Mr. Porter is based upon very simple principles.* "It consists of a flask (A, Fig. 6), in which the nitrate is heated by the burner x; this flask is connected to a three-necked Woulfe's bottle (B); one neck (b) leads to the wash bottles (1, 2, 3), and the other is in connection with another bottle (c). This bottle is fitted up with two other tubes, the one (d) reaching half way into the water, and towards its top widening, and above that a whistle (E); the other is bent over the top of the bottle (c) to the widening at the point (F), the other end reaching to

* I am indebted to Mr. Porter for the following description of his apparatus. I believe he has slightly altered it since, but the main features are the same.

the bottom of the bottle (c). Within the tube (r) a float (L) is suspended from the end of a lever (g, h), the fulcrum being

FIG. 6.



the plug of a gas-tap in the centre of the lever g, h, the other end (h) pointing to an index (k).”

“The working of the apparatus is as follows:—When the gas generated in the flask by the heat of the burner (x) increases so as to produce a pressure of gas within (b), beyond that escaping by the wash bottles, and therefore upon the surface of the fluid in c, and as this fluid is syphoned over into the tube f, and therefore of the same level as that in c, any pressure exerted on c would cause the column in f to rise; and in proportion to the pressure in c, so would be the height of the column f, also of the float l. Now, as the float l is counterpoised by the weight m, and as the lever is essentially the gas-tap, it follows that the rising and falling of the column f will, by its connection, raise or lower the arm g h, or, in other words, turn off or on the supply of gas to the burner x. When the pressure has increased so much as to lower the arm g to the point n (n being a stop situated so as to allow the gas to be at its lowest, and yet prevent its going out), the water in c, by filling the tube f, will have diminished in c below the orifice of the tube d, when the gas rushing up into the widening p will sound the whistle e.”

“So that, taking a general view, we have an apparatus that

will, when the gas is going too slow, turn on its own heat, or when going too fast will turn it off, and should the pressure become dangerous will indicate the same by sounding a whistle. When the nitrate is exhausted and the gas turned out, the vacuum in the flask is supplied by air being drawn in through the whistle, passing into B, and up the tube into the flask A, so preventing any accident, so often the case when the tube from the neck of the retort is under water."

"Many experiments have been made to use only the bottle B, and do away with C, but have *not* succeeded, on account of the difficulty in the increase of water by decomposition of the nitrate, which would interfere both with the action of the float and whistle, by not allowing the gas to rise up the tube at its proper time. Many simpler forms will, no doubt, be added, this one being made of apparatus at hand."

"With an apparatus of this kind, having a flask of 60-oz. capacity, containing 4 lbs. Ammon. Nit., and three 40-oz. Woulfe's bottles, each containing respectively 16 oz. of water, protosulphate of iron, and Liq. Potassæ, 100 gallons of gas have been produced in four hours, the arm of the lever only moving from 7 to 8 on the index."

One of the most simple but effective, and, as he calls it, rough and ready methods, is that adopted by Mr. Barth. It consists merely of three earthenware tubs, about a foot and a half in diameter, and a foot deep; inside of these he places a glass funnel with the broad part downwards, a piece about the size of a halfpenny being notched out of the rim of each, so as to admit a tube of common gas piping. The funnels are weighed down with a ring of lead round each, and the tubs are filled about three inches full of water, containing the usual solutions; from the suspended retort a tube, first of glass, then connected with india rubber to the metal tube, passes over the side of the first tub, under the water, and through the notch in the side of a funnel to its centre; the nitrous oxide passing from the retort is thus conveyed into the funnel, and bubbling up through the water escapes up through the neck of the funnel, from which an india-rubber tubing conveys it to the second and third tub to pursue a similar course; from the third it is conveyed into the bag or gasometer for use.

Another plan invented by Mr. Divine, an American chemist, and introduced to my notice by Mr. Rosenthal of Liege, is to get a glass barrel, such as is used by spirit merchants, holding six or eight gallons, with an opening at the top, and one at the bottom; fill this with coke broken into pieces about an inch square and saturated with a solution of sulphate of iron—

about three pounds dissolved in water is enough—the water being poured off, the dried coke is placed in the barrel; a glass tube passes from the retort into the lower aperture of the barrel through a cork, and the nitrous oxide passing up through all the intricacies of the coke is purified by contact with the sulphate of iron, and passes out of the upper opening into the receiver. This is an excellent and simple plan, but will only do with very *slow* working.

