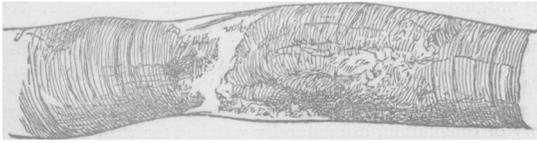


various stand-points, and in the interpretation of her language by different minds, that our store of knowledge is extended; and he who works in an honest spirit, even though he fail to read her lessons aright, may still have done some service in helping forward the cause of Truth.

#### ADDENDUM.

THIS woodcut, from a drawing by Dr. Stewart, the Curator of the Museum at St. Thomas's Hospital, exemplifies the condition alluded to in a former Lecture, in which the primitive muscular fibres are found



ecchymosed, disintegrated, and ruptured, in tetanus. The specimen was taken from the patient referred to in the text, who died of acute traumatic tetanus; and is magnified 300 diameters.

#### ON THE USE OF PROTOXIDE OF NITROGEN GAS; AND ON A NEW MODE OF PRODUCING RAPID ANÆSTHESIA WITH BICHLORIDE OF METHYLENE.\*

By RICHARD RENDLE, Esq.

It is my intention to place before you the results of my experience in the use of protoxide of nitrogen gas and the bichloride of methylene, which, I think, from the variety of cases in which these agents were used, and the varied modes in which they were administered, may prove interesting to you. Having had, since the last meeting of the Association, some opportunities of studying the use of anæsthetics in various departments of surgery, I have been often struck with many disadvantages in the use of chloroform; such as the length of time in the production of anæsthesia, the occurrence of vomiting and muscular excitement, and the tardy recovery which in some cases attended its use.

With the idea of lessening, if not of remedying these evils, I began to administer the bichloride of methylene with a modification of Dr. Junker's apparatus, which is here before you. I gave it in this way in forty cases taken indiscriminately—19 males and 21 females, from 14 months to 76 years of age. In 32 of the cases, the time required to produce anæsthesia was—over 20 minutes in 3; over 10 minutes in 4; over 5 minutes in 9; over 3 minutes in 6; over 2 minutes in 2; and over 1 minute in 8. In eight cases, all over 20 years of age, after continuing the administration for 3, 5, 10, 11, 14, 15, 16, and 17 minutes respectively, using from 30 minims to 4½ drachms, chloroform was substituted, and in 5 of the 8 produced anæsthesia in 1 minute; in 1 in 2 minutes where the methylene had been used 14 minutes; in 1 in 3 minutes where the methylene had been used 15 minutes; in 1 in 9 minutes where the methylene had been used 16 minutes; in this last case, complete muscular relaxation was required and produced. Of the 32 cases, in 1 anæsthesia was kept up for 45 minutes (ovariotomy); in 2, for 10 minutes; in 9, for 5 minutes; in 15, for 2 minutes; in 5, for 1 minute. On an average, three or four fluid-drachms were used. It was given for iridectomy in 11 cases; for strabismus in 11; for extraction of cataract, needle-operation for cataract, excision of eyeball, applying nitric acid, setting fractures, reducing dislocations, ovariotomy, and various other operations, in 18. Vomiting occurred in 8 cases—that is, 1 in 5. Thus, in the majority of the cases, it took longer to induce anæsthesia, required more of the anæsthetic, and was consequently much more expensive (bichloride of methylene being at present more than three times as costly as chloroform). Vomiting occurred as often as with chloroform; and the only advantage which I noticed the bichloride of methylene, administered in this manner, to possess over chloroform, though a very important one, was, that there was scarcely any muscular excitement.

I next gave the protoxide of nitrogen gas in 74 cases. The details of manufacture and of administration having been published in the Odonological Society's *Transactions*, and in papers read by Mr. Fox and Mr. Clover at Oxford last year, I shall proceed at once to mention the modes in which I have given it, and the observations I have made. Its mode of action, I believe, is similar to that of all other anæsthetics; viz., that the blood supplied to the nerve-organs is not duly oxygenated,

or is not able to interchange its oxygen for carbonic acid sufficiently for the due performance of their duties. Anæsthesia is a consequence of the air supplied not producing the necessary changes in the nerve-organs, and not of a deprivation of respirable air, as has been stated.