My strong advice to those who really desire to work the gas with a will is, send at once for Sprague's apparatus, and fit up a sixty-gallon gasometer; you will spend a little more at the outset, but you will save yourself much trouble and vexation. As to the receivers, india-rubber bags are of no use for over twelve hours, even then you will lose some of your gas. A simple form of gasometer is a tank of water with a bell floating therein. My first gasometer, now No. 1 in my set, was of this kind, and holds forty-five gallons, but the large body of water it requires absorbs much gas, and when it has to be changed there is a greater loss. I therefore had a second made, holding fifty-five gallons, with a central core; this is now No. 2 in my set. I found that these two held sufficient for my daily use, but they involved the necessity of sitting up late into the night to fill them for the next day's work; I therefore had my third built, which holds 275 gallons; and now we scarcely ever find any pressure on us in working the gas; it is allowed to work quietly on during the day, unnoticed and unwatched, save when one gasometer, being nearly full, a little watchfulness is needed to turn the taps at the right time—this reliance on its steady working we owe entirely to the use of Sprague's regulator.

The nitrate of ammonia that I use I get granulated from Hopkins and Williams, New Cavendish Street, Portland Place. Messrs. Evans and Lescher, of Bartholomew Close, have recently supplied me with some, which appears to be excellent. The crystalline is less expensive if you buy a quantity; but you lose on the other hand, in time, coal-gas, and extra risk of breakage.

As to the amount of nitrate used accounts vary; we say that five pounds of granulated make 125 gallons of gas; Bell says about the same. Mons. Dumas considers that two pounds of granulated nitrate of ammonia should take forty-four gallons, so that he would use six pounds where we should use five. Another author declares that one pound of dry ammonia should make thirty-seven and a half gallons of gas. I find I have omitted to mention that in the wash bottles should be placed—in the first, pure

water ; in the second, a solution of caustic potash, half a pound of potash to one gallon of water to take up any nitrous acid that may be formed ; and in the next a solution of protosulphate of iron, one half pound to one gallon of water to purify the gas from any nitric oxide. This is a precautionary measure only, as, if the gas is made with proper care, none of these products should be evolved. If I proceed with these details I may only be wearying you ; therefore, as my paper is becoming unreasonably long, I will close this part at once ; and, begging you to consider me present in person, I will ask you at the end to put any questions upon such points as you desire me to answer ; and if you will note them down, I will answer them at your next meeting, or in the pages of the Journal.

With regard to the administration of the gas, I have seen many different forms of mouth-pieces and inhalers, but neither in theory, nor practice did I ever meet with one equal to Clover's as now made by Messrs. Coxeter and Son. When I add that Colton, after his years of experience, went back to America rejoicing in the possession of one of these, I think I have said enough. You will find a full account of it, with engravings, in the August and September numbers of the 'British Journal of Dental Science.' There are still some one or two who prefer to use the original tube which was inserted into the mouth, the lips firmly closed by the administrator's fingers, two hands over it, whilst a third party pinched the nose—a more inelegant or unpleasant proceeding I cannot well conceive.

With Clover's inhaler you need no assistant in the administration ; the thumb of one hand is sufficient to keep the instrument in its place, the remaining fingers are ready to lift the eyelids, whilst the other hand is left free to watch the pulse at the wrist.

If you wish to have a steady, uniform flow of successful cases, you must insist on the matter being treated with a certain amount of preparation, your instruments must be all at hand, though not necessarily in sight ; if a female, the dress must be full slack, the throat free, the head well supported forward, the hands spread out flat on the knees. All this reads rather formidably, but, with a little practice and tact, it, and much more, may be carried out, as it is in my operating room almost before the patient is aware of it all, and I have certainly never known any take alarm at my preparations.

If the head be not well thrown forward, you will some time or other have a failure from the patient choking with accumulating saliva, which they cannot swallow ; you will be

obliged to desist from giving the gas, air is admitted, and the patient rises up in a frantic, desperate state, which it will need some little tact to pacify and to prevent from terminating in a violent fit of hysterics. The hand extended on the knee allows of watching the gradually increasing lividity of the nails, and detection of the first approach of that twitching, without which I rarely care to operate. One thing I would strongly insist upon—let there not be the slightest interference with the administrator of the gas. I allude now to such cases as may be operated upon in the presence of professional witnesses. Let whoever has the responsibility of the case feel that he has it whole and entire; if he sees that some one else is touching the pulse, he may himself neglect it, and at a critical moment it may be found that it is unwatched. Such precautions, I fancy I hear you say, savour little of the confidence expressed in the commencement of this paper. But I would have you see that confidence need not beget carelessness; my confidence in the gas arises from a belief that if an untoward case occurred, there would be such warning to the watchful man, that evil may be promptly averted. It is not so with chloroform; in most fatal cases the sign of danger has only come when the system was so thoroughly impregnated with the vapour that it could not be dispersed in time to restore life. With nitrous oxide it is otherwise; the moment the face-piece is removed recovery begins, and culminates rapidly; therefore all that is needed is watchfulness and knowledge of the symptoms of danger, the arrested respiration, the failing pulse, the dilating pupils, must each be watched for and weighed at their proper value. Perfect quiet should be maintained. No idea impressed upon the patient's mind, but that they are to go into a deep sleep.

When I think the patient has had nearly enough, and from habit I can generally tell this, almost without knowing how or why, I say gently, "Raise your finger."* If this is done readily and sharply, I say, peremptorily, "That will do." If the finger is not raised, I repeat the command more sharply, and if not attended to, in ten or fifteen seconds more the patient is ready for a prolonged operation;† but it is a difficult and dangerous thing to lay down rules of this nature—

* So impressed am I with the importance of profound quiet about the patient that latterly I have avoided even this chance of exciting the attention, and prefer to rely entirely on my own judgment, from experience, as to the moment when the patient is thoroughly anæsthetized.

† The time taken to produce entire insensibility to pain varies from fifty to one hundred seconds, and the whole time—from the moment when patients begin to inhale the gas to the moment when they are sitting up expressing their surprise and pleasure at seeing their enemy, a long-aching tooth, lying before them—rarely exceeds two minutes.

a droop of the head, a snore, gentle twitching of the fingers, all indicate profound sleep. In young children the twitching is often most violent, and their appearance far more alarming than in the adult. I have given the gas now myself in 1017* cases, and I have never had but one case that gave me a second's uneasiness, and that proved to be a case of concealed pregnancy, in which the patient had evaded my instructions to loosen her dress. I should add that I have inhaled the gas to complete insensibility some thirty times, and always with the most pleasant results. Besides having given it myself in 1017 cases, I have seen it administered to my own patients, by Mr. Clover, in over 200 other cases, always with the most satisfactory result. I have witnessed many other cases; and in some that I have seen and heard of violent hysterics occurred. My own impression is, that this often arises from not giving enough.

(This impression is confirmed by increased experience, and I believe it will be observed by practitioners that as they give the gas more frequently, acquiring confidence in its safety and giving it more fully and boldly, they will have fewer cases of hysteria. It must be remembered too that where *no* gas has been given violent hysterics have not unfrequently resulted from the extraction of a tooth after perhaps many sleepless nights of pain, and abstinence from food. If similar results should occur occasionally when gas happens to have been given it is scarcely fair to set it all down to the "gas." Latterly I have had no difficulty in giving the gas to the most hysterical girls with perfect success, provided I have had time previously to show them the perfect simplicity of the apparently formidable apparatus, and convince them by a little demonstration how perfectly pleasant the gas is to inhale; the gas should *never* be forced on unwilling patients, and those who take it freely and cheerfully with confidence in the administrator and in a happy result will rarely, however hysterically they may be disposed, end in hysterics.)

An essential point in operating with nitrous oxide is the necessity of operating *rapidly*, and yet coolly. You must "make haste slowly." It is not so much that you must *hurry*, but that you must lose no time—the exact position, depth of sound wall, condition, hard or soft, &c., of every root and tooth to be extracted, must be carefully ascertained and mentally photographed, so that when your patient's mouth is closed you can still see the teeth in the mind's eye as you have to operate upon them; every instrument must lie ready just under your hand, in the order in which you

* These numbers are given up to the date when this paper was reprinted, August, 1869.

will want them. I remember once giving the gas for a brother practitioner; an upper and lower molar had to be removed. He was an excellent operator. The teeth looked fair, easy pulls, so I did not put the lady into that *profound* sleep I should have done had there been more to do; but, to my dismay, after removing the upper tooth, he had to turn right round to his cabinet for his lower molar forceps, and in that slow, deliberate turn precious seconds were lost. The lady awoke, declaring she "felt that last tooth."

When I first began to operate, Mr. Clover giving the gas, I broke more teeth in a week than I had previously done in three or four years. I had never professed to be a *rapid* operator, but I hoped I might be considered a *safe* one. *Now*, the nervous anxiety lest the patient should awake before I had completed my work completely changed me, and for a time I was neither *safe* nor *rapid*; but happily it struck me to ignore the presence of the anæsthetic altogether, to operate as deliberately as before, and if the patient did come to before the tooth was out, not to be tempted to *hurry* one second.