At first, I obtained the gas compressed in iron bottles from Mr. Barth, and gave it in the manner recommended by Mr. Coleman, which consists in causing the gas, when expired, to pass through a chamber of slaked lime (as shown in this diagram). This economises the gas very much, about three gallons being sufficient for each patient for almost any length of time, but the apparatus required is rather complicated; moreover, there must be some arrangement for getting rid of the air already in the lungs, instead of allowing it to return into the bag. This is effected by a valve near the mouth-piece, which opens on expiration, and after the first three expirations can be closed. Here are two made for this purpose. After this the gas, when expired, returns to the bag over the slaked lime, by which any carbonic acid is removed, and the gas is rebreathed. It was given in this way in 24 cases, 13 males and 11 females, from 3 to 73 years old: for strabismus, in 7 cases; for iridectomy, in 6; for operations on the eyelids, in 8; removal of opaque lens capsule, in 1; extraction of teeth, in 2. The shortest period in which anæsthesia was produced was 60 seconds; the longest, 150 seconds; average, 93 seconds. Anæsthesia was maintained 13 minutes in 1 case; 6 minutes in 5; 4 minutes in 5; 2 minutes in 12; and 1 minute in 1. Intervals of air were allowed in all but one. The gas was given until deep anæsthesia was produced, air being then admitted until the natural colour returned, when the gas was again turned on, and so on alternately as long as desired. The gas was required for a shorter period at each successive time. The period during which air was admitted varied very much, and it would require a much larger experience to state whether it had any relation to the time of each inhalation of gas or to the whole period of anæsthesia. In the earlier cases, before I succeeded in getting well-fitting mouth-pieces, some failures occurred from the admission of air with the gas; yet I noticed that, if the quantity of air admitted were small, anæsthesia was produced, though less rapidly, and the blueness was less marked. One of these patients laughed uproariously on recovery, and had lost all idea of the time. One, a woman, aged 48, on whom iridectomy was performed in both eyes, was under the influence in 60 seconds. The gas was continued five minutes longer without any admission of air; at the end of this time she was most unusually blue; the respiration and pulse very slow and failing. The gas was removed; the patient was turned slowly over on her left side (a proceeding, I believe, peculiar to the ophthalmic department at Guy's, and which has never failed to restore cases manifesting unpleasant symptoms from anæsthetics). She gradually recovered completely, and walked away in five minutes more. I next had a small gasometer made, a modification of one made by Mr. Barth (seen in section in this diagram); it has a core to diminish the quantity of water, and on the top of this is a tray containing slaked lime; a pipe passes in from beneath for the passage of the gas in and out; the upper part is exactly counterbalanced, and, as the gas is breathed out and in, this falls and rises. The expired gas is thus exposed to the slaked lime before being again inspired. Of course the same arrangement has to be made in the mouth-piece for getting rid of the air in the lungs, by the first three expirations being allowed to escape instead of being expired into the gasometer, but all other valves are done away with. This is a very suitable apparatus for an operating-room, but is not portable. This was used in 15 cases—7 males and 8 females, from 4 to 70 years of age; for strabismus, in 3; for needle operation for cataract, in 1; for operations on the nasal duct, extraction of teeth, removal of toe-nails, and various others, in 11. The shortest period in which anæsthesia was produced was 30 seconds; the longest, 85 seconds; average, 64 seconds. Anæsthesia was maintained half a minute in one case; 1 minute in 8; 2 minutes in 3; 4 minutes in 1; 6 minutes in 1; and 8 minutes in 1. One of these cases, a man, aged 30, short-necked, plethoric, who began to inhale it for the extraction of a tooth, pushed away the inhaler and refused to continue. He complained of very unpleasant sensations in his head for some hours after, but this eventually passed off. One woman complained of headache afterwards.

Having now a store of gas at my command, economy was not studied, and it was given in the ordinary way from a large bag, with a mouth-piece having an inspiratory and expiratory valve; in this way a much larger quantity of gas was used, about five gallons for each minute's inhalation. Thirty-four inhaled it in this way—22 males and 12 females, from 3 to 58 years of age; for strabismus, 3; enlarging lacrymal duct, 2; fistula *in ano*, 6; opening of abscess, 4; extracting teeth, 8; removal of nails, reducing paraphimosis, removal of small cysts, attempt to reduce a dislocation, 5. The shortest period in which anæsthesia came on was 40 seconds; the longest, 100 seconds; the average, 61 seconds. Anæsthesia was maintained 1 minute in 23; 2 minutes in 6; 3 minutes

\* Read in the Surgical Section before the Annual Meeting of the British Medical Association in Leeds, July 1869.