To my gratification I soon found that the evidence of returning consciousness on the part of the patient was most deceptive, that, as in the case that ruined poor Horace Wells, although the patient gave signs of suffering (some will even cry aloud), yet they wake up declaring that they felt no pain. This is essentially the case with children; they will scream almost under the gas, because from their restlessness it is often a matter of considerable difficulty to keep the air excluded; and yet, though they will sometimes wake up sobbing and screaming, five minutes after they will stare with astonishment, and then a glad smile beams on their countenance when told "Both your teeth are out"—two permanent lower molars, for instance. It is almost useless to attempt to operate without previously inserting a gag between the teeth. This gag is sometimes a great source of annoyance, sometimes to the patient, and sometimes to the operator; it must, therefore, be made as light as possible. I have tried a variety of forms, some really ingenious, and others *perfect* in the art of how *not* to do it. I find that the lightest and best are those made of vulcanite, not thicker than a small quill in the stem, expanding only close to the top and bottom, sloped down one way so as to be shortest towards the wisdom teeth, and deeply grooved. These I have of all sizes, graduated from two inches long down to half an inch. Coxeter will supply them from my pattern, if desired. Soft wood must be thicker, and hence, in my opinion, is objectionable. If you use a short one near the back of the mouth, your patient will perhaps heave and retch; if placed near the front, they in-

terfere sometimes sadly with the operator. Practice alone can teach how to overcome these minor difficulties. Of course, a fine strong string must be attached to the gag; red thread I find to be the best, anything *thicker* interferes with the adjustment of the face-piece. It is well to tie the gags in pairs, then the one not being used hangs down on the patient's chest, and counteracts any tendency of the other to slip down the patient's throat. One of the recorded deaths from nitrous oxide!! arose from a cork slipping down a patient's throat, forgotten, unnoticed, until too late.

There are many other points of interest upon which I have not even touched, but the extreme length of the paper, and shortness of time, warn me to conclude. Let me ask the kind indulgence of my hearers for the meagreness of my paper in quality, if not in quantity, and beg that they will note down their remarks upon it, that I, as well as those present, may profit by the discussion. One word more and I have done.

I would earnestly desire to impress one fact on the minds of my hearers, and that is, that although I may seem to them to imply that I do not fear any evil result from the gas, except as a consequence either of bad gas or a want of watchfulness, I am well aware that the moment of unwatchfulness, the moment of over-confidence, and perhaps it may be only momentary carelessness, may seize upon any one of us, however experienced or trustworthy we may conceive ourselves to be; charity should especially rule our judgment upon our professional neighbour's conduct, for we none of us know how soon we may need that charity to be shown to ourselves. I trust, therefore, that I may not be misjudged when I advocate the giving of the gas with a certain amount of boldness, the boldness of confidence in its utility under due watchfulness, not the boldness of rash, careless presumption—a boldness which I desire to temper with an humble readiness to learn all I can on the one hand, and to impart all I can on the other.

The PRESIDENT.—Gentlemen, you have all heard this very excellent paper sent by our friend Mr. Fox, and I shall be glad to hear any remarks which you may feel disposed to make on the subject.

Dr. ORPHOOT said,—The Odonto-Chirurgical Society must agree with me in thinking that we cannot too highly appreciate the fact that a paper so lucid and instructive, and upon a subject so interesting, should have been prepared by Mr. Fox for our meeting. It is valuable to us, not only on account of the important information it affords, but also as a proof of goodwill from influential quarters, which, as members

of an infant Society, is very encouraging to us. Mr. Fox offers to answer any questions that the paper might suggest to us; but, for my part, I have found his descriptions and diagrams so intelligible as to make me feel no hesitation whatever in attempting to prepare the apparatus, and I would do so at once but for the circumstance which, I suppose, influences a good many of us, and mentioned in the paper we have heard—that we are waiting to see if the nitrous oxide can be prepared in a portable form, and therefore dispensed by chemists in the same way as chloroform. I trust that the paper will be published. It will form a useful guide to those who, whatever may be the result of the “compression” experiments, wish to prepare the gas at home, both on the score of economy as well as for more extended physiological research.

Mr. D. HEPBURN.—I think, Mr. President, we must all feel very much indebted to Mr. Fox for the very interesting paper which we have just heard. It contains a large amount of practical information on the subject, and represents a great deal of painstaking labour on the part of its author. I believe he is quite competent to give a decided opinion on this matter, and I feel quite sure any advice it contains may be relied upon as being both sound and practical. I only regret that, coming late into our Secretary's hands, we have been unable to do it the justice which it deserves, and which a second reading of it would have enabled us to do. The subject itself is one of much interest; and from all that I have heard, read, or seen of the action of the nitrous oxide when used as an anæsthetic, I am quite disposed to believe that it will become a most useful agent in minor surgical operations, such as the extraction of teeth, &c. I had recently an opportunity of seeing its exhibition in a number of cases at the Dental Hospital, London, and in the most of these it was successful; in some of them two, and even three, teeth or roots were extracted. On the first morning it was administered by Mr. Coleman, by means of his ingenious instrument for economising the gas, by which, I understand, there is a saving of two thirds. On the second morning the pure gas was given by Mr. Braine, the chloroformist, who spoke most warmly in its favour. I left under the impression that the anæsthesia was of a more profound character when the pure gas was administered; but of this I could form no decided opinion, having seen it in such a limited number of cases. I may also state that my brother in Nottingham has been making use of this agent for the last two months in his practice, and he writes me that the results have been most favorable. It is certainly remarkable, sir,

that the opinions of men so eminent should be so opposed to each other in regard to the physiological effects of the gas. And I must say it rather takes us by surprise to be told that the laughing gas, which has been used almost as a plaything since our boyish days, is the deadly agent which it is said by some to be. I trust, however, sir, the experiments now being made will put this question at rest for ever, and enable us not only to speak of, but to give the gas with some degree of confidence.

Dr. HOGUE said,—I have had no experience of the nitrous oxide gas; but what struck me in listening to the paper as one great advantage the gas possessed over chloroform in ordinary Dental operations was the extreme rapidity in which it produces its effects, and the equally rapid manner in which the patient recovers from them completely. This rapidity renders it necessary that a gag should be placed between the teeth during its administration, thus rendering it impossible for the patient to swallow; and I recollect a case mentioned in the 'Dental Cosmos,' when the patient was suffocated from the gag getting into the windpipe during the administration of the gas.

Mr. CHISHOLM.—Mr. President, I am not in a position to make any practical remarks on the nitrous oxide as an anæsthetic, not having had an opportunity of seeing it administered; but from what we hear of the successful results of the numerous cases in London we may hope soon to let our patients have the benefit of it; and we cannot but feel obliged to Mr. Fox for his interesting paper on the subject.

The PRESIDENT.—The paper which we have now heard, so kindly forwarded to us by Mr. Fox, contains much that is deeply interesting. The application of nitrous oxide in Dental Surgery, which he advocates, may be a matter of great importance to suffering humanity; but from the symptoms evolved and described by him, I think much caution must be used in administering it. The report of the London Committee is, I believe, so far satisfactory; and various members with whom I have had communication speak enthusiastically of the rapidity with which the patient recovers. I am, therefore, inclined to take a favorable view of this novel anæsthetic, and give it a fair trial. I am glad to hear from the remarks elicited from the various members that they coincide with me in their conclusions.

A unanimous vote of thanks to Mr. Fox was moved and carried, for the elaborate paper which had just been read,

and the Secretary was requested to intimate the same to him, with the desire of the Society that the paper should be published in the 'British Journal of Dental Science.'

The question is so frequently asked as to how far this valuable anæsthetic Nitrous Oxide may be used in general surgery, that I have thought it well to subjoin various short papers bearing on the subject, reprinted from the 'British Journal of Dental Science' and the 'Lancet.' In addition to the case mentioned therein I have administered the gas on three other occasions for the removal of tumours, by Mr. Tegart and Mr. Jackson, the time occupied in the different cases being nine, sixteen, and eleven minutes, and for two other cases in which it was necessary to make long and deep incisions in the arm and leg.

Mr. Clover, Mr. Coleman, and Mr. Rendle have also frequently administered it in short surgical cases, but I believe I am correct in stating that the first case in which I administered the gas for Mr. Carr Jackson is, as yet, the longest case on record in England.

It is a singular coincidence that more than fifty years ago Mr. Carr Jackson's father occasionally administered the gas for the relief of prolonged pain, and on repeated occasions inhaled it himself as a refresher when over-fatigued. Of its beneficial effect in this particular I have often heard Dr. Colton speak, and, indeed, I can testify to the fact from my own personal experience.

C. J. F.

MEDICAL SOCIETY OF LONDON.

MONDAY, NOVEMBER 30TH, 1868.

Dr. B. RICHARDSON, President, in the Chair.

Previous to the reading of the paper of the evening, by Mr. ALFRED HAVILAND, on the "Geographical Distribution of Cancer in England and Wales,"

Mr. CHARLES JAMES FOX rose and said,—Mr. President and Gentlemen—In the face of the valuable paper that is offered us to-night, I cannot detain you with many words. I simply desire to place on record in the annals of this Society the fact that, on Monday, September 7th, at the request of my friend and colleague, Mr. Carr Jackson, I administered nitrous oxide to a patient of his, for whom it was necessary to remove the whole of the cicatrix and unhealed portion resulting from a previous operation on the breast. The operation was, in fact, almost equivalent to the original one of removing the entire gland. Anæsthesia was successfully maintained for twenty minutes, with the exception of a few seconds lost in renewing the supply, owing to defects in the apparatus: this I have since rectified, and also made such alterations in the inhaler and method of administration as will, I think, in future remove all difficulty.

Several similar cases have been recorded in America, and in France one by Dr. Marion Sims and Dr. Colton; but I believe this to be the first instance of nitrous oxide having been used for so long a period in England.

I have, therefore, deemed it worth bringing under your notice, as the medical gentlemen present at the time are at your hand to reply to any inquiries as to the particulars of the case.

That nitrous oxide with its present appliances is a suitable anæsthetic for prolonged operations I am not prepared to assert, but that some such improvements as I have introduced would render it so I am inclined to believe possible.

But, gentlemen, the development of any such improvement is checked by the condemnation that has been passed upon the gas in this room.

The general study of the effects of nitrous oxide, as now administered, is arrested. The confidence of our patients in us is shaken when they are told by their medical advisers that

one of the most earnest investigators in the science of anæsthetics, one who deservedly stands high in the estimation of his *confrères* and the public as a deep thinker and clear-headed reasoner, has pronounced the gas to be one of the "*most dangerous of all the substances that had been applied for the production of general anæsthesia.*"*

Gentlemen, Dr. Colton, of New York, writes to me that he and his assistants have now given it in 40,000 cases without a fatal result. In the last five years (that is, since the only death that was ever directly ascribed to the gas) upwards of 400 practitioners have employed it in the United States. It is calculated that it has been given in upwards of 200,000 cases in America; but we will waive all that, and come close home. I have letters showing that it is used daily by at least twenty gentlemen in Paris; that it is employed in Liège, in Brussels, and I believe in Sweden and Germany. Here in England it is supported by such names as Clover, Braine, Coleman, and (I believe I may add) Sansom, Sander-son, Murray, Marcet, with a host of others.

Without enumerating the cases in which I have given it successfully myself, I will only add that I hold in my hands letters recording nearly 2000 successful cases from different parts of England, and on Monday, the 7th of December, the committee appointed by the Odontological Society to investigate the matter will present their report to the meeting, and I have no doubt double the number I have given.

As the chief admirers are Dentists, it being very suitable to their practice, nearly every voice at that meeting will be in favour of the gas. Now, it would add considerably to the value of the discussion if some of the gentlemen who are so much opposed to the gas would come and give us their views, otherwise it will, I fear, be—it must necessarily be—a one-sided argument. Although its greatest admirers have scrutinised it most vigilantly, yet they *are* admirers of the gas; their testimony will therefore, however unintentionally, be somewhat *couleur de rose*.

As an humble fellow of this Society, I must crave pardon, Mr. President, for striving to seduce your subjects from their allegiance for one night. Do but consider that you are sending them as missionaries in the cause of truth to turn us from the errors of our ways. We will pervert them if we can, and if we cannot we will only charitably hope that they may not one day, in the anguish of that

* Dr. Richardson's remarks on nitrous oxide at the Medical Society of London, April 13th. See 'Lancet,' April 18th, 1868.

suffering which commands no sympathy, pray for gas where no gas is to be had.

The facts I have related tend at least to throw some doubt on the statement that has gone forth to the world supported by the weight of your presidential chair. Time is creeping on; public confidence in the gas is hourly increasing, despite medical warnings. Is it not time, then, for the fellows of this Society to review the matter, and point out more plainly the dangers we are incurring; or, if perchance they think their former dictum may have been somewhat hastily pronounced, give us the benefit of their reconsideration, and not wait until perhaps they may have to follow where they should have led?

Mr. Mason, who had observed the action of the Anæsthetic in certain cases of extraction of teeth, was favorably impressed with it.

Mr. Laurie paid a tribute to the energy of Mr. Fox, in his efforts to introduce the use of this gas. He cited cases from a considerable experience. He thought the chief trouble arose from chance admission of atmospheric air with the gas in the course of inhalation.

Mr. Walker testified to the value of the Anæsthetic. It had been said that it could be safely breathed for twenty minutes. He himself had seen it breathed for fifteen minutes, with brief admissions of atmospheric air, four times during that period. The after effects in that case were but slight headache. For operations of half a minute its effect was thorough.

A desire was expressed by several members to continue the discussion on this subject of nitrous oxide, but it was ruled from the chair that the laws did not admit of a prolongation of the allotted time.

Among those present we observed Messrs. Clover, Braine, Kidd, and other well-known anæsthetists, who had attended the meeting expressly to take part in the anticipated discussion, but were prevented by the short time allowed.—*British Journal of Dental Science.*

ON NITROUS OXIDE IN GENERAL SURGERY.

By CHARLES JAMES FOX, M.R.C.S., L.D.S.

At the recent meetings of the Medical Society of London and the Odontological Society, I briefly stated my conviction that although nitrous oxide, as at present administered, is not a suitable anæsthetic for prolonged operations, it may

become so. I pointed out at the first-named society how all investigation on such a subject was checked by the condemnation that had been passed upon the use of the gas by their president, Dr. Richardson, and I felt that until that condemnation was withdrawn it would be time thrown away to speak of certain theories I entertained respecting the manner in which a state of continuous anæsthesia might be maintained. From various experiments upon animals, upon myself, and others, I am convinced that, provided a patient is first thoroughly anæsthetised with pure gas, all atmospheric air being totally excluded, it is possible subsequently to permit the access of a *small* proportion of atmospheric air, without inducing any excitement. But, to effect this successfully, the first anæsthesia should be a perfect and complete success, unaccompanied by any excitement. My attention was first drawn to this question by observing, when giving the gas to Mr. Jackson's patient for the removal of the breast, that, having put her into a deep sleep, she did not become in the least excited or restless when the mask was entirely removed, unless it was kept off too long. Her colour revived the *moment* air was admitted by the removal of the face piece, but restlessness did not come on for many seconds after it. It therefore occurred to me to have a gas inhaler, made with two of Clover's stopcocks (one to admit gas, the other air), so arranged that, by a graduated scale marked upon them, I could tell exactly how evenly or to what degree each one was open. I endeavoured at first to utilize the air-hole already in existence in Clover's admirable two-wayed stopcock, but as it was the wrong side of the valve I could not ensure a free mixing of the gas and air, and lost much gas at each expiration. The two stopcocks answered very well, but were clumsy, and I have now, with Mr. Coxeter's aid, contrived a double sliding valve, which enables me to effect my purpose admirably. Although my attention has been directed to this point chiefly with a view to utilising the gas in general surgery, yet it is not a matter devoid of interest to the Dentist, for I have found in many cases that, provided the first anæsthetic sleep is quickly and thoroughly produced, the continued administration of the gas for another minute or two, with a careful admixture of atmospheric air, renders the anæsthetic state more prolonged, so that more teeth may be removed before the patient awakes. It must, however, be borne in mind that the patient, after such an administration of gas and air, is generally dull and stupid on recovering, and must be left quite quiet, indeed, not only on such but on *all*

occasions I would deprecate any endeavours to rouse a patient from the anæsthetic condition.

I fear that sometimes our desire to re-assure an anxious waiting friend, as well as some regard for the credit of the gas, which has a reputation for quick recovery, has induced us to hurry a patient into full wakefulness when it would really be best for them to lie quietly back and dream out their dream. I have taken the gas myself so often to *complete* insensibility, and under so many varied conditions, that there are few symptoms or sensations detailed by patients on awaking that I cannot understand and fully sympathise with from my own experience.

In conclusion, I would add, that in all administrations of gas mixed with air, the greatest caution must be exercised, as an undue amount of air, admitted at an injudicious moment, might result in a scene of hysteria and subsequent depression, which would in no way redound to the comfort of the patient or the credit of the administrator.—*British Journal of Dental Science.*

NITROUS OXIDE IN PROLONGED SURGICAL OPERATIONS.

To the Editor of the 'Lancet.'

"SIR,—In your report of the proceedings of the Medical Society of London on November 30th, it is stated that I introduced the subject of the action of nitrous oxide in Dentistry, but the discussion was adjourned. As this does not quite correctly represent the part I took, and as I am anxious that the matter I really introduced should be well ventilated, will you permit me to say a few words in explanation.

"That nitrous oxide is a safe anæsthetic for short operations, such as the extraction of teeth, I never doubted, after a few weeks' experience and an intimate intercourse with Dr. Colton; that it is a safe anæsthetic in such cases is now too fully and too generally recognised to render it needful for me to bring its claims simply as a Dental anæsthetic before the notice of a purely Medical Society. But I have the most perfect conviction that it will eventually prove a safe and efficient anæsthetic in the more prolonged operations of general surgery—not, indeed, as at present given, but with certain modifications and improvements in the apparatus used for its administration. I am led to this conviction from my experience of its effects in a case of removal of the breast by

Mr. Carr Jackson on Sept. 7th, 1868, when I maintained the anæsthesia for twenty minutes, and from my subsequent experiments upon animals, upon myself, and upon members of my family. And I was anxious to bring the question prominently under the notice of my medical brethren, because from their greater opportunities I believed the question would be more readily fully tried. My present theory is, that although the admixture of atmospheric air with the gas when first administered tends to induce excitement, yet when once the patient is fully anæsthetised, the anæsthesia may be kept up for an indefinite period by the continued administration of the gas, diluted with certain proportions of atmospheric air without any excitement supervening. I have had some instruments constructed by Mr. Coxeter to effect this measured admixture, so as to pursue my experiments with greater exactness; and as one of the greatest bars to the use of the gas in general surgery lies in its want of portability, I have exerted myself so far to remedy this evil that I expect in a week or two, with the help of Mr. Coxeter, to arrive at a means of obtaining the gas in a more convenient form for general use than at present exists.*

“Meanwhile, I throw out these hints in order to secure the early co-operation of my medical friends in this path of investigation, and I have no doubt, with their aid, some means will be found of prolonging the anæsthesia induced by nitrous oxide, either by the admixture of atmospheric air or some other chemical agent.

“I am, Sir, yours faithfully,

“CHARLES JAMES FOX.

“27, Mortimer Street, Cavendish Square;
“Dec. 28, 1868.”

Evans and Lescher, in their monthly paper, have the following remarks on the gas :

“In the early part of the year 1868, the attention of the Medical and Dental professions was recalled to the value of protoxide of nitrogen, more commonly called laughing-gas, as an anæsthetic agent, and especially by Dr. Evans, of Paris. The results were somewhat curious. Instead of entering into a calm and critical examination of the asserted merits of the gas, scientific men, with some warmth, arranged themselves into opposing sections; whilst some

* These endeavours have resulted in the production by Messrs. Coxeter and Co. of wrought-iron bottles, holding respectively 36 and 90 gallons of compressed gas, conveniently arranged in wood or leather cases.

at once condemned the use of the agent as dangerous in any case, others declared that it was calculated to supersede chloroform. However, after a while, more moderate views were entertained, when experience was enabled to produce proof of its utility at least in certain minor operations. It is of greatest use in the extraction of teeth, be it one or several, and there is little doubt that the nitrous oxide gas will supersede chloroform generally with Dentists. In America the gas has been exhibited in 200,000 cases, with only one death*—the gas being given oftentimes more than once at a sitting. There do not appear to be any special conditions of the system, age, or temperament, or the like, which forbid the use of the anæsthetic. Children are most readily affected by the gas, remain the shortest time anæsthetized, and recover more rapidly than others.

“The gist of the investigation made by the representatives of the Odontological profession is satisfactory for the public. It is to substitute in Dental operations for chloroform—the inhalation of which is not only always attended by a certain amount of danger, but followed by many disagreeables—an agent which rapidly produces a transient insensibility sufficiently long, and not too long, for the operator to do what he wants, and does not entail danger or discomfort. This is clearly a great boon. It may be that further experience will show that the agent is sufficient for minor surgery, but that point is not well settled yet. And so the old laughing-gas, which has caused so much amusement in the past, has been invested with a utility little imagined.”

* This is the only death that was ever directly ascribed to the gas, but was declared by a jury to be quite irrespective of it. The patient was in the last stage of consumption, and did not die under the influence of the gas, but some hours after the operation. Moreover, this occurred five years ago, since which it is calculated that the gas has been administered in over 200,000 cases without a fatal result.—C. J. F.

COMPLETE/NORMAL